European Journal of
Investigation in Health,
Psychology and Education

Special Issue Reprint

Health Disparities

The Emerging Trends and Pressing Challenges

Edited by
Keren Dopelt

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Guest Editor

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This is a reprint of the Special Issue, published open access by the journal *European Journal of Investigation in Health, Psychology and Education* (ISSN 2254-9625), freely accessible at: www.mdpi.com/journal/ejihpe/special_issues/8DZ07T5VE4.

For citation purposes, cite each article independently as indicated on the article page online and using the guide below:

Lastname, A.A.; Lastname, B.B. Article Title. *Journal Name* **Year**, *Volume Number*, Page Range.

ISBN 978-3-7258-3148-7 (Hbk)
ISBN 978-3-7258-3147-0 (PDF)
https://doi.org/10.3390/books978-3-7258-3147-0

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About the Editor

Keren Dopelt

Keren Dopelt, Ph.D., is an associate professor and the head of the Ethics Committee in the Department of Public Health at Ashkelon Academic College, Israel. In addition, she is the head of the college committee for research students. Prof. Dopelt is a research associate at the Ben Gurion University School of Public Health, ASPHER, and the Taub Center for Social Policy Studies in Israel. Her main research interests are the sociology of health, health promotion, health policy, health disparities, and healthcare leadership.

Preface

Health disparities represent one of the most pressing challenges in modern healthcare systems worldwide. The *European Journal of Investigation in Health, Psychology and Education* has dedicated a Special Issue to the exploration of the critical topic of "Health Disparities: The Emerging Trends and Pressing Challenges". This collection of research aims to shed light on the multifaceted nature of health disparities, their root causes, and potential solutions, bringing together insights from various disciplines to inform policy, practice, and future research directions.

The Special Issue audience reflects the multi-disciplinary and multi-sectoral approach required to address complex health disparities effectively; the audience consists of public health academic and clinical researchers, healthcare practitioners, policymakers, educators and students, and community and advocacy organizations.

I would like to sincerely thank Ms. Jayda Su, the managing editor, who was a full partner throughout the entire process of editing the Special Issue. Her professionalism, dedication, and kindness are commendable. Jayda, I was honored to work with you!

Keren Dopelt
Guest Editor

European Journal of
Investigation in Health,
Psychology and Education

Editorial

Health Disparities: The Emerging Trends and Pressing Challenges

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1. Introduction

Health disparities represent one of the most pressing challenges in modern healthcare systems worldwide (Shadmi et al., 2020). The Centers for Disease Control and Prevention (CDC) defines health disparities as "preventable differences in the burden, disease, injury, violence, or in opportunities to achieve optimal health experienced by socially disadvantaged racial, ethnic, and other population groups and communities" (The Centers for Disease Control and Prevention (CDC), 2024). Health disparities have a profound influence on communities and individuals, shaping their overall health, well-being, and social dynamics (Cogburn, 2019). These preventable differences in health outcomes, disease burden, and access to quality care continue to affect socially disadvantaged populations, perpetuating cycles of inequality and undermining the fundamental principle of health equity (Hoagland & Kipping, 2024). As we delve deeper into the 21st century, the urgency to address these disparities has never been more apparent, with emerging trends highlighting both the persistence of long-standing issues and the rise of new challenges in our rapidly evolving global landscape.

The *European Journal of Investigation in Health, Psychology and Education* has dedicated a Special Issue to the exploration of the critical topic of "Health Disparities: The Emerging Trends and Pressing Challenges." This collection of research aims to shed light on the multifaceted nature of health disparities, their root causes, and potential solutions, bringing together insights from various disciplines to inform policy, practice, and future research directions.

Received: 27 December 2024
Revised: 3 January 2025
Accepted: 7 January 2025
Published: 8 January 2025

Citation: Dopelt, K. (2025). Health Disparities: The Emerging Trends and Pressing Challenges. *European Journal of Investigation in Health, Psychology and Education*, *15*(1), 7. https://doi.org/10.3390/ejihpe15010007

2. Understanding Health Disparities

Health disparities are common everywhere, both within countries and between countries (Crimmins et al., 2019; Ravallion, 2018). It has become among the most pressing health challenges, according to different international organizations such as the World Health Organization and non-health bodies such as the UN and the World Bank (Kirigia & Asante, 2021). Ministries of health around the world are preoccupied with measuring health disparities, building interventions, and evaluating them (Mackenbach et al., 2018).

Although this topic is troubling health systems and researchers, health disparities still exist and reflect societies' structures, historical backgrounds, as well as economic, environmental, and political factors, on top of the approaches of ministries of health (Schillinger, 2020). Solutions have been sought for years, but this wicked problem still persists.

The current volume presents current perspectives on how to measure health inequalities, the fundamental roots for their persistence, and what the approaches for tackling this problem should be. Case studies emerging from different countries and areas, ranging from Brazil to Japan, are crucial as there are no "cut and paste" solutions. Even in a specific country or area, there might be general or specific developments, ranging from very diverse backgrounds, such as in regulation, demography, and climate change, to healthcare delivery and its financing.

The impact of health disparities extends far beyond individual health outcomes. Health disparities shape community resilience, erode trust in healthcare systems, strain resources, and perpetuate cycles of disadvantage across generations (Parenteau et al., 2023). Addressing these disparities requires a nuanced understanding of their underlying determinants and a commitment to systemic change.

3. Key Dimensions of Health Disparities

Race and Ethnicity: Racial and ethnic minorities often face disproportionate health challenges due to a complex interplay of socioeconomic factors, cultural barriers, and systemic racism within healthcare systems (Churchwell et al., 2020; Javed et al., 2022). These disparities manifest in higher rates of chronic diseases, reduced access to preventive care, and poorer health outcomes overall (Davidovitch et al., 2013).

Socioeconomic Status: Income, education, and occupation significantly influence health outcomes (Lindberg et al., 2022). Lower socioeconomic status is associated with reduced access to quality healthcare, nutritious food, and safe living environments, all of which contribute to health disparities (Carethers & Doubeni, 2020).

Geographic Location: Rural and urban underserved areas often face unique health challenges, including limited access to healthcare facilities, shortages of healthcare professionals, and inadequate health infrastructure (Dopelt et al., 2021).

Gender and Sexual Orientation: Gender-based health disparities persist in many areas, while LGBTQ+ individuals often face unique health challenges and barriers to care due to discrimination and a lack of culturally competent healthcare services (Lampe et al., 2024).

4. Emerging Trends and Pressing Challenges

As we confront long-standing health disparities, new trends and challenges continue to emerge, such as the following:

Technological Disparities: The rapid digitalization of healthcare has the potential to exacerbate existing disparities, as access to and proficiency with digital health technologies may be limited among certain populations (Badr et al., 2024; Richardson et al., 2022; Wilson et al., 2024).

Climate Change and Health Equity: Environmental changes disproportionately affect vulnerable populations, introducing new health risks and exacerbating existing disparities (Bolte et al., 2023; Gutschow et al., 2021).

Global Pandemics: The COVID-19 pandemic has starkly highlighted and, in many cases, worsened existing health disparities, emphasizing the need for equitable public health responses (Dopelt et al., 2024).

Mental Health Disparities: Growing recognition of mental health issues has revealed significant disparities in access to mental health services and outcomes across different populations (Parenteau et al., 2023).

5. Addressing Health Disparities: A Multifaceted Approach

Tackling health disparities requires a comprehensive, multi-level approach (Paskett et al., 2016), as follows:

Policy Interventions: Developing and implementing policies that address social determinants of health, improve access to care, and promote health equity across all sectors of society (Gómez et al., 2021).

Healthcare System Reform: Transforming healthcare delivery to be more culturally competent, accessible, and equitable, including diversifying the healthcare workforce.

Community Engagement: Empowering communities to participate in health decision-making and implementing community-based interventions tailored to local needs (Dopelt et al., 2023).

Research and Data Collection: Continuing to invest in research that explores the nuances of health disparities, evaluates interventions, and monitors progress over time.

Education and Awareness: Raising public awareness about health disparities and educating healthcare providers about implicit biases and culturally sensitive care (Dopelt et al., 2014).

6. The Role of This Special Issue

This Special Issue of the *European Journal of Investigation in Health, Psychology and Education* serves as a platform for researchers, policymakers, and practitioners to share insights, innovative approaches, and critical analyses related to health disparities. By bringing together diverse perspectives, the issue aims to achieve the following:

1. Raise awareness about the existence, magnitude, and impact of health disparities across various dimensions and populations.
2. Deepen understanding of the complex determinants of health disparities, including social, economic, and environmental factors.
3. Inform policy development and healthcare practice with evidence-based strategies to reduce disparities and promote health equity.
4. Highlight innovative interventions and best practices in addressing health disparities at local, national, and global levels.
5. Identify gaps in current knowledge and priority areas for future research and action.

The collection of articles in this Special Issue spans a wide range of topics, including but not limited to health inequality on local and global scales, health justice and distributive justice, food insecurity, public versus private health insurance systems, health challenges faced by immigrants and minorities, racism and diversity in healthcare, health service utilization among marginalized populations, public health policy, workforce issues in underserved areas, and the broader social determinants of health.

By fostering a multidisciplinary dialog on these critical issues, this Special Issue aims to contribute to the ongoing efforts to reduce health disparities and achieve greater health equity for all populations. As we confront the emerging trends and pressing challenges in health disparities, the insights gathered here will serve as valuable resources for researchers, policymakers, healthcare providers, and community leaders committed to creating a more just and equitable healthcare landscape.

The urgency of addressing health disparities cannot be overstated. As we move forward, it is crucial that we continue to build on the knowledge shared in this Special Issue, translating research into action and working collaboratively across sectors to dismantle the barriers that perpetuate health inequities. Only through sustained effort, innovation, and commitment can we hope to create a world where everyone has the opportunity to achieve optimal health, regardless of their social, economic, or demographic background.

Conflicts of Interest: The author declares no conflict of interest.

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European Journal of
Investigation in Health, Psychology and Education

Article

“I Believe More in the Ability of the Small Person to Make Big Changes”: Innovation and Social Entrepreneurship to Promote Public Health in Israel

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Abstract: Social entrepreneurship has grown worldwide in recent decades as it attempts to create and implement innovative solutions to social and environmental issues through business strategies. The aim of this study was to explore what motivates public health social entrepreneurs to act, the challenges and barriers they face, achievements, and competencies required for success. As such, we interviewed 15 social entrepreneurs in Israel. Budget issues, regulatory barriers, and struggles against powerful companies were the frequent barriers to success. The interviewees indicated several achievements at the health policy level by positioning and becoming an authority in the field, positively influencing other people’s lives. They highlighted the importance of creativity, determination and courage, leadership, and the ability to persevere in the face of overwhelming adverse odds as essential for the social entrepreneur’s success. Social entrepreneurship in public health is essential when struggling with health disparities. Nevertheless, recognizing that social entrepreneurship is not a substitute for methodological government planning and accountability is crucial.

Keywords: social entrepreneurship; social innovation; motivations; barriers; public health; Israel

Citation: Dopelt, K.; Mordehay, N.; Goren, S.; Cohen, A.; Barach, P. “I Believe More in the Ability of the Small Person to Make Big Changes”: Innovation and Social Entrepreneurship to Promote Public Health in Israel. *Eur. J. Investig. Health Psychol. Educ.* **2023**, *13*, 1787–1800. https://doi.org/10.3390/ejihpe13090130

Academic Editors: Georgios Rachiotis and María del Mar Simón Márquez

Received: 26 July 2023
Revised: 15 August 2023
Accepted: 12 September 2023
Published: 13 September 2023

1. Introduction

Global health inequality is deepening. The social, political, and environmental concerns contributing to inequality range from social tensions, rising unemployment, and weakened representative democracy to severe weather events, corruption, and inadequate infrastructure [1]. The interconnectedness of these concerns makes it difficult to address them using traditional solutions. Social entrepreneurship, defined as a person who explores business opportunities that have a positive impact on their community, is key to success in addressing global inequality and reducing health disparities [2]. Social entrepreneurship has grown worldwide in recent decades as it attempts to create and implement innovative solutions to social and environmental issues through business strategies [3,4]. The persistence of pressing wicked issues—intractable social issues that require new ways of thinking, learning, and doing [5]—is fueling an explosion in social entrepreneurship.

A few decades ago, “nonprofit entrepreneurship” may have seemed an oxymoron. The need for social entrepreneurship has grown as governments have struggled and failed to address pressing social and environmental challenges effectively, and the willingness of organizations and people to “change the world” has increased [6,7]. Social entrepreneurship is a new arena characterized by blurring disciplinary boundaries, unifying contrasts, and pooling resources [8]. Social entrepreneurs prioritize the needs of marginalized or underserved communities and strive to create a more equitable and just society [9]. Social entrepreneurship is vital in addressing societal and community problems, promoting sustainability, and empowering marginalized groups in society to achieve their full potential [10,11]. Social entrepreneurship can help bridge the gaps between the public and private sectors, applying resources and expertise to address critical public health needs such as poverty, homelessness, and food deserts [12] through effective collaborations with government agencies [13]. The social entrepreneur works for the social benefits of a large group in the population or society as a whole [14]. Contributions to health policy, reducing service gaps, and promoting health are at the core of public health [15]. Roy et al. [16] provide evidence that engagement in social enterprise endeavors has the potential to yield favorable effects on mental well-being, self-sufficiency, self-esteem, health-related behaviors, the attenuation of stigmatization, and the cultivation of social capital. These outcomes collectively contribute to the enhancement of overall health and holistic well-being. Nevertheless, there is little research on the motivations for social entrepreneurship's underlying factors of individuals' intention to create a new social enterprise [17,18].

Barendsen and Gardner [19] contend that the founder's background can catalyze the inception of a social enterprise. Asarkaya and Keles-Taysir [20] explored Turkish social entrepreneurs' life narratives, revealing that their past encounters with specific experiences and individuals significantly influenced their trajectory. Van Ryzin et al. [21] posit that individuals possessing higher levels of education, occupational status, and prior experience in employment and business are more inclined toward adopting the role of social entrepreneurs. Williams and Nadin [22] elucidate that social entrepreneurs present a dual array of motivations: individualistic or societal. Individualistic motives encompass the aspiration for greater autonomy, freedom from hierarchical authority, or pursuing a fresh vocation post-retirement. Societal rationales encompass the desire to aid others or enhance the environment. Koe Hwee Nga and Shamuganathan [23] reveal that social entrepreneurs exhibit kindness, receptiveness to novel ideas, and heightened self-expectations regarding job performance compared to their counterparts. Sastre-Castillo et al. [24] further contribute by indicating that the value most closely associated with an entrepreneurial mindset is openness to embracing change.

The current study aims to fill this gap by exploring the experience and perspectives of social entrepreneurs in public health to help identify strategies and practices for leveraging the power of entrepreneurship to improve population health. We hypothesized that social entrepreneurs are motivated by an inner desire to address unmet public health needs and achieve sustainable impact through innovative approaches and community engagement.

2. Methods

2.1. Context—The Public Health System in Israel

Israel's health system is predominantly public [25]. All residents are entitled to comprehensive public health insurance [26]. The Israeli Ministry of Health is responsible for providing public health services. The public health division includes the units responsible for policymaking and guidelines for regional health departments providing community-based services. The regional leadership is provided by public health physicians, public health nurses, epidemiologists, environmental engineers, nutritionists, health promoters, and other public health-related professionals [27].

2.2. Participants

Eighteen public health social entrepreneurs were contacted by e-mail to explain this study's purpose and ask if they agreed to participate. Fifteen social entrepreneurs consented to participate.

2.3. Data Collection

We conducted a prospective qualitative study using a pretested semi-structured individual interview guide (Appendix A). The topics that guided the interview guide question development were based on the literature and public health social entrepreneurship studies [28].

Three senior public health experts from Ashkelon Academic College and Ben Gurion University of the Negev validated the interview guide for clarity, accuracy, and relevance using the content validation method. The interview guide was pilot tested with one social entrepreneur and two senior public health researchers involved in health equality programs to ensure a smooth interview flow and verify comprehension of the questions. We added one question and refined two questions following the pilot phase. The experts agreed that the interview guide corresponds well to the topic and reliably addressed the goals of this study. Information collected during the interviews included the description of the social initiatives, the motivations and barriers, successes and failures, and background demographic details of the interviewee. Interviewees shared their recommendations regarding the need to ease and shorten the bureaucratic obstacles and processes for future social entrepreneurs.

All interviews were conducted between December 2021 and January 2022 over the Zoom App due to COVID-19 social distancing restrictions. The interviewer was a Public Health undergraduate student (SG), trained in qualitative research methods and supervised by this study's senior staff, experts in qualitative methods (KD and PB). No relationships were established between the interviewer and this study's participants before this study's commencement. Each interview was audio recorded, lasted between 20 and 40 min (average 25.10 ± 8.33), and was transcribed verbatim in Hebrew in a standardized format. The research team discussed the emerging key themes and data richness during the interview, and some of the interviews were analyzed in parallel with the data collection. We derived new hypotheses as a result of this ongoing data analysis.

2.4. Data Analysis

Two researchers (KD and PB) analyzed all interviews using a thematic analysis method [29]. The analysis included themes arising from the research topics, data, and review of the public health social entrepreneurship literature. In the first data stage of the analysis, all the interviews were read twice to achieve comprehensive knowledge (saturation) and understanding of the data. Researchers identified categories and themes related to this study's objectives in the second stage. In the last stage, themes were redefined to include quotes and examples based on the transcripts. The themes and quotes were translated into English at the final step. The translations from Hebrew to English were validated using the retranslation method [30] and a standardized codebook to ensure the validity of the translations from Hebrew to English. We conducted an ongoing internal quality audit using the Consolidated Criteria for Reporting Qualitative Studies (COREQ) checklist [31] to determine whether the data were collected, analyzed, and reported consistently according to the study protocol.

3. Results

3.1. Participants

Eleven female and four male public health social entrepreneurs participated in this study, of ages 31–76 years (average 47.33 ± 14.04). All interviewees agreed to reveal the name of their social initiative (Table 1).

Table 1. Social entrepreneur initiatives list.

No	Initiatives Translated into English (Hebrew)	Initiative Goal	Characteristics
1	Shades (Gvanim)	Establish a therapeutic and educational center for parents and children	Female, 51, Married + 3, MBA
2	Netball for moms (Mama-net)	Form a Mothers' Netball League	Female, 43, Married + 2, BA
3	Walking circles	Establish walking groups	Female, 73, Married + 3, MA
4	Vaccinated kindergarten (Mehusgan)	Make reliable medical information about vaccinations and the prevention of infectious diseases accessible to the community, kindergartens, parents, and kindergarten teachers	Male, 42, Married + 3, BEd
5	Healthy Cities	Start an association of local authorities, government ministries, health funds, and academia working together to develop health and sustainability at the local level	Female, 76, Married + 3, MD, MPH
6	Sheets from home	Provide new and fun bedding for children with cancer	Female, 45, Married + 3, BA
7	The project to eradicate smoking	Prevent smoking initiation among teenagers and young adults	Female, 48, Married + 2, MA
8	La Leche League	Breastfeeding encouragement	Female, 40, Married + 4
9	Yoga in the neighborhood	Make the practice of yoga accessible to the entire population	Female, 31, Married, BA
10	A healthy foundation for women (Keren Bri'a)	Improve health services, accessibility, and care for women	Female, 39, Married, MA
11	Aware (Mida'at)	Advance health promotion in the fields of medical treatment and preventive medicine	Female, 40, Married, MA
12	Embrace (Hibuk)	Enhance access to health services in the community for chronically ill patients and alleviating loneliness for those who, due to their medical condition, rarely leave their house	Male, 37, BA
13	The Association of Patients' Rights	Provide assistance and guidance in dealing with various medical conditions, focusing on the realization of the rights in the healthcare system in Israel	Male, 69, Married, MHA
14	Mind and Fitness	Improve the lifestyle for those dealing with mental disabilities	Male, 42, Single, BA
15	Mortal (Enosh)	Provide rehabilitation and treatment for people facing a mental disability and their families, and promote policies in the field	Female, 45, Married + 3, MA

3.2. Themes

The data analysis resulted in four main themes that emerged from the interviews:

- Motivations to act (sub-themes: internal motivational factors and external motivational factors),
- Challenges in the establishment and operation of the initiative (sub-themes: budget issues, regulatory challenges, and feeling similar to 'David against Goliath'),
- Achievements of the initiatives (sub-themes: new procedures and legislation, positioning as an authority in the field, impact on people's lives and self-empowerment), and
- The virtues of the social entrepreneur.

3.2.1. Theme I: Motivations to Act

All interviewees talked about establishing the initiative, starting from the ideation stage until the initiative began to operate in the field and prosper. Sharing made it possible to identify internal and external motivational factors that motivated them. Nine of the fifteen interviewees identified the importance of internal motivational factors in supporting their social initiative.

Internal motivational factors

Internal motivational factors are a product of the personal experience of the interviewees, who generally experienced unmet needs, difficulties in getting support, and service implementation gaps (in relationships, knowledge, service, etc.). Nine of fifteen interviewees felt a responsibility and a need to fill these gaps for other citizens coping (or will cope in the future) with similar challenges based on their personal experience. For example, interviewee 14, who struggles with post-traumatic anxiety, initiated the rehabilitation of the mind through movement:

> *"Basically, my idea was to teach from my experience that it is both mental coping in all its shades... and also my knowledge of movement that I have developed over the years... to bring it into "Enosh," the largest mental health association in Israel was a dream for me".*

Some interviewees talked about a disappointing experience in receiving care and their interactions with the health system when they or their relatives were sick and experienced poor service and inattention from the medical staff. This experience gave them the desire to change how they and others could deal with the health system. Interviewee 13 shared his founder's story:

> *"She got sick and was admitted to the hospital where she worked, and suddenly she became a patient. She said she was lying in bed as if she didn't exist. The doctors were talking to each other and the nurses about what should be done to her. 'I'm here! Let them ask me!' Then She swore that if she could, she would establish an organization that would represent the patients and strengthens them in dealing with the health system".*

Interviewee 10 described a similar experience:

> *"Once, I came to a medical center with sharp pain, and they didn't believe me. They told me that it was probably imaginary labor. In the end, I arrived alone at the hospital, and it led to a premature birth. Then as I delved deeper into the effects between gender and medicine, I decided to found a body that represents women".*

Some interviewees felt empowered by their physical activity. They described it as an inner 'enlightenment' and wanted to "spread the word" to everyone possible. Interviewee 2 recalled:

> *"I played volleyball, and when I returned home, I had two insights: one, only we decide on our priorities in life because we constantly have excuses... the other, suddenly, something I had before the wedding and the children that disappeared came back to me. And suddenly, the opportunity to experience it again enlightened me. I couldn't leave it to myself because other mothers surely feel exactly like me. Who give the same excuses and therefore I have to act".*

External motivational factors

The primary motive among six of the interviewees was described as an external motive, either when offered a job or an external trigger that caused them to develop the initiative or join an international ongoing initiative. Interviewees who started establishing the initiative as a response to a job offer understood from the beginning the existing gaps in the health system and the importance of the initiative to advance public health. Interviewee 7 recalled:

> *"I was offered to set up a project to prevent smoking, and as soon as I started going deeper, I realized something was interesting about it. I can take my abilities in the field of prevention, and I will use them to prevent smoking".*

An external trigger influenced interviewee 11, but she also described the deep sense of mission that accompanied her during the process:

> *"We founded the association following the polio outbreak that occurred in Israel in 2013, and as part of this outbreak, the Ministry of Health decided that we would have to complete polio vaccines for a group of children who did not receive them... we looked at what was happening in the world, and we realized that such challenges would continue to happen, and we decided to establish Midaat... In my eyes, public health is a significant civic issue, and I believe that health is significant for creating an equal and just society"*.

Two initiatives were imported from abroad: the Healthy Cities Network and La Leche League. Interviewee 5 commented:

> *"This is a program of the World Health Organization that started in 1987"*.

3.2.2. Theme II: Challenges in the Establishment and Operation of the Initiative

The interviewees shared the challenges and barriers they faced during the establishment of and running of the initiative.

Budget issues

Six interviewees shared the difficulties of raising funds and limited budgets. Interviewee 13 said:

> *"You need money to do things. Today we live on donations. An entrepreneur needs financial resources"*.

Regulatory challenges

Most interviewees talked about the pervasive hyper-regulation and the difficulties in dealing with the various branches of the health system, including the Ministry of Health, hospitals, health funds, and government offices that oversee health and wellness services in Israel. Interviewee 10 addressed this as follows:

> *"The health system is a huge body. Some didn't understand why this woman suddenly came and thought she could tell the doctors what to do. I don't come from the medical field, so what is my legitimacy to come and demand to be part of the national council and the committees and influence health insurance protocols as a patient? It is not a standard thing."* Interviewee 5 emphasized: *"The Ministry of Health is interfering. Their vision is very narrow, and our vision is very broad and holistic"*.

Interviewee 12 elaborated on the regulatory difficulties:

> *"It was a tremendous difficulty. Everyone I talked with and told that nurses were going to refer patients all laughed and said there was no way it was going to work. We have a very complex regulation here because a nurse can't just give a patient's phone number to a student. You must sign a confidentiality agreement. So, you must go through the whole legal aspect of each health fund"*.

Feeling similar to 'David against Goliath'

The interviews highlighted the difficulties and complexity starting from when the idea was born until its successful implementation. All spoke about the challenges mentioned, but many times there was also a feeling of "weak versus strong" and going up against all odds. For example, interviewee 2 talked about the world of sports, where a dominant male hegemony makes it difficult for women to enter this world:

> *"Directors of sports departments, heads of unions and associations, the majority are men. There is complete male control. When I wanted to establish a league of mothers, the mayor kicked me out of his office"*. Interviewee 7 encountered a severe problem as her venture deals with very powerful companies in terms of power, money, and interests:

> *"I was told this is a problem that cannot be solved. The tobacco companies have a lot of money. There is no chance to move anything. Full of politics, full of interests. I'm like David against Goliath"*.

3.2.3. Theme III: Success of the Initiatives

The interviewees indicated several achievements at the health policy level by positioning and becoming an authority in the field, positively influencing other people's lives. At a personal level, this contributed to their growth and empowerment.

New procedures and legislation

New procedures and legislation are significant achievements that affect the health of the public and result from hard work and lobbying the decision-makers. Everything must be backed up by studies and statistics. Legislation is the fruit of tireless efforts by many and is considered one of the most important principles in health promotion. New legislation achievements can change reality and benefit many people, and interviewees said this was the most significant change they could achieve. For example, interviewee 7 proudly shared:

> *"One achievement is the law banning advertising, and electronic cigarettes were included. And second, we handled the comparison of the tax on rolling cigarettes to regular cigarettes. The initiative got appreciation from the World Health Organization for these two achievements".*

Positioning as an authority in the field

The interviewees were proud that their initiative developed from a nascent idea to a recognized professional authority. Interviewee 8 shared:

> *"We are members of some committees in the Knesset, the welfare committee for the children's rights, the Ministry of Health contacts us during the breastfeeding week. It says everything".*

Interviewee 2 spoke about international resonance:

> *"I am one of the only women's sports entrepreneurs in the world who managed to break male hegemony, which is now being replicated in many countries in the world".*

Interviewee 4 also shared their achievement:

> *"Even the Ministries of Health and Education consult with us. We have become the country's largest center of knowledge for treating vaccine resistance in all aspects. And that is the big thing".*

Impact on people's lives

Social entrepreneurs strive to impact people's lives positively and to create equality, fairness, and social justice in society. Interviewee 12 talked about the importance of helping elderly citizens who struggle with chronic diseases:

> *"There were exciting and amazing stories about how we actually saved people. We realized that this was a tremendous result..."*

Interviewee 14 elaborated on the help needed for the mentally challenged while changing the perceptions on healing and providing inspiration for new projects in the mental health field:

> *"This is something new, groundbreaking that brings healing, it brings relief to suffering... It brings solutions in places that have not been touched and inspires many other projects. In general, bringing a healing approach to mental health is the point. Bringing a healing approach, not holding the contenders to a level of minimal functioning that they are simply some kind of burden or won't make too much noise, but to see that it is possible to build the person's coping journey into a journey of development and recovery".*

Interviewee 11 spoke about an indirect effect on people:

> *"In the end, tens of thousands of people we talked to and hundreds of thousands of people who received the content we produced and were helped by them directly and indirectly and millions of people who heard us in the media that we were able to influence as part of our activities. I am happy that I could do something that has a positive impact. It is not without frustrations because we never get to do everything we want, and our influence*

> *is always limited. But every time I meet someone who says thank you for receiving information that helps him, for helping him to make a decision".*

Self-empowerment

One of the initiatives' secondary goals was to support entrepreneurs' empowerment. Although this is not an achievement, it came up in all the interviews. All the entrepreneurs experienced frustration and disappointment and faced many difficulties and obstacles along the way. They did not give up and had complete convictions in their idea and the righteousness of their ways. The challenges strengthened their resolve on a personal level.

For example, interviewee 4 sees the initiative as the most significant thing they have done:

> *"That is bigger than anything else I've done in my life. I was an officer in the army, learned skydiving, founded kindergartens, was an educator, and many things. And 'Mehusgan' orders of magnitude are bigger than anything I've done in my life. It's not money, it's not profit, just a tendency to do good. It's fun. All the people who connect with 'Mehusgan' are great. Amazing doctors. Everyone. Wonderful people are All around us, and we are in an amazing place. It drains us of many, many, many hours at the expense of the family and everything, but every time we think we have reached a peak, it reaches a new peak."* Interviewee 6 added: *"I learned a lot about myself and many things beyond what I expected. I had to learn how to build a website. I had to call hospitals and collect donations. I don't know if it changed me, but it gave me the strength to do other things".*

Interviewee 2 explained:

> *"It made me a stronger mother, a more aware mother, and the successes and the fact that other mothers made me realize that I can influence others. That is very, very strengthening and empowers me and my ability. It made me very sensitive to people and attentive. My motto as the director of the largest women's league organization in Israel is that there are many good people like me, and we give them the platform to grow and grow".*

Interviewee 10 summed up nicely:

> *"My involvement in the association has greatly changed me. I believe more in the ability of the small person to make a big change".*

3.2.4. Theme IV: The Virtues of the Social Entrepreneur

The participants discussed the essential qualities of an effective social entrepreneur. The majority agreed that creativity and innovation were crucial, as well as tolerance and perseverance to face and overcome challenges without giving up. Interviewee 14 emphasized:

> *"The entrepreneur needs to be creative, think outside the box, and be innovative. He also needs patience and a willingness to work hard. There is a possibility that the dream will not come true. Now the idea is not to give up on the dream and not to be afraid of difficulties, to be dedicated and go to the end even if it takes time".*

Interviewee 2 added:

> *"In sports, you live by rules, and to do entrepreneurship in sports, you must break this thing. Because you can't enter and fit into any cube that was there before".*

Interviewee 1 mentioned the need to deal with situations of uncertainty:

> *"You have to be a person who sees a challenge and sets out to conquer it. Someone willing to take risks, who knows how to deal with situations of uncertainty".*

Interviewee 12 emphasized the more practical level, the need to identify gaps and ensuring is needed versus what is available:

> *"To create an initiative that will be successful, you have to do a lot of testing and distilling and understanding which is the right answer to a need that exists and is significant, it needs to be examined very comprehensively and to understand who the different players are, who the competitors are, what exists and what does not exist".*

Interviewee 13 spoke about flexibility and the ability to convince and build diverse coalitions:

> *"Many social initiatives are founded thanks to crazy people. As an entrepreneur, you need to be flexible with learning ability, persuasiveness, and know how you create coalitions because alone, in many cases, it is difficult for you to do".*

Interviewee 12 averred:

> *"One of the dangers of entrepreneurs is falling in love with an idea because what happens when you fall in love with an idea? You become blind, and you don't look at other options. The process requires tremendous flexibility, listening to what is happening, and rapid changes and corrections. When I obscure or am busy with my worldview, I can miss and even sabotage the initiative".*

4. Discussion

Social entrepreneurship has gained widespread importance in recent years as a powerful way to address pervasive societal gaps [32,33]. Our findings highlight the motivations, challenges, and achievements of public health entrepreneurs in Israel and the key character traits required for effective social entrepreneurship in the field of public health. The findings provide a comprehensive understanding of social entrepreneurs' experiences, perspectives and identify strategies and best practices for leveraging social entrepreneurship to address public health challenges.

Social entrepreneurs are often driven by a desire to make the world a better place and to create sustainable solutions to pressing issues [17]. The driving factors for many social entrepreneurs were a keen sense of fairness and deep motivation, an internal process that occurred within the individual, that brought with it the intention to act and the persistence to persevere [19,20,34]. Motivation influences entrepreneurial behavior in three ways: the choice of the individual, the intensity of the action, and the persistence of the action [35]. The theory of self-direction [36] distinguishes between types of motivation according to the reasons or goals that cause action. The most basic distinction is between internal motivation, which relates to doing something because it relates to an inner experience, while external motivation relates to doing something because it gives rise to a particular distinct result.

The health system in Israel is changing at an unprecedented rate, and entrepreneurship is one way to deal with these challenges. In developed countries such as Israel, social entrepreneurship is on the rise due to the decline and shortcomings of the welfare state. In less developed countries, social entrepreneurship arises from a combination of government mistrust, indifference in the private sector, and the inability of the government to provide effective services to people [37]. Being an entrepreneur means taking responsibility and leading actions to change it. This reality can be a personal journey for the entrepreneur himself or a social fact [38]. A central theme in our interviews dealt with the motivation for the initiative. The personal exposure of the social entrepreneur to health service shortfalls and the needs not met by the existing policy often triggered a change or renewal of policy to address the real-world gaps.

Our findings highlight the importance of internal and external motivational factors. Internal motivational factors are personal experiences: a desire to improve an existing situation, direct experience with inequality, opacity on the part of the system and the medical staff, dealing with bureaucracy, and lack of knowledge. The external motivational factors in this study included being offered a job or taking part in an international initiative. Once they launched the initiative, the entrepreneurs immediately understood its importance and the potential to contribute and cause lasting change. The interviewees internalized the reasons for action and assimilated them so that the activities performed out of external motivation were ultimately done out of increased self-directedness [39].

The interviewees shared the difficulties they faced and reinforced the idea that their motivation came from an internal place and a desire to improve people's health in their dealings with their health and social systems. The motives of these entrepreneurs were noble and often not self-interested. They identified a local concern and brought creative ideas that could affect a recognized social problem [40]. This study and previous studies, e.g., the studies in [40,41] found that internal motivational factors are stronger than external ones in initiating and sustaining action.

The second theme dealt with the challenges encountered by entrepreneurs during the development of their initiative. We found that facing challenges or obstacles in the early stages of establishing new ventures is normal and can be a powerful driving and positive process [17]. Studies have identified that entrepreneurs face several challenges, such as regulation, lack of financial assistance, information, and excessive taxation, and the need to face them with an open mind and mental flexibility [17,42,43].

In contrast, the entrepreneurs in our study were exposed to the daily needs and difficulties, as well as the problems and shortcomings of Israeli policies in health and public health. In the interviews, several barriers came up that the entrepreneurs had to deal with, such as the lack of organizational management knowledge, recruiting partners, budgets, experience dealing with government officials and recognition from the establishment, heavy-handed regulation, and a lack of understanding in the field in which the venture is engaged [44,45].

Social entrepreneurship needs ongoing financial support and dedicated budgets to achieve its goals, especially in the early stages of establishing and operating the venture. The interviewees emphasized that access to funding was the main difficulty. On the other hand, the health system presents numerous regulatory obstacles to entrepreneurs, and the entrepreneur must overcome complicated technical processes, which significantly slow down the pace of progress. Financial and regulatory problems were a common theme among all interviewees. Some entrepreneurs felt similar to "David against Goliath" at the beginning of their journey. They felt "small" and powerless, struggling against powerful and wealthy multinational companies and capricious regulators.

Another theme dealt with the achievements and products of the initiative. Becoming a social entrepreneur has a profound impact—people choosing social entrepreneurship to do good for others was repeated in all the interviews, and it deeply impacted the social entrepreneurs [46]. Social entrepreneurs succeed in gathering legitimacy for their actions and support for their efforts in the face of many obstacles and despite uncertainty. They increase their resources and the scope of their activities through volunteers, public support, donations, and funding from public sources [47]. The interviewees noted their main achievements were at the policy level, positioning the initiative as a trusted authority, lobbying for the passing of legislation, raising knowledge and awareness, and positively impacting other people's lives. While the purpose of a business organization is to generate profit for shareholders, the purpose of a social organization is to create social impact, and its success is measured by its social impact measures [48].

The research findings suggest that the entrepreneurial experience can cause personal empowerment. This phenomenon is complex and includes emotional and rational elements [49]. Entrepreneurs usually approach entrepreneurship from a personal, deeply emotional, and responsible point of view. The entrepreneurial journey becomes a very personal journey in which the values, beliefs, assumptions, positions, and personal strengths of the entrepreneur are leveraged and regularly tested simultaneously. The life experience of the entrepreneur is significant and leads to personal growth, increased awareness, and self-confidence [50]. When entrepreneurs go through the entrepreneurial experience, they seek to find meaning and personal fulfillment and enable a change in the way they are perceived by others, perhaps to improve their self-image, confidence, and personal power [51]. Many of the interviewees said that they chose this arduous journey to fulfill something deeper within themselves, find their place in the world by helping others, and create deeper meaning in their lives while creating changes in the world around them [52].

The last topic dealt with the virtues of the social entrepreneur. The interviewees mentioned a cluster of characteristics, such as creativity, determination and courage, patience, persuasiveness, leadership, and immunity to criticism and failure, needed to overcome challenges and persevere. In addition, we noted that the entrepreneur must show mental flexibility and not be "in love with their own idea". These findings are consistent with previous studies that showed that successful social entrepreneurs are committed to the social mission and work to create significant change and social value [53], identify a gap in needs [54], define a vision [55], succeed in overcoming obstacles and challenges [53] (Short et al., 2009), and succeed in mobilizing the needed resources to advance the initiative [56].

Limitations

Our study has several limitations. First, we had to select the interviewees from a small number of public health initiatives and had limited participants. Fortunately, all the participants we approached agreed to be interviewed. Second, the study results reflect the unique experiences of an Israeli public health entrepreneur. Israel is recognized internationally as the "startup nation (https://sifted.eu/articles/israel-startup-ecosystem-tech-vc-brnd, accessed on 17 March 2023)", which may not be generalizable to other countries within diverse legislations, cultural and social contexts. Third, the interviews were transcribed from Hebrew, the native language of Israel. This may have increased the chances for variations in the interpretation of our data. We made many efforts to ensure methodological rigor and validity of the translations from Hebrew to English by using a standardized codebook, meeting frequently, sharing and comparing our results, and performing a pilot analysis. Throughout this study, we conducted an ongoing internal quality audit during our meetings, adapted from Tong et al. [31], to determine whether the data were collected, analyzed, and reported consistently according to the study protocol.

5. Conclusions

This study considerably advances the understanding of the drives and motivations of public health social entrepreneurs. The themes of resource mobilization, financial viability, cross-disciplinary collaboration, and systems strengthening were woven throughout the interviews. At the micro level, the interviewees talked about their motivations to make a social change, the difficulties, and the assertive personality characteristic required for social entrepreneurship success. At the meso level, they shared the feeling of struggling against powerful and rich companies when they had only limited financial means and influence but with a strong faith in the righteousness of their way to do good for the public and reduce health disparities. It is nicely reflected in the 'David against Goliath' metaphor. At the macro level, the regulatory challenges that the state piles up can be overwhelming, and the ability to stand firm and lead change to the point of creating new guidelines or legislation is critical. In addition to motivation, entrepreneurs must consider the personal and professional challenges and time demands involved in effective social entrepreneurship in public health. Social entrepreneurs initiate reforms and structural changes in the social sector, where social value is created by introducing new forms of activity with the aim of solutions to be sustainable for political change.

Implications of This Study

While social entrepreneurship can help address critical public health needs, it is essential to recognize that it is not a substitute for government planning and accountability. Government services and funding remain crucial for ensuring a strategic health equality vision, access to healthcare, disease prevention, and health education for all members of society. Social entrepreneurship in public health should be seen as a complement to government services, not a replacement. Future studies should compare social entrepreneurs in public health versus social entrepreneurs in other fields (such as education and welfare) and examine whether there are meaningful differences. More research is needed to understand the implications for capacity building, financing, scaling, and policy making. Finally, more must be done to evaluate the contributions of public health entrepreneurship in promoting population health.

Author Contributions: Conceptualization, K.D., N.M., S.G., A.C. and P.B.; methodology, K.D. and P.B.; validation, K.D., N.M., S.G. and A.C.; formal analysis, K.D. and P.B.; data curation, N.M., S.G. and A.C.; supervision, K.D. and P.B.; writing—original draft, K.D. and P.B.; writing—review and editing, All authors. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the Ashkelon Academic College (Approval # 33-2021, 14 October 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study before the interviews. All participants signed two agreements to conduct and record the interview and disclose their initiative's name.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Social Entrepreneur's Interview Guide

1. Can you tell me about yourself: age, marital status, profession, workplace, etc.?
2. Tell me about the social initiative in which you are involved, what is the purpose of the initiative, when did the initiative begin, how did you think about it, and what needs you did you try to meet.
3. Where did you get the motivation to implement the initiative? How did you manage to progress the initiative from a dream to reality?
4. What obstacles did you encounter along the way? Can you give an example? Have you had moments of despair where you thought of giving up? What helped you to go on?
5. What are your most significant achievements concerning the initiative as far as you are concerned? What are your failures?
6. Would you like to add anything else?

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European Journal of
Investigation in Health, Psychology and Education

Article

Factors Contributing to the Health of 0- to 5-Year-Old Low-Birth-Weight Children in the United States: Application of the Multiple Disadvantage Model

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Abstract: This secondary data analysis of 1731 low-birth-weight children and their parents in the United States investigated children's health and its associations with social disorganization, social structural factors, social relationships, health/mental health, and access to health insurance/services. The study drew on data from the 2021 National Survey of Children's Health. Logistic regression yielded results showing low-birth-weight children's excellent/very good/good health to be associated positively with parents' education and health. In turn, child health was associated negatively with being Black, having a family income at or below the 100% federal poverty level, difficulty parenting the child, child chronic health condition(s), parent mental health, and substance use in the family. The implications of the present findings in terms of interventions promoting maternal and child health as well as participation in government assistance programs for low-income families are discussed.

Keywords: low birth weight; child health; chronic health problems; hospital use; poverty

Citation: Cheng, T.C.; Lo, C.C. Factors Contributing to the Health of 0- to 5-Year-Old Low-Birth-Weight Children in the United States: Application of the Multiple Disadvantage Model. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 203–214. https://doi.org/10.3390/ejihpe14010013

Academic Editors: Keren Dopelt and María del Mar Molero Jurado

Received: 8 November 2023
Revised: 2 January 2024
Accepted: 5 January 2024
Published: 9 January 2024

1. Introduction

In 2011, over 24,000 infants died before their first birthday, and low birth weight (less than 2500 g) was the major cause of such infant mortality in the U.S. [1]. Prior studies showed that low birth weight was related to racism [2], being part of a racial/ethnic minority [2–7], poverty [2,3], food insecurity and a lack of health insurance coverage [7], having a single mother, the mother's age and education [3,5], maternal smoking [4,5,7], parenting [8], stressful work [6], and being a female infant [3]. Furthermore, two prior studies reported that low birth weight was negatively associated with children's growth in their early childhood [9,10]. Since these risk factors probably continue during infants' growth, it is thus crucial to identify risk and protective factors in low-birth-weight children's health in early childhood.

Literature Review

The present study applied the *multiple disadvantage model* to investigate factors in low-birth-weight children's health in early childhood. The model proposes that the distress of socioeconomic disadvantages is likely to impair low-income parents' mental and physical health, and further hinders their care of low-birth-weight children to such a degree that children's health is adversely affected (see Figure 1). The model was applied to explain children's health [11–13]. By applying the multiple disadvantage model, the present study investigated the impact of five socioeconomic disadvantages (social disorganization, social structural factors, social relationships, health/mental health, and access to care) on the health of low-birth-weight children in their early childhood.

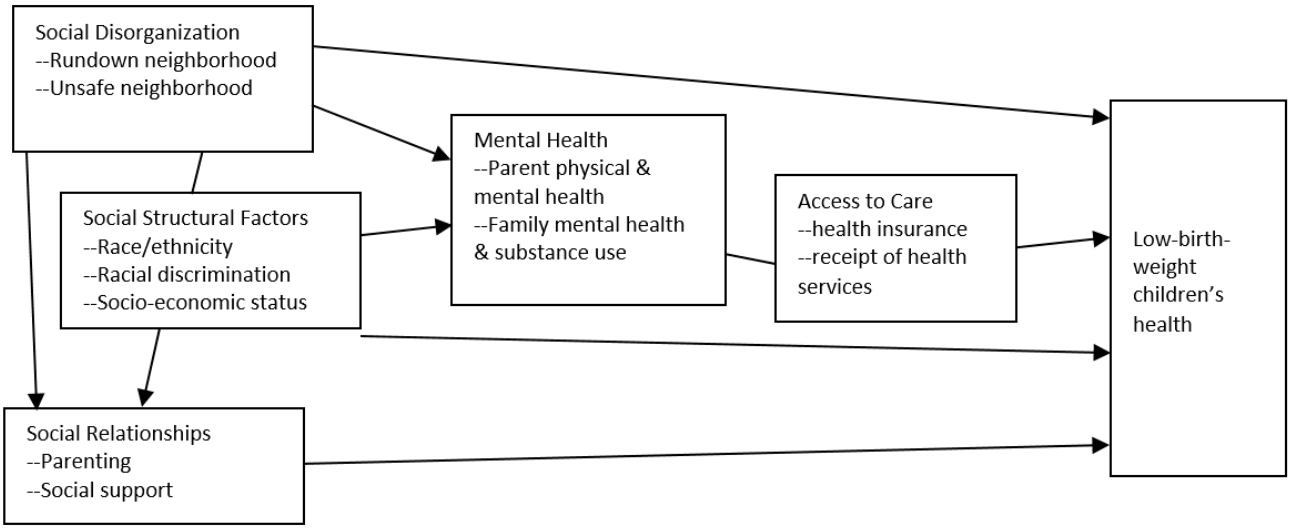

Figure 1. The multiple disadvantage model explaining low-birth-weight children's health.

Social disorganization, such as living in unkempt and unsafe neighborhoods, is a form of socioeconomic disadvantage. Some prior studies showed that living in impoverished neighborhoods and polluted environments increased the risk of having low-birth-weight infants [2,3]. Moreover, many prior studies on children in the general population have indicated that social disorganization is negatively associated with children's health [12–22]. Hence, the researchers of the present study speculated that social disorganization factors like these would adversely affect low-birth-weight children's health.

Race/ethnicity and racial discrimination are two vital social structural factors related to low-birth-weight children's health. The multiple disadvantage model acknowledges that historical and structural racism impact racial/ethnic minorities [23]. Racism-related frustration or distress experienced by parents in racial/ethnic minorities probably has an adverse effect on their parenting. Prior research reported that racism was related to infant mortality [24]; another prior study on low-income families showed that racial discrimination was negatively associated with children's health [12]. In fact, within the first two years of life among low-birth-weight children, children from racial/ethnic minorities have a greater risk of death than White children have [25]. Other social structural factors—parents' low education, under-employment, and low income—also heighten the risk of low-birth-weight infants' mortality [24,26] and low-birth-weight children's poor health within their first five years of life [27]. For low-income families who cannot afford sufficient food, their low-birth-weight infants' mortality risk is escalated [28].

Supportive social relationships can lighten the distress of parents facing multiple socioeconomic disadvantages. With the support of strong social networks, parents generally demonstrate effective parenting [29] that promotes children's health [20,30,31]. Prior studies of children in the general population demonstrated that poor health seemed to be associated with single-parent families [32,33]. Without social support, single-motherhood is likely to increase the risk of low-birth-weight infants' mortality [26]. Furthermore, many low-birth-weight children have chronic conditions (e.g., asthma, poor cholesterol and blood pressure levels, and developmental delays) [27,34,35] that require constant parental attention and may generate parental distress. Also, low-birth-weight children tend to have negative affect and difficulties in social interactions [36,37]; consequently, many parents have difficulties in communicating with their low-birth-weight children and react with negative parenting behaviors [38]. In addition to low-birth-weight children's chronic conditions, negative parent–child interactions are ultimately linked to these children's poor health [39].

The multiple disadvantage model suggests that the challenges of socioeconomic disadvantages can affect parents' physical health and mental health. A prior study indicated that parents' physical health was associated negatively with the mortality risk of their low-birth-weight infant [24]. Moreover, parents with depression or anxiety may be unable to provide effective parenting and care their low-birth-weight children [40,41]. Under the stresses of multiple disadvantages and caring for low-birth-weight children, some mothers may use substances such as alcohol, tobacco, and/or drugs. In fact, mothers who smoke continue to negatively affect their low-birth-weight children's health [42]. The present study assumed that the health of low-birth-weight children would have a positive relationship with their parents' health and mental health, but a negative relationship with their parents' substance use.

A lack of health insurance coverage is the fifth socioeconomic disadvantage affecting families with low-birth-weight children. Low-birth-weight children are more likely than other children to be covered by public health insurance [27]. Medicaid and Children's Health Insurance Program (CHIP) are two public health insurance programs in the U.S. While Medicaid provides free or low-cost healthcare services to families whose incomes are at or below 133% of the federal poverty level [43,44], CHIP provides low-cost comprehensive healthcare coverage to uninsured children of families whose incomes are too high to be eligible for Medicaid but who cannot afford private health insurance [45,46]. In a study of the general population, publicly insured infants reportedly have a lower risk of mortality than other infants [24]. These findings imply that uninsured low-birth-weight children are likely to have poor health. Many low-birth-weight children with chronic health problems have great need of medical attention. In fact, prior studies showed that low-birth-weight children had a high tendency to use hospital care [47–50]. In other words, medical health insurance coverage for low-birth-weight children is crucial to their access to healthcare services and to their health.

The reviewed literature provided only a small number of U.S. studies of low-birth-weight children's health in their early childhood. With the application of the multiple disadvantage model, the present study hypothesized that (1) low-birth-weight children's health would be associated negatively with social disorganization (e.g., impoverished and unsafe neighborhoods), social structural factors (e.g., being a member of a racial/ethnic minority), social relationships (e.g., having a single mother, difficulties in parenting), parents' mental health struggles and substance use, and children's healthcare use; and (2) low-birth-weight children's health would be associated positively with social structural factors (e.g., parents' education, parents' employment, and family income), social relationships (e.g., family support), parents' health, and health insurance coverage.

2. Materials and Methods

2.1. Sample

This secondary data analysis of a nationally representative sample of 1,731 children was extracted from a public-use data set, the 2021 National Survey of Children's Health (NSCH). Between June 2021 and January 2022, NSCH researchers interviewed 50,892 children and their caregivers in the U.S., gathering information on health status, insurance coverage, social relationships, family relationships, and neighborhood characteristics [51]. Of the 48,877 children (ages 0–17 years) with reports of their birth weight, 8.9% reportedly had low birthweight. The present sample was limited to children ages 0–5 years with low birth weight (less than 2500 g); their average birth weight was 2227.6 g. Furthermore, of all the children in the data set, no children reportedly had a birth weight below 1500 g. As a secondary data analysis, the present research received exempted approval from the institutional review board of the university.

2.2. Measures

The outcome variable *child health* was dichotomized as "excellent/very good/good" versus "fair/poor" (the reference). The original responses in the NSCH data set were: "excellent", "very good", "good", "fair", and "poor".

The first group of two explanatory variables represented social disorganization factors. *Rundown neighborhood* (yes/no) was denoted if a parent's neighborhood had "litter or garbage on street or sidewalk"; "poorly kept or rundown housing"; or "vandalism such as broken windows or graffiti". *Safe neighborhood*, a continuous variable, measured how safe parents perceived their children to be in the neighborhoods they lived in. The range of responses were 4 (*definitely agree*), 3 (*somewhat agree*), 2 (*somewhat disagree*), and 1 (*definitely disagree*).

The second group of explanatory variables represented social structural factors. *Racial discrimination* (yes/no) was denoted if a child had reportedly ever been treated or judged based on the child's race/ethnicity. A child's racial/ethnic background was indicated by four dummy variables—*Black*, *Hispanic*, *Asian*, and *other ethnicity/race*; *White* served as the reference group. *Parent education level*, a continuous variable, described the highest program completed by a parent, as follows: 1 (*8th grade or below*), 2 (*9th–12th grade*), 3 (*graduated high school or GED*), 4 (*vocational school*), 5 (*some college*), 6 (*associate degree*), 7 (*undergraduate degree*), 8 (*master's degree*), 9 (*doctoral or professional degree*). *Employed parent* (yes/no) indicated if a parent had been an employee for 50 of the 52 weeks preceding the survey. Three dummy variables signified the ratio of each family's income to the federal poverty level (FPL): *family income at or below 100% of FPL*, *family income at 101–200% of FPL*, and *family income above 200% of FPL* (the reference). The original NSCH data set provided the percentage of federal poverty level that a family's income represented.

The third group of explanatory variables represented social relationships and social support. *Single mother* (yes/no) indicated those who were not married or cohabiting with a partner, suggesting lack of access to the support of a spousal relationship. *Family cohesiveness* was a total score of two items: (a) whether their families drew on strengths family members possessed, and (b) whether their families talked with each other when facing problems. The response scale for the two items was as follows: 1 (*none of the time*), 2 (*some of the time*), 3 (*most of the time*), 4 (*all the time*). Higher total scores suggested greater family cohesiveness. The two items' Cronbach's alpha was 0.91. *Family support* (yes/no) denoted a parent's emotional support received from a spouse/partner, other family members, and friends. *Difficulty of parenting the child* was the total score of three items regarding parents' perception of caring for the child: "hard to care for", "really bothers me", and "angry with the child". Responses included 1 (*never*), 2 (*rarely*), 3 (*sometimes*), 4 (*usually*), and 5 (*always*). The Cronbach's alpha for the three items was 0.80. A higher total score suggested greater difficulty parenting the child.

The fourth group of explanatory variables represented health and mental health factors. *Child chronic health condition(s)* (yes/no) indicated if a child had chronic difficulties/problems breathing, trouble with coordination or moving around, using her/his hands, physical pain, trouble swallowing, or difficult digestion during the 12 months preceding the NSCH interview. Two continuous variables, *parent health* and *parent mental health*, were measured with the same five responses provided by the NSCH: "excellent", "very good", "good", "fair", and "poor". *Family mental health problem* (yes/no) denoted whether a child lived with a family member who was severely depressed, suicidal, or experienced other mental illness. *Family substance use* (yes/no) described if a child lived with a family member who abused alcohol and/or used other drugs.

The fifth group of explanatory variables measured children's access to healthcare. Three dummy variables were *private health insurance coverage*, denoting whether a child was covered by the parents' employer-sponsored or privately-purchased health plan; *public health insurance coverage*, denoting if a child was covered by Medicaid or Medical Assistance; and *other health insurance coverage*, indicating if a child was covered by some other public health insurance program; *uninsured* served as the reference group. *Unavailability of health services* (yes/no) indicated that a child did not receive needed health services because they were not available in the area, their offices were closed, or they had no appointments available. *Hospital care* (yes/no) was a measure of a child's hospital use during the 12 months preceding the NSCH interview. Finally, *female child* (versus *male child*), *child age* (in years), and *parent age* (in years) were demographic variables serving as controls in the modeling.

2.3. Data Analysis

The analysis excluded any children with birth weights at or above 2500 g. Excluding these children's data introduced the possibility of selection bias during outcome modeling. A two-stage process addressed such a threat to our results' validity. Firstly, we formulated a selection equation based on all employed explanatory variables plus an additional one, *food insecurity*, which indicated if a family could not afford sufficient food. This selection equation estimated, for each child included in our analysis, the probability of having low birth weight. That is, the selection equation obtained a *hazard rate* for each child. We incorporated *food insecurity* in our selection equation based on a prior finding that low-birth-weight infants were associated with food insecurity occurring in the year preceding data collection [7]. Moreover, including *food insecurity* furthered our pursuit of an identified outcome model [52]. Obtaining hazard rates provided an additional variable for the second stage of analysis, which constituted the final regression model. Each hazard rate stated the likelihood that the associated low-birth-weight child would be included in the final model [52].

Since the present study used a binary outcome variable, it employed STATA logistic regression featuring linearized variance estimations with robust standard errors. Moreover, the present study applied the sampling weights provided by NSCH researchers. A preliminary analysis indicated that *racial discrimination* generated a singularity because there were no cases in which a low-birth-weight child who experienced racial discrimination was reportedly in "fair/poor" health. Since the modeling was unable estimate the variable's coefficient or odds ratio, our final analysis excluded the variable *racial discrimination*. On the other hand, preliminary assessment of multicollinearity problems indicated that the variables *private health insurance coverage* and *public health insurance coverage* generated low tolerance statistics (<0.4) and strong correlation ($r = -0.72$). We kept these two variables in final data analysis because understanding families' and children's medical insurance status was important to the present study. The final model yielded correlations among explanatory variables of $-0.72 \leq r \leq 0.60$.

3. Results

3.1. Descriptive Statistics

Descriptive statistics showed that a great majority (98.3%) of the low-birth-weight children had "excellent/very good/good" health (see Table 1). The average age of children and of parents was 3 years and 38.3 years, respectively; 53.7% of children were girls. Furthermore, 24.2% of these children lived in impoverished neighborhoods and the average score for safe neighborhoods was 3.6 (i.e., "somewhat agree"). Of the children, 58.6% were White, 10.7% were Black, 12.4% were Hispanic, 8.3% were Asian, and 10.0% were other ethnicity/race. In this study, parents' average educational attainment was 6.1 (an associate's degree), and 73.1% of parents were employed. Of the families in the sample, 15.4% had incomes at or below 100% of the FPL, 16.8% had incomes between 101% and 200% of the FPL, and 67.8% had incomes above 200% of the FPL.

Of parents in the present sample, 13.7% were single mothers. The average score for family cohesiveness was 10.6 (of 12.0 possible), and 79.7% reportedly received emotional support from family members and friends. On average, difficulty parenting the child was 5.1 (of 15.0 possible). Of the children, 24.4% had chronic health condition(s). Parents' average health (3.8) and mental health (3.9) were good. Among children's family members, 5.8% reportedly had mental health problems and 5.6% used substances.

Concerning insurance coverage, 64.9% of the insured children had private health insurance; 33.9% had public health insurance; and 3.4% had some other type of health insurance; only 3.5% of the children had no health insurance coverage. While only 1.8% of families reported the unavailability of health services, 6.6% of the children did use hospital care.

Table 1. Descriptive statistics of low-birth-weight children (n = 1731).

		Percent	**Mean**	**Range**	**sd**
Child health (excellent/very good/good)		98.3			
(fair/poor)		1.7			
Rundown neighborhood	(yes)	24.2			
	(no)	75.8			
Safe neighborhood			3.6	1–4	0.6
White		58.6			
Black		10.7			
Hispanic		12.4			
Asian		8.3			
Other ethnicity/race		10.0			
Parent education level			6.1	1–9	1.9
Employed parent	(yes)	73.1			
	(no)	26.9			
Family income at or below 100% of FPL		15.4			
Family income at 101–200% of FPL		16.8			
Family income above 200% of FPL		67.8			
Single mother	(yes)	13.7			
	(no)	86.3			
Family cohesiveness			10.6	3–12	1.8
Family support	(yes)	79.7			
	(no)	20.3			
Difficulty of parenting the child			5.1	3–15	2.0
Child chronic health condition(s)	(yes)	24.4			
	(no)	75.6			
Parent health			3.8	1–5	0.9
Parent mental health			3.9	1–5	0.9
Family mental health problem	(yes)	5.8			
	(no)	94.2			
Family substance use	(yes)	5.6			
	(no)	94.4			
Private health insurance coverage		64.9			
Public health insurance coverage		33.9			
Other health insurance coverage		3.4			
Uninsured		3.5			
Unavailability of health services	(yes)	1.8			
	(no)	98.2			
Hospital care	(yes)	6.6			
	(no)	93.4			
Female child		53.7			
Male child		46.3			
Child age (years)			3.0	0–5	1.5
Parent age (years)			38.3	19–75	9.3

Note: sd = standard deviation.

3.2. Multivariate Analysis Results

Multivariate analysis results confirmed that the hypothesized model differed significantly from the null model (Wald's χ^2 = 120.10, $p < 0.01$; see Table 2). The likelihood of children's excellent/very good/good health was decreased among Black children (OR = 0.05; $p < 0.05$), but such a likelihood showed no association with other racial/ethnic minorities, living in impoverished neighborhoods, and residing in safe neighborhoods. While such a likelihood was positively associated with parent education (OR = 1.31, $p < 0.05$), such a likelihood had a negative association with family income at or below 100% of the FPL (OR = 0.26, $p < 0.05$). However, having a single mother, parent employment, and a family income between 101% and 200% of the FPL demonstrated no significant association with the outcome variable.

Table 2. Logistic regression results for low-birth-weight child health (excellent/very good/good) (n = 1731).

Variables	OR	RSE	90% CI
Hazard rate	6.83×10^{15} *	1.38×10^{17}	$22.67–2.06 \times 10^{30}$
Rundown neighborhood (no)	1.92	0.90	0.89–4.14
Safe neighborhood	0.60	0.19	0.36–1.01
Black (White)	0.05 *	0.09	0.00–0.87
Hispanic (White)	0.71	0.68	0.14–3.46
Asian (White)	0.10	0.25	0.00–5.24
Other ethnicity/race (White)	0.90	0.69	0.26–3.20
Parent education level	1.31 *	0.18	1.04–1.65
Employed parent (no)	0.65	0.37	0.26–1.65
Family income at or below 100% of FPL (above 200% of FPL)	0.26 *	0.17	0.08–0.79
Family income at 101–200% of FPL (above 200% of FPL)	2.44	1.61	0.66–5.82
Single mother (no)	1.96	1.30	0.02–0.40
Family cohesiveness	1.17	0.14	0.96–1.43
Family support (no)	0.66	0.40	0.24–1.80
Difficulty of parenting the child	0.66 **	0.06	0.56–0.77
Child chronic health condition(s) (no)	0.02 **	0.02	0.00–0.12
Parent health	2.39 **	0.75	1.43–4.02
Parent mental health	0.31 **	0.11	0.17–0.55
Family mental health problem (no)	0.44	0.27	0.16–1.21
Family substance use (no)	0.26 *	0.17	0.09–0.76
Private health insurance coverage (uninsured)	0.46	0.48	0.08–2.55
Public health insurance coverage (uninsured)	0.09	0.13	0.01–1.08
Other health insurance coverage (uninsured)	4.60	6.66	0.42–49.87
Hospital care	0.01 **	0.01	0.00–0.09
Female child (male child)	0.81	0.44	0.33–1.99
Child age	0.92	0.21	0.63–1.33
Parent age	0.97	0.02	0.93–1.01
Wald’s χ^2 =	120.10 **		

Notes: ** $p < 0.01$; * $p < 0.05$; OR = odds ratio; RSE = robust standard error; CI = Confidence Interval; reference groups are in parentheses.

On the other hand, children’s likelihood of excellent/very good/good health was diminished by difficulty parenting the child (OR = 0.66, $p < 0.01$) but had no significant association with family cohesiveness and family support. Although we observed a positive association (OR = 2.39, $p < 0.01$) between parent health and the likelihood of children’s excellent/very good/good health, child chronic health condition(s) (OR = 0.02, $p < 0.01$) had a negative association with such a likelihood. Moreover, reported parent mental health (OR = 0.31, $p < 0.01$) and family substance-use problems (OR = 0.26, $p < 0.05$) were found in this study to be associated negatively with a children’s likelihood of having excellent/very good/good health. Family mental health problems indicated no associations with the outcome variable. Finally, children’s likelihood of having excellent/very good/good health had a negative association with the use of hospital care (OR = 0.01, $p < 0.01$), but such a likelihood showed no significant association with health insurance status and the availability of health services.

4. Discussion

Our study showed that over 98% of low-birth-weight children had “excellent/very good/good” health. A closer examination of the data revealed that 0.4% of low-birth-weight children had poor health and 1.3% of low-birth-weight children had fair health.

Moreover, multivariate analysis findings showed that child health had associations in the positive direction with parents' education and health and associations in the negative direction with being Black, having a family income at or below 100% of the FPL, difficulty parenting the child, child chronic health condition(s), parent mental health, and substance use in the family. No other variables showed significant associations with low-birth-weight children's health.

Although prior studies in a single state [2,3] reported unkempt and unsafe neighborhoods' positive associations with low-birth-weight outcomes, the present results indicated that living in such neighborhoods had no significant impact on low-birth-weight children's health in their early childhood. However, close examination of the data revealed that the interaction term between living in a rundown neighborhood and child chronic health condition(s) (OR = 7.84×10^{-7}, $p < 0.01$) yielded a strongly negative association with child health, implying residing in rundown neighborhoods worsens the health of low-birth-weight children with chronic health conditions in early childhood. Furthermore, these neighborhoods may still have long-term negative impacts on these children's health and development in middle childhood and adolescence.

While this study found low-birth-weight children who were Black to be 95% less likely than low-birth-weight White children to have "excellent/very good/good" health, other low-birth-weight children from racial/ethnic minorities had no significant health difference with low-birth-weight White children. Moreover, consistent with the results of a prior study [27], the present study demonstrated that parents' low education and having a family income at or below 100% of the FPL significantly reduced low-birth-weight children's likelihood of "excellent/very good/good" health. Moreover, close examination of the data revealed that child chronic health condition(s)' interaction terms with family income at or below 100% of the FPL (OR = 0.09, $p < 0.05$) and family income at 101–200% of the FPL (OR = 4.37×10^{-7}, $p < 0.01$) yielded strongly negative associations with child health, implying low-birth-weight children with chronic conditions in low-income families would have an escalated risk of poor/fair health. On the other hand, although the present study's finding on the insignificant impact of parent's employment status was contrary to the result of a prior study [27], another close examination of the data showed that the interaction term between parent employment and family income at 101–200% of the FPL (OR = 17.15, $p < 0.05$) had a strong positive association with low-birth-weight children's likelihood of "excellent/very good/good" health. In other words, parent's full employment did help low-birth-weight children gain good health among many low-income families. One plausible explanation was that parents' employment helped families obtain health insurance coverage.

As expected, the present study found that low-birth-weight children who had chronic health condition(s), utilized hospital care, and were difficult to be taken care of were likely to have "fair/poor" health. Moreover, consistent with the finding of a prior study [42], the present results indicated that substance use in the family increased the likelihood of low-birth-weight children's "fair/poor" health. These findings imply that many parents are the only caretakers of their low-birth-weight children with chronic health problems, and such responsibility may generate parental distress in caring for children. On the other hand, living with a spouse/partner, family cohesiveness, and family support had no significant association with children's health. However, a close examination of the data indicated that the interaction term between single motherhood and family support had a positive association (OR = 8.66, $p < 0.05$) with the likelihood of "excellent/very good/good" health among low-birth-weight children. In other words, having a single mother with support from relatives and friends apparently improved low-birth-children's health.

Although parent health promoted low-birth-weight children's health in the present study, its interaction terms with child chronic condition(s) and difficulty parenting the child yielded no significant association with child health. In other words, relying on parents' good health alone probably is not sufficient to counter the challenges of taking care of these children. On the other hand, contrary to the findings of prior studies on small samples [40,41], the present research demonstrated that parent mental health had a negative association with low-birth-weight children's health. One plausible explanation was that some parents had high anxiety because they vigorously maintained the good health of their low-birth-weight children. Although the present results found that both health insurance types and the unavailability of health services had no significant association with low-birth-weight children's health, a closer examination of the data showed that the interaction term between private health insurance coverage and the unavailability of health services yielded a strong positive association (OR = 372.54, $p < 0.01$) with low-birth-weight children's likelihood of "excellent/very good/good" health. Such a finding suggested that private health insurance probably covered regular care and gave more choices of providers and services despite the occasional unavailability of health services.

One limitation in the present study was that the measures of rundown neighborhood and safe neighborhood for the families were not estimated with standardized scales. Generalizations of the results obtained from these proxy measures should be cautious. Another limitation was that the present findings were applicable to developed countries but not developing countries.

5. Conclusions

Applying the multiple disadvantage model provided a new perspective on understanding low-birth-weight children's health and factors associated with their health. Most important is the implication from the present findings that interventions would most benefit low-income families with low-birth-weight children.

To fortify the health of these children, community health workers and social workers should promote maternal health and help mothers gain access to prenatal care as well as continuous care through health coaching [53]; such interventions focus on risk factors such as maternal substance use, breastfeeding, and infant safe sleeping practices. Family-centered medical homes can be also helpful for these families (especially among Black families) by providing quality healthcare services and developmental screening [27,54].

To alleviate the distress of socioeconomic disadvantages such as poverty and social disorganization, government cash assistance, food stamps, and housing assistance can be helpful to low-income families with low-birth-weight children. To reduce mortality and improve the health of low-birth-weight children, the government should promote Kangaroo Mother Care (KMC) programs that require the mother to maintain continuous skin-to-skin contact with the infant as well as breastfeeding or breastmilk feeding at the facility or at home; moreover, home visits by health professionals and the support of other family members are crucial to children's healthy development [55].

Future research studies might seek out the unique pattern of significant factors in the health of low-birth-weight children throughout their childhood. To understand low birth weights in terms of child development, future research might also involve longitudinal data accommodating an analysis of the full conceptual framework of the multiple disadvantage model. Use of the multiple disadvantage model would also allow future researchers to focus on the long-term impact of low birth weight on children's specific medical and mental health conditions. Finally, future research in the same vein as the present study might investigate how Black low-birth-weight children's health is affected by their parents' participation in government assistance programs and medical home programs.

Author Contributions: Conceptualization, T.C.C. and C.C.L.; Methodology, T.C.C. and C.C.L.; Formal analysis, T.C.C. and C.C.L.; Writing—original draft, T.C.C. and C.C.L. The two authors made equal contributions to the preparation of the manuscript as well as to data analysis. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The institutional review board of the author's university of affiliation exempted from review the present secondary analysis of public-use data.

Informed Consent Statement: This research employed a public-use data set that does not contain identifiable information about participants. Prior to collecting the data set, the original researchers obtained the participants' informed consent.

Data Availability Statement: The data applied in this study are openly available on the U.S. Census Bureau website https://www.census.gov/nsch accessed on 11 July 2023.

Conflicts of Interest: The authors declare no conflicts of interest.

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European Journal of
Investigation in Health, Psychology and Education

Article

Determinants of Inequalities in the Exposure to and Adoption of Multiple Health Risk Behaviors among Brazilian Adolescents, 2009–2019

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Abstract: The occurrence of multiple risk behaviors among adolescents imposes challenges in the context of public policies of health, particularly in low- and middle-income countries. Evidence on the conditions leading to the exposure to and adoption of multiple risk behaviors allows the identification of vulnerable groups of adolescents, and may support the proposition of targeted strategies directed to individuals at risk. Therefore, the aim of this study was to perform a quantitative analysis to identify recent trends in the exposure to and adoption of multiple health risk behaviors among Brazilian adolescents, highlighting individual-, household-, and school-level characteristics linked to inequalities among social groups. The analysis was based on cross-sectional data from the National Student Health Survey (PeNSE), conducted by the Brazilian Institute for Geography and Statistics in 2009, 2012, 2015, and 2019. The trends in the occurrence of multiple risk behaviors among adolescents were estimated according to social strata, allowing the calculation of concentration indexes and their disaggregation into major determinants of inequalities in the exposure and adoption of risk behaviors. The analyses were conducted using a complex survey design to allow representativeness at the population level. The results showed a rise in the incidence of multiple risk behaviors among youngsters in Brazil from 2009 to 2019. Factors influencing inequalities in the exposure to multiple risk behaviors were socioeconomic status and the characteristics of the household and school environments, whilst the adoption of multiple risk behaviors was also influenced by early exposure to multiple risk behaviors. Furthermore, trends in inequalities in the exposure to and adoption of multiple risk behaviors showed an intensification from 2009 to 2019, being initially concentrated among wealthier adolescents, followed by a transition to higher incidence in the lower socioeconomic strata in 2012 and 2015, respectively. The findings underscore the role of support systems for adolescents at risk within the familial and school contexts, whereas strategies of public policies of health based on the strengthening of community ties may require improvements to tackle socioeconomic inequalities in the occurrence of risk behaviors among youngsters.

Keywords: multiple risk behaviors; social determinants of health; health behavior; adolescence; inequalities

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Citation: Haddad, M.R.; Sarti, F.M. Determinants of Inequalities in the Exposure to and Adoption of Multiple Health Risk Behaviors among Brazilian Adolescents, 2009–2019. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 2029–2046. https://doi.org/10.3390/ejihpe14070135

Academic Editors: Keren Dopelt and Samuel Fernández-Salinero

Received: 9 February 2024
Revised: 26 June 2024
Accepted: 10 July 2024
Published: 11 July 2024

1. Introduction

Adolescence represents a challenging life stage linked to substantial changes in various dimensions of the daily life of individuals. The cognitive, emotional, and physical transformations experienced during adolescence comprise drivers for experimentation, exercising decision-making and autonomy, and rebellion against rules and authority figures. In addition, changes during adolescence may be triggers for negative feelings (e.g., insecurity, depression, and anxiety), contributing to the initiation of health risk behaviors compelled by peer pressure, upheaval, or a sense of inadequacy [1–3].

Furthermore, the social interactions established by the adolescents with their peers and their families or other individuals within the household and the school environments may influence the formation and the choices of youngsters, potentially enabling the exposure to and the maintenance of risk behaviors [4,5]. An integrative review of the literature synthesized the effects of social capital on the formation of health risk behaviors in adolescents from diverse countries, showing that positive family relationships, parents' attention to the adolescents' activities, and school quality may comprise important factors to minimize trends in health risk behaviors [6].

The promotion of a positive household environment through family support includes attention to daily activities and attendance at school, in addition to fostering healthy habits like family meals and leisure practices. On the contrary, a negative household environment may enable the ascendence of the influence of other social actors on adolescents' choices, including peer pressure, opinions of friends, and the imitation of school colleagues and teachers, among others [7–9]. Similarly, experiences at school may be marked by the support of friends, colleagues, and teachers or situations of bullying and violence, characterizing positive or negative school environments with diverse effects on adolescents' health risk behaviors, respectively [9].

Other elements that influence adolescents' exposure to risk, including contextual attributes (i.e., economic crises, changes in public policies of health, and others), may represent challenges or opportunities to reduce the assimilation of risk behaviors during adolescence [10]. Strategies of public health based on strengthening community ties tend to prevent the consolidation of multiple health risk behaviors [11], particularly health programs to monitor families' health through regular household visits of multidisciplinary health professionals' teams with the participation of community health workers, like the Brazilian Family Health Strategy. Furthermore, the factors influencing the initiation of health risk behaviors during adolescence display complex interactions, which may encourage simultaneous experiences with diverse health risk behaviors, leading to the early co-occurrence of health risk behaviors [12–18].

The increase in the adoption of multiple risk behaviors among youngsters represents a worrying trend in recent decades [19,20], especially considering that health behaviors initiated during childhood and adolescence tend to persist throughout adulthood [3]. The exposure to and adoption of multiple risk behaviors compromise short- and long-term health outcomes of the population, including well-being and productivity, which may turn into a vicious cycle of disease, productivity loss, unemployment, and impoverishment among vulnerable individuals [10], especially in low- and middle-income countries characterized by considerable socioeconomic inequalities like Brazil.

The investigation of the conditions leading to the exposure and adoption of multiple risk behaviors among adolescents allows the identification of vulnerable groups and the proposition of strategies in public policies of health targeting individuals at risk. Yet, the major part of the studies on the exposure to and adoption of multiple health risk behaviors focuses on adolescents in high-income countries [6]. Evidence from the 2015 Youth Risk Behavior Surveillance System showed a high adoption of risk behaviors among US adolescents in the context of unhealthy eating patterns, unsafe sexual behavior, abusive alcohol consumption, and the use of tobacco [4].

The National Student Health Survey (PeNSE) was designed to monitor risk and protection factors to inform evidence-based decision-making processes in public policies directed to adolescents' health in Brazil. The PeNSE has been conducted regularly every 3–4 years since 2009, allowing the assessment of the effectiveness of public health programs and campaigns targeting risk factors among youngsters [11,21]. Studies on health risk behaviors using data from the PeNSE usually focus on inequalities of the incidence of isolated behaviors [18], or the co-occurrence of risk behaviors among Brazilian adolescents [15,16,20]. However, there is a lack of evidence on trends and determinants of inequalities in the exposure to and adoption of multiple risk behaviors among Brazilian students throughout the period from 2009 to 2019.

Previous evidence showed an increase in the occurrence of unsafe sexual practices and violence and an increase in alcohol consumption in Brazilian adolescents until 2015, although there was a higher probability of co-occurrence of the use of cigarettes and alcohol consumption among youngsters in Brazil [20]. Nevertheless, there was an absence of studies investigating links between public policies of health and changes in inequalities in the occurrence of multiple risk behaviors during adolescence, including the use of cigarettes, the consumption of alcoholic beverages, interpersonal violence, sexual behavior, traffic practices, and the use of illicit drugs.

Therefore, the present study aimed to investigate the trends and determinants associated with inequalities in the exposure to and adoption of multiple health risk behaviors among Brazilian youngsters between 2009 and 2019, including the potential role of prevention performed by the Brazilian Health Family Strategy. The research focuses on the dissemination of evidence to support the design of public policies targeting vulnerable adolescents, considering that the publication of scientific evidence comprises a key element for evidence-based decision-making in the design, implementation, and evaluation of public policies of health in Brazil.

2. Materials and Methods

2.1. Study Design

The study focuses on the quantitative analysis of cross-sectional data from four editions of the National Student Health Survey (PeNSE), performed by the Brazilian Institute for Geography and Statistics (IBGE) through a partnership established with the Brazilian Ministry of Health. The survey is conducted every 3–4 years in Brazil since 2009, i.e., there are four editions currently available: 2009 (n = 63,411), 2012 (n = 61,145), 2015 (n = 51,135), and 2019 (n = 40,017).

The adolescents invited to participate in the four editions of the survey were students enrolled in public or private schools in Brazil, independently of their age. The first edition of PeNSE (2009) selected students enrolled in the last year of primary school (9th grade) in the 26 Brazilian state capitals and in the Federal District (Brasilia). The second edition of PeNSE (2012) included an additional subsample of interviews with students enrolled in schools out of state capitals clustered into the five Brazilian macro-regions. The third edition of PeNSE (2015) included an additional subsample of interviews with students enrolled in other school levels to allow comparison with the international survey of the Global School-Based Student Health Survey (GSHS). Finally, the fourth edition of PeNSE (2019) involved a sample of students enrolled from the later primary school (7th to 9th grade) to the secondary school (1st to 3rd year), being representative at population level.

The adolescents were selected using probabilistic sampling process in two stages (schools and classes within schools) for representativeness at the level of Brazilian state capitals. The sample design was based on information from the previous School Census available during survey planning (i.e., using data from 2007, 2010, 2013, and 2017, respectively) [22,23]. Considering the changes in the target population across the four editions of the survey, the present study focused on the analysis of data from subsamples that were directly comparable, according to information from the Brazilian Institute for Geography and Statistics, i.e., individuals with similar characteristics of the target population interviewed in 2009 [24,25].

The study was approved by the Brazilian National Research Ethics Commission (opinions #11,537; #16,805; #1,006,467; and #3,249,268), following the ethical principles of the Helsinki Declaration. The adolescents were invited to the research and signed electronic written consent before participating in the study. Parents or relatives were informed of the participation of the adolescents in the study [21–25]. The Brazilian Child and Adolescents Statute (Law 8,069/1990) grants autonomy to adolescents regarding the decision to participate in surveys with an observational design to support public policy decision-making; thus, parents were exempt from signing informed consent. The Brazilian National Research Ethics Commission prohibits approaching human subjects for participation in surveys and other studies in exchange for money, and therefore, neither the adolescents nor their parents or relatives received payment for participating in the survey.

2.2. Data

The datasets encompass individual-, household-, and school-level data collected by the IBGE through electronic questionnaires presented in portable devices to adolescents attending public and private schools. The National Student Health Survey (PeNSE) comprises part of the national efforts to monitor adolescents' health, risk factors, and health-related behaviors. The selection of variables from PeNSE datasets was based on the availability of information directly comparable across the four editions of the survey.

The PeNSE questionnaire encompasses subsections on sociodemographic, lifestyle, and health-related questions previously validated and adopted in other population-based surveys, including family and household characteristics, and food consumption patterns and practices; physical activity during physical education classes, transportation, and others; tobacco use, the consumption of alcoholic beverages, and the use of illicit drugs; security in the school and the streets; mental health; sexual experience; oral health and personal hygiene; the utilization of health services; and body image.

Questions on health risk behaviors were based on the questionnaire of the Youth Risk Behavior Surveillance System, translated, adapted, and validated for the Brazilian population [21,26]. Part of the questions included in each subsection of the questionnaire changed according to the edition of the survey; however, several questions were maintained, allowing the comparison of variables throughout the four editions. The timeframe in the questions regarding risk behaviors was defined by the Brazilian Institute for Geography and Statistics based on previously validated questionnaires.

This study focused on the analysis of inequalities in the exposure to and adoption of multiple risk behaviors among Brazilian students, including only variables that were directly comparable in the four editions of PeNSE, i.e., questions that were similar in 2009, 2012, 2015, and 2019. The outcome variables investigated were two composite indicators based on the estimation of the proportion of adolescents declaring multiple health risk behaviors: (1) exposure to multiple health risk behaviors, and (2) adoption of multiple health risk behaviors. The risk behaviors investigated corresponded to the use of cigarettes, the consumption of alcoholic beverages, the use of illicit drugs, sexual behavior, involvement in episodes of violence, traffic practices, and reckless driving.

The emission of driver permits, and the sale or utilization of licit drugs (e.g., cigarettes and alcoholic beverages) are forbidden for individuals under 18 years of age, and the sale or use of any illicit drugs (e.g., marijuana, cocaine, and crack) is prohibited in Brazil. Therefore, driving and the consumption of cigarettes, alcoholic beverages, and illicit drugs were considered risky behaviors in the study. Concerning sexual behavior, the age of consent in Brazil is 18 years old, and therefore adolescents reporting an initiation of sexual experiences and the absence of the use of condoms during sexual relations were considered at risk.

Regarding violence, two risk behaviors were considered in the context of the present study: involvement in fights with firearms, and involvement in fights with other types of weapons (knives, blunt objects, or others). Referring to traffic practices, violations of the Brazilian laws regarding the requirements of the use of seatbelts in cars or helmets in motorcycles, and of the prohibition of driving under the influence of alcohol were considered risk behaviors.

Thus, the outcome variable representing the exposure to multiple risk behaviors referred to the co-occurrence of three or more of the following experiences, according to the variables available in the survey: the use of cigarettes at least once in life, the consumption of alcoholic beverages at least once in life, the use of any illicit drug at least once in life, intercourse at least once in life, involvement in fights with firearms or other types of weapons in the last 30 days, the adoption of any unsafe practice in traffic during the last 30 days (the absence of a seatbelt in cars or a helmet in motorcycle rides, or riding a vehicle driven by a drunk driver), and driving without a permit at least once in the last 30 days. The cutoff point regarding the co-occurrence of three of more experiences was based on the requirement to establish a pattern of exposure to health risk behaviors, especially because 50% of the experiences were characterized as occurring once in the adolescent's lifetime (the use of cigarettes, the consumption of alcoholic beverages, the use of illicit drugs, and sexual intercourse).

The outcome variable representing the adoption of multiple risk behaviors referred to the co-occurrence of two or more of the following high-risk behaviors according to the variables available in the survey: the use of cigarettes for more than 6 days in the last 30 days, the abusive consumption of alcohol more than three times in life, the use of illicit drugs more than three times in the last 30 days, sexual intercourse without a condom, involvement in fights with firearms and other types of weapons in the last 30 days, the adoption of unsafe practices in traffic (rarely or never using seatbelts in cars and helmets in motorcycles, or riding a vehicle with a drunk driver more than four times in the last 30 days), and driving without a permit more than four times in the last 30 days.

The variables of interest that were selected for the identification of potential policy approaches to minimize the co-occurrence of risk health behaviors among Brazilian adolescents were exposure to $\geq$1 health risk behavior, and coverage of the Family Health Strategy program at the municipal level. Other variables potentially linked to the exposure to and adoption of multiple risk behaviors included in the models were as follows:

- Individual characteristics: age bracket (<14 years old, 14–16 years old, or $\geq$17 years old); skin color/ethnicity (white, black, brown, yellow, or indigenous); gender (female or male); age-series distortion of educational attainment; frequency of consumption of foods considered healthy-eating markers (beans, fruits, and vegetables); frequency of consumption of foods considered unhealthy-eating markers (sweets, candies, and soft drinks); physical activity level within international recommendations.
- Household environment characteristics: socioeconomic strata (based on ownership of assets); living with one or two parents or other relatives; parents' or relatives' attitudes towards the youngster (attention to the adolescent's leisure activities; frequency of family meals during the week; and allowing the adolescent to watch television or other activities during the meals).
- School environment characteristics: type of school (public or private); skipping school; relationship of the adolescent with colleagues (support from the colleagues; frequency of being a victim of bullying); security for participating in school activities (absences due to lack of security traveling to and from school; absences due to lack of security at school).
- Control variables: region of residence (North, Northeast, South, Southeast, or Midwest); year of the survey (2009, 2012, 2015, or 2019).

The categorization of individuals according to skin color/ethnicity into five standard categories officially adopted in Brazil (white, black, brown, yellow, or indigenous) was based on self-declared responses. Although quantitative studies usually report "yellow" skin color (East Asian descendants and admixed individuals reporting light yellow skin color) and "indigenous" ethnicity (native American individuals reporting indigenous ancestry) into a single group of "others", the descriptive statistics of the present study presents them separately to promote the visibility of the groups [27].

In addition to data from the PeNSE, information from the Brazilian Ministry of Health on the coverage of the Family Health Strategy at the municipal level according to year was incorporated in the datasets to allow the identification of potential effects of the Brazilian Family Health Strategy on inequalities in the exposure and adoption of risk behaviors among adolescents.

2.3. Statistical Analyses

The descriptive statistics of individual, household, and school environment characteristics of individuals interviewed in the four editions of the survey were presented in frequency and 95% confidence intervals (discrete variables), or mean and standard error (continuous variables), according to year. The analyses were conducted using a complex survey design to allow representativeness at the population level.

The analysis of inequalities in health focused on the identification of differences in the occurrence of health outcomes among individuals in different socioeconomic levels through the estimation of concentration indexes, similar to the Gini index [28]. The concentration indexes measure the deviation between the situation of perfect equality and the current situation of the population, showing the cumulative proportion of individuals presenting the health outcome of interest within the population, ranked by socioeconomic level from the poorest to the richest.

The analyses of inequalities performed in the present study identify differences in the exposure to and adoption of multiple health risk behaviors among Brazilian students according to socioeconomic strata and year, allowing to verify changes in the proportion of adolescents declaring a co-occurrence of behaviors from 2009 to 2019. Thus, the concentration indexes estimated measure inequalities in the exposure to or adoption of multiple risk behaviors (y) according to the socioeconomic position of the adolescent in the population, showing the cumulative share of individuals exposed to or adopting multiple risk behaviors according to the cumulative proportion of individuals ranked from the lowest to the highest socioeconomic strata (Equation (1)).

$$CI = \frac{2}{n\mu}\sum_{i=1}^{N} y_i R_i - 1 \tag{1}$$

where μ = mean of y; R_i = proportional rank of the ith person in the income/wealth distribution; and n = sample size. Thus, it is possible to estimate the horizontal inequality index (HI) addressing the measurement of inequality across groups of individuals controlling for personal characteristics regarding the exposure to or adoption of multiple risk behaviors. The HI represents the difference between the overall concentration index (CI) and the concentration index linked to personal characteristics (CN) (Equation (2)).

$$HI = CI - CN \tag{2}$$

In addition, the analyses of inequalities allow the disaggregation of the concentration indexes according to their potential determinants, using a set of independent variables linked to the exposure to or adoption of multiple risk behaviors. The share of socioeconomic inequalities attributable to individual characteristics accounts for potential sources of prejudice (gender, age, and skin color/ethnicity), and the share associated with external factors allows the identification of social pressures from the household and school environments.

The disaggregation of socioeconomic inequalities was performed through linear regression models, with the dependent variable representing the concentration index, y^*, a latent non-observed variable describing the exposure or the adoption of multiple health risk behaviors (Equation (3)).

$$y^* = \beta_1'.X + \beta_2'.Z + \varepsilon \tag{3}$$

where β'_k = coefficient of the variable of interest k; X = matrix of variables referring to the individual characteristics (gender, age bracket, and skin color/ethnicity); Z = matrix of variables referring to the external factors (household environment, school environment, lifestyle choices, Family Health Strategy coverage, and geographical region); and ε = error term.

The descriptive statistics, and the estimation of concentration indexes and their disaggregation were performed using the software Stata, version 17.0, at a 5% statistical significance level, based on the application of survey sample weights through the utilization of a complex survey design that allows representativeness at the population level. Therefore, the characteristics of participants correspond to the distribution of students enrolled in public and private schools in Brazil during 2009, 2012, 2015, and 2019.

3. Results

Table 1 reports information on sociodemographic, household, and school characteristics, whereas Table 2 presents information on lifestyle characteristics, multiple health risk behavior indicators, and their components (health risk behaviors).

Table 1. Sociodemographic and environmental characteristics of adolescents. Brazil, 2009–2019.

Sociodemographic Characteristics	**2009**		**2012**		**2015**		**2019**	
N	63,411		61,145		51,135		40,017	
	%	95%CI	%	95%CI	%	95%CI	%	95%CI
Gender								
Male	46.2	45.3;47.0	48.8	48.0;49.6	48.8	47.9;49.7	49.5	48.3;50.7
Female	53.8	53.0;54.7	51.2	50.4;52.0	51.2	50.3;52.1	50.5	49.3;51.7
Age								
<14 years old	2.3	2.1;2.6	2.4	2.2;2.7	1.5	1.3;1.7	0.2	0.2;0.3
14–16 years old	90.9	90.1;91.6	90.9	90.1;91.5	93.1	92.5;93.6	72.6	69.9;75.1
$\geq$17 years old	6.8	6.1;7.5	6.7	6.1;7.4	5.5	4.9;6.0	27.2	24.6;29.8
Skin color/Ethnicity								
White	40.4	38.6;42.2	37.8	36.2;39.5	36.7	34.9;38.5	35.8	33.4;38.3
Black	12.6	11.8;13.5	14.0	13.3;14.8	13.3	12.6;14.1	15.1	13.9;16.4
Brown	39.2	37.7;40.7	40.0	38.7;41.4	41.8	40.2;43.3	42.3	40.1;44.5
Yellow	3.7	3.4;4.1	4.5	4.2;4.8	5.1	4.7;5.4	3.7	3.4;4.2
Indigenous	4.0	3.7;4.4	3.7	3.4;3.9	3.2	2.9;3.4	3.0	2.6;3.5
Age-grade distortion	10.2	9.3;11.2	11.4	10.5;12.4	8.6	7.9;9.4	9.4	8.0;10.9
Family Health Strategy coverage [1]	0.32	0.31;0.33	0.38	0.38;0.39	0.45	0.44;0.46	0.46	0.44;0.47
Region								
North	10.6	9.1;12.4	11.6	10.2;13.3	12.9	11.3;14.6	15.6	10.6;22.5
Northeast	23.5	20.9;26.4	23.8	21.5;26.3	24.0	21.6;26.5	24.1	19.8;28.9
Southeast	49.8	45.3;54.3	45.2	41.1;49.3	44.5	40.4;48.6	39.2	32.0;46.8
South	5.9	5.0;7.1	7.1	6.0;8.4	6.0	5.0;7.1	7.6	5.6;10.4
Middle-West	10.1	8.7;11.7	12.2	10.7;14.0	12.7	11.1;14.6	13.5	10.0;18.0
Household characteristics	2009		2012		2015		2019	
Socioeconomic strata								
Low	41.1	39.0;43.3	32.7	31.0;34.5	47.6	45.4;49.8	47.2	44.7;49.7
Middle	47.5	45.7;49.2	56.4	55.1;57.7	46.5	44.8;48.3	47.3	45.4;49.2
High	11.4	9.7;13.5	10.9	9.5;12.4	5.9	4.7;7.3	5.5	4.5;6.8
Living with parents	59.3	58.1;60.4	56.8	55.7;57.8	55.8	54.6;57.0	51.0	49.7;52.2
Family monitoring leisure activities	57.0	55.8;58.2	60.5	59.5;61.5	67.6	66.5;68.6	70.6	69.5;71.6
Consumption of meals with family	69.6	68.8;70.4	67.9	67.0;68.8	74.0	73.2;74.8	66.5	65.2;67.7
Consumption of meals watching TV	56.5	55.5;57.5	59.4	58.5;60.2	55.9	54.9;56.9	72.8	71.2;74.3
School characteristics	2009		2012		2015		2019	
Type of school								
Private	20.9	17.8;24.4	25.6	22.5;29.0	27.6	24.3;31.3	25.0	20.9;29.7
Public	79.1	75.6;82.2	74.4	71.0;77.5	72.4	68.7;75.7	75.0	70.3;79.1
Skipping school	18.2	17.2;19.2	25.6	24.5;26.8	23.6	22.5;24.7	21.4	19.9;22.9
Support of colleagues in school	65.5	64.2;66.7	61.8	60.6;63.0	65.0	63.9;66.0	64.9	63.5;66.3
Victim of bullying	4.6	4.2;5.1	16.2	15.7;16.8	21.6	20.9;22.2	21.5	20.3;22.6
Lack of security at school	5.2	4.7;5.8	7.9	7.3;8.5	9.1	8.5;9.8	11.4	10.5;12.4
Lack of security on the way to school	6.2	5.7;6.8	8.9	8.3;9.6	12.6	11.9;13.4	13.4	12.3;14.5

Figures express frequencies. 95% CI, 95% confidence interval. [1] mean ± standard deviation. Analyses include sample weight and complex survey design for population-level representativeness.

The majority of the participants in the survey were female (~54% in 2009 to ~51% in 2019) in the age bracket of 14–16 years old (~91% in 2009 to ~73% in 2019), self-declaring a white (~40% in 2009 to ~36% in 2019) or brown (~39% in 2009 to ~42% in 2019) skin color/ethnicity, from low socioeconomic strata (~41% in 2009 to ~47% in 2019), and living with both parents (~59% in 2009 to ~51% in 2019) in the Southeast region (~50% in 2009 to ~39% in 2019). The proportion of students presenting age-grade distortion showed a reduction during the decade (from 10.2% in 2009 to 9.4% in 2019) (Table 1).

A substantial proportion of the adolescents declared that their families regularly monitor their leisure activities (~57% in 2009 to ~71% in 2019), and frequently consume meals together (~79% in 2009 to ~67% in 2019). However, most of them also indicated that they frequently consume meals watching television (~57% in 2009 to ~73% in 2019).

Regarding school environment, most students were enrolled in public schools (~79% in 2009 to 75% in 2019), and only a small proportion of adolescents declared absences at school due to a lack of security at the school (~5% in 2009 to ~11% in 2019), or on the way to the school (~6.2% in 2009 to ~13% in 2019). In addition, there was a high percentage of students declaring the frequent support of their colleagues at school (~66% in 2009 to ~65% in 2019), and skipping school (~18% in 2009 to ~21% in 2019). However, there was a substantial increase in the proportion of students being frequent victims of bullying (~5% in 2009 to ~22% in 2019). The Family Health Strategy program coverage increased until 2015 (~0.32 in 2009 to ~0.45 in 2015), and maintained a similar level in 2019 (~0.46) (Table 1).

Table 2. Lifestyle characteristics and risk behaviors of adolescents. Brazil, 2009–2019.

Lifestyle Characteristics	**2009**		**2012**		**2015**		**2019**	
N	63,411		61,145		51,135		40,017	
	%	95%CI	%	95%CI	%	95%CI	%	95%CI
Recommended physical activity level	23.4	22.5;24.3	34.1	33.2;35.0	36.5	35.6;37.5	28.9	27.9;30.0
Healthy food consumption pattern [1]	0.52	0.51;0.52	0.53	0.52;0.54	0.54	0.53;0.54	0.48	0.47;0.49
Unhealthy food consumption pattern [1]	0.56	0.55;0.57	0.53	0.52;0.53	0.49	0.49;0.5	0.43	0.43;0.44
Risk behaviors	2009		2012		2015		2019	
Exposure to ≥1 risk behavior	91.3	90.7;91.8	93.5	93.0;93.9	95.2	94.8;95.5	96.2	95.7;96.6
Exposure to ≥3 risk behaviors	34.9	33.7;36.1	39.7	38.6;40.8	36.7	35.4;38.0	48.0	46.3;49.7
Use of cigarettes	21.5	20.5;22.6	21.7	20.8;22.6	18.7	17.9;19.6	26.4	25.2;27.6
Consumption of alcohol	68.3	67.4;69.2	62.1	61.2;63.0	54.4	53.3;55.6	70.3	68.9;71.6
Use of illicit drugs	7.6	7.0;8.2	9.3	8.6;10.0	10.2	9.6;10.9	17.7	16.5;19
Sexual experience	27.3	26.1;28.6	30.4	29.3;31.6	26.7	25.5;28.1	39.6	37.7;41.5
Involvement in fight with firearms	3.5	3.2;3.9	6.6	6.2;6.9	5.4	5.0;5.8	2.5	2.1;2.9
Involvement in fight with other weapons	5.4	5.0;5.8	7.8	7.3;8.3	7.9	7.5;8.4	4.3	3.8;4.8
Driving without permit	17.9	17.1;18.7	22.3	21.5;23.0	24.6	23.7;25.6	24.2	23.2;25.2
Adoption of unsafe traffic practices	72.0	70.7;73.3	80.9	79.7;81.9	87.2	86.4;87.9	87.2	86.1;88.2
Adoption of ≥2 behaviors	14.2	13.5;14.8	18.9	18.2;19.7	20.7	19.8;21.7	31.5	30.0;33.0
Use of cigarettes ≥ 6 days in last 30 days	2.1	1.8;2.4	2.0	1.8;2.3	1.7	1.5;1.9	2.7	2.4;3.0
Abusive alcohol consumption ≥ 3 times in life	6.0	5.6;6.4	8.0	7.5;8.5	7.4	6.9;7.9	16.8	15.8;17.9
Use of illicit drugs ≥ 3 times in last 30 days	1.2	1.0;1.4	1.7	1.5;2.0	2.3	2.1;2.6	3.6	3.1;4.1
Sexual intercourse without condom	6.2	5.7;6.7	7.7	7.3;8.2	9.7	9.0;10.4	17.5	16.2;18.8
Involvement in fights with weapons	2.2	2.0;2.5	3.5	3.3;3.8	3.3	3.0;3.6	1.6	1.3;1.8
Frequent unsafe traffic practices	7.9	7.4;8.4	9.7	9.2;10.3	10.6	10.1;11.2	12.1	11.2;12.9

Figures express frequencies. 95% CI, 95% confidence interval. [1] mean ± standard deviation. Analyses include sample weight and complex survey design for population-level representativeness.

Trends regarding the exposure to and adoption of multiple risk behaviors among adolescents in Brazil showed an increase in the proportion of adolescents declaring exposure to ≥1 health risk behavior (~91% in 2009 to ~96% in 2019) or ≥3 health risk behaviors (~35% in 2009 to ~48% in 2019), and the adoption of ≥2 health risk behaviors (~14% in 2009 to ~32% in 2019) (Table 2).

Yet, there were generally mixed patterns in the exposure to or adoption of isolated health risk behaviors. The proportion of adolescents reporting involvement in fights with firearms and/or other weapons showed a decrease during the period from 2009 to 2019, whereas the proportion of students declaring an experience and regular use of illicit drugs, sexual intercourse and unsafe sex, an abusive consumption of alcoholic beverages, and dangerous traffic experiences and practices presented a statistically significant increase (Table 2).

The exposure to and adoption of risk behaviors presented a significant association with the major part of the personal, household, and school characteristics during the period of the study (Tables 3 and 4). The exceptions were the association of the exposure to and adoption of risk behaviors among adolescents in the North region of Brazil in 2019, declaring white skin color/ethnicity and being enrolled in a public school in 2009, and being in a family of low social class in 2015.

Table 3. Associations between exposure to risk behaviors in relation to personal, household and school characteristics. Brazil, 2009–2019.

Characteristics		**Exposure to ≥3 Risk Behaviors**							
		2009		**2012**		**2015**		**2019**	
		%	**Sig.**	**%**	**Sig.**	**%**	**Sig.**	**%**	**Sig.**
Gender	Male	44.69	<0.001	47.73	<0.001	43.27	<0.001	52.49	<0.001
	Female	28.54		33.78		30.36		43.65	
Age	<14 years old	17.60	<0.001	22.75	<0.001	15.59	<0.001	28.38	<0.001
	14–16 years old	34.87		39.09		35.16		40.85	
	≥17 years old	59.88		67.28		68.85		67.34	
Ethnicity	White	34.47	<0.001	37.21	<0.001	33.16	<0.001	43.74	<0.001
	Others	37.45		42.71		38.80		50.48	
Age-grade distortion	Yes	33.62	<0.001	37.18	<0.001	33.83	<0.001	45.35	<0.001
	No	58.39		67.26		66.83		73.98	
Social class	Low	33.67	<0.001	39.82	<0.001	37.83	0.001	50.89	<0.001
	Middle	38.33		42.05		36.36		46.28	
	High	36.66		35.72		30.30		39.29	
Living with parents	Yes	32.47	<0.001	35.95	<0.001	31.88	<0.001	40.94	<0.001
	No	41.43		46.69		42.86		55.47	
Region	North	35.40	<0.001	42.90	<0.001	41.11	<0.001	49.89	0.174
	Northeast	34.02		37.81		34.01		46.81	
	Southeast	36.17		39.95		34.92		46.81	
	South	42.03		45.01		42.16		50.55	
	Middle-West	38.31		43.88		41.03		50.68	
Family monitoring leisure activities	Yes	30.76	<0.001	33.26	<0.001	29.86	<0.001	43.41	<0.001
	No	42.60		51.36		51.06		58.95	
Consumption of meals with family	Yes	34.42	<0.001	37.82	<0.001	34.24	<0.001	44.46	<0.001
	No	39.76		46.24		43.93		55.27	
Consumption of meals watching TV	Yes	39.58	<0.001	44.10	<0.001	39.88	<0.001	51.02	<0.001
	No	31.29		35.24		32.82		40.47	
Public school	Yes	37.04	<0.001	43.44	<0.001	40.13	<0.001	52.12	<0.001
	No	33.03		32.43		27.52		35.79	
Skipping school	Yes	56.77	<0.001	58.59	<0.001	53.83	<0.001	66.13	<0.001
	No	31.32		34.22		31.52		43.14	
Support of colleagues in school	Yes	34.36	<0.001	38.38	<0.001	33.88	<0.001	45.19	<0.001
	No	39.04		43.89		42.14		53.32	
Victim of bullying	Yes	66.54	<0.001	43.05	0.003	39.53	<0.001	53.72	<0.001
	No	34.46		39.99		35.99		46.65	
Lack of security at school	Yes	53.96	<0.001	59.06	<0.001	58.89	<0.001	63.10	<0.001
	No	35.03		38.82		34.52		46.09	
Lack of security on the way to school	Yes	52.89	<0.001	56.62	<0.001	53.76	<0.001	63.80	<0.001
	No	34.94		38.91		34.32		45.62	

Figures express frequencies. Analyses include sample weight and complex survey design for population-level representativeness.

Table 4. Associations between adoption of risk behaviors in relation to personal, household and school characteristics. Brazil, 2009–2019.

Characteristics		**Adoption of ≥2 Risk Behaviors**							
		2009		**2012**		**2015**		**2019**	
		%	Sig.	%	Sig.	%	Sig.	%	Sig.
Gender	Male	21.67	<0.001	25.74	<0.001	27.21	<0.001	35.79	<0.001
	Female	9.56		13.26		14.30		27.40	
Age	<14 years old	8.59	<0.001	11.04	<0.001	9.42	<0.001	30.12	<0.001
	14–16 years old	14.19		18.21		19.47		25.20	
	≥17 years old	31.35		37.97		43.90		48.43	
Ethnicity	White	14.80	0.097	18.04	<0.001	18.76	<0.001	28.81	<0.001
	Others	15.64		20.23		21.77		33.22	
Age-grade distortion	Yes	13.51	<0.001	16.92	<0.001	18.51	<0.001	29.06	<0.001
	No	30.35		38.49		43.09		55.59	
Social class	Low	12.95	<0.001	17.47	<0.001	20.96	0.572	32.73	0.032
	Middle	16.85		20.69		20.47		30.73	
	High	17.48		18.54		19.51		29.52	
Living with parents	Yes	14.03	<0.001	17.33	<0.001	18.20	<0.001	26.40	<0.001
	No	16.95		22.07		23.80		36.98	

Table 4. *Cont.*

Characteristics		Adoption of ≥2 Risk Behaviors							
		2009		2012		2015		2019	
		%	Sig.	%	Sig.	%	Sig.	%	Sig.
Region	North	14.91	<0.001	19.37	0.004	22.28	0.003	29.47	0.594
	Northeast	14.33		18.69		20.65		31.99	
	Southeast	14.98		18.83		19.19		31.84	
	South	18.01		20.63		22.15		32.91	
	Middle-West	17.54		22.15		23.44		32.10	
Family monitoring leisure activities	Yes	11.87	<0.001	15.44	<0.001	16.15	<0.001	28.09	<0.001
	No	18.90		25.04		30.04		39.61	
Consumption of meals with family	Yes	14.22	<0.001	18.07	<0.001	19.61	<0.001	28.64	<0.001
	No	17.02		21.84		23.69		37.48	
Consumption of meals watching TV	Yes	16.69	<0.001	21.30	<0.001	23.01	<0.001	33.72	<0.001
	No	12.91		16.28		17.75		26.08	
Public school	Yes	15.52	0.085	20.42	<0.001	22.71	<0.001	34.28	<0.001
	No	14.50		16.42		15.13		23.48	
Skipping school	Yes	26.06	<0.001	29.80	<0.001	31.51	<0.001	48.10	<0.001
	No	12.49		15.59		17.33		27.01	
Support of colleagues in school	Yes	13.99	<0.001	18.20	<0.001	18.83	<0.001	29.33	<0.001
	No	16.79		21.00		24.19		35.49	
Victim of bullying	Yes	38.41	<0.001	21.48	0.003	22.58	0.002	34.33	0.004
	No	13.80		18.85		20.19		30.88	
Lack of security at school	Yes	28.85	<0.001	34.03	<0.001	37.54	<0.001	44.35	<0.001
	No	14.23		17.97		19.00		29.82	
Lack of security on the way to school	Yes	26.95	<0.001	30.30	<0.001	33.63	<0.001	45.18	<0.001
	No	14.18		18.20		18.85		29.45	

Figures express frequencies. Analyses include sample weight and complex survey design for population-level representativeness.

Table 5 and Figure 1 present data on the concentration indexes (i.e., socioeconomic inequality in the incidence of multiple health risk behaviors), horizontal inequalities (i.e., CI excluding inequalities attributable to personal characteristics like gender, age, and skin color/ethnicity), and the coefficients representing the effects of major determinants of socioeconomic inequalities (i.e., their contribution to the scenario of inequality).

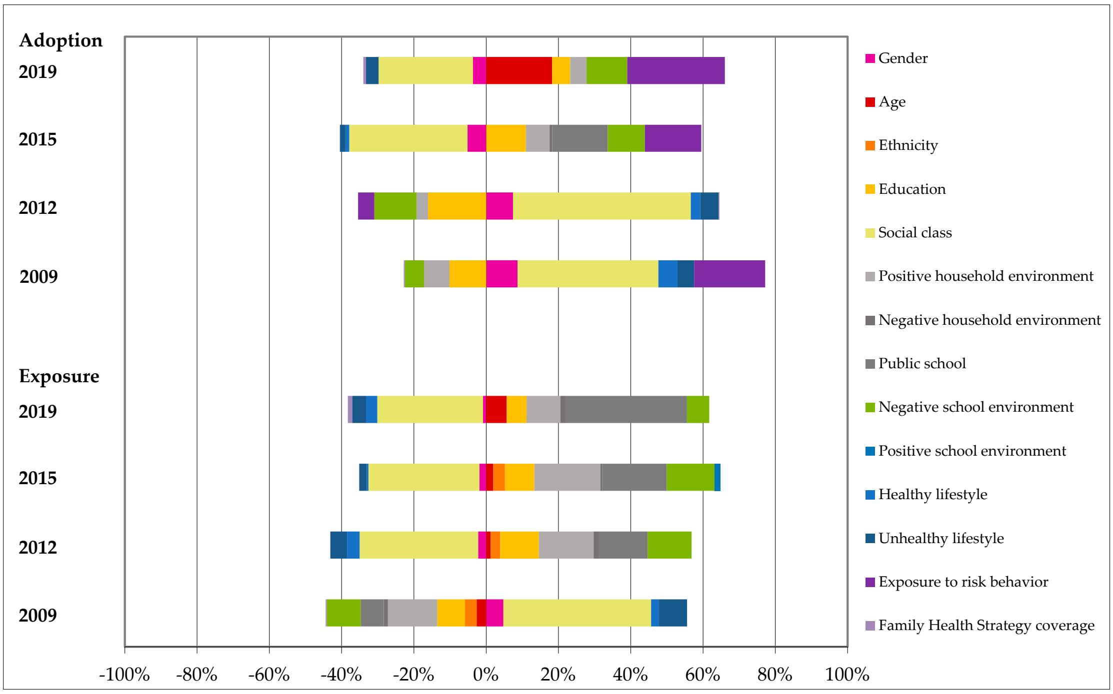

Figure 1. Disaggregation of concentration indexes for exposure to and adoption of risk behaviors according to the contribution of determinants. Brazil, 2009–2019.

Table 5. Trends in inequalities in exposure to and adoption of multiple risk behaviors among adolescents. Brazil, 2009–2019.

Exposure to Risk Behavior	**2009**	**2012**	**2015**	**2019**
CI	0.034	−0.006	−0.021	−0.032
HI	0.036	−0.004	−0.017	−0.026
Gender	0.006	0.003	0.002	0.001
Age	−0.004	−0.002	−0.002	−0.008
Skin color/Ethnicity	−0.004	−0.003	−0.004	0.000
Age-grade distortion	−0.010	−0.013	−0.010	−0.008
Socioeconomic strata	0.055	0.040	0.038	0.040
Positive household environment	−0.018	−0.019	−0.022	−0.013
Negative household environment	−0.002	−0.002	−0.001	−0.002
Public school	−0.009	−0.017	−0.022	−0.046
Positive school environment	0.000	0.000	−0.002	0.000
Negative school environment	−0.013	−0.015	−0.016	−0.008
Healthy lifestyle patterns	0.003	0.004	0.001	0.004
Unhealthy lifestyle patterns	0.010	0.006	0.003	0.005
Family Health Strategy coverage	0.000	0.000	0.000	0.002
Region	0.004	0.003	0.003	0.000
Residual	0.016	0.008	0.012	0.000
Adoption of Risk Behavior	2009	2012	2015	2019
CI	0.084	0.033	−0.004	−0.018
HI	0.073	0.028	−0.009	−0.008
Gender	0.011	0.006	0.004	0.003
Age	0.000	0.000	0.000	−0.013
Skin color/Ethnicity	0.000	0.000	0.000	0.000
Age-grade distortion	−0.013	−0.012	−0.009	−0.004
Socioeconomic strata	0.049	0.037	0.026	0.019
Positive household environment	−0.009	−0.002	−0.005	−0.003
Negative household environment	0.000	0.000	−0.001	0.000
Public school	0.000	0.000	−0.012	0.000
Positive school environment	0.000	0.000	0.000	0.000
Negative school environment	−0.007	−0.009	−0.008	−0.008
Healthy lifestyle patterns	0.007	0.002	0.001	0.000
Unhealthy lifestyle patterns	0.006	0.004	0.001	0.003
Exposure to risk behavior	0.025	−0.003	−0.013	−0.020
Family Health Strategy coverage	0.000	0.000	0.000	0.001
Region	−0.002	−0.001	0.000	0.001
Residual	0.017	0.012	0.011	0.004

CI = concentration index; HI = horizontal inequality index. Analyses include sample weight and complex survey design for population-level representativeness. Coefficients shown refer to statistically significant determinants of concentration indexes.

In addition to the increase in the incidence of the exposure to and adoption of multiple risk behaviors among Brazilian youngsters between 2009 to 2019, the concentration indexes showed an increase in inequalities referring to the co-occurrence of health risk behaviors throughout the period of analysis. The concentration indexes for the exposure (0.034) to and adoption (0.084) of health risk behaviors in 2009 indicate a higher incidence among adolescents from a high socioeconomic status, followed by a transition to negative concentration indexes for the exposure to and adoption of risk behaviors in 2012 and 2015, respectively (Table 5).

The estimation of the horizontal inequality index showed similar trends, presenting a similar magnitude to the concentration index, which indicates that socioeconomic inequalities in the exposure to and adoption of health risk behaviors were generally linked to external factors, i.e., the influence of household and school environments surrounding adolescents (Table 5).

The disaggregation of socioeconomic inequalities into major groups of determinants indicated that socioeconomic strata represented the main factor contributing to the occurrence of differences in the exposure (0.055 in 2009 to 0.040 in 2019) to and adoption (0.049 in 2009 to 0.019 in 2019) of multiple health risk behaviors among Brazilian youngsters. In addition, a positive household environment (−0.018 in 2009 to −0.013 in 2019) influenced the exposure to multiple health risk behaviors, whereas enrollment in public schools and a negative school environment presented effects in both the exposure to and adoption of multiple health risk behaviors.

Nevertheless, the Family Health Strategy coverage at the municipal level presented very low coefficients (although statistically significant), i.e., indicating the minor role of the public policy of health in influencing socioeconomic inequalities in multiple health risk behaviors. Early exposure to any health risk behavior showed a higher influence on socioeconomic inequalities in the adoption of multiple risk behaviors than the coverage of the Family Health Strategy (Table 5).

Figure 1 presents the proportional contribution of the main groups of determinants of socioeconomic inequalities to the concentration indexes. The positive concentration indexes, representing a higher incidence of multiple health risk behaviors among wealthier individuals, present a distribution of determinants skewed to the positive effects (right side of the graph) for the exposure to and adoption of risk behaviors in 2009, changing to negative concentration indexes for the exposure to multiple risk behaviors in 2012, and for the adoption of multiple risk behaviors in 2015.

4. Discussion

The present study investigated the evolution and determinants of socioeconomic inequalities in the exposure to and adoption of multiple risk behaviors among Brazilian adolescents between 2009 and 2019. The results showed an intensification in socioeconomic inequalities referring to the incidence of multiple risk behaviors, shifting from a higher concentration among wealthier individuals in 2009 to lower socioeconomic strata in the following periods. The determinants of inequalities in the exposure to and adoption of multiple risk behaviors among Brazilian adolescents were predominantly connected to socioeconomic status, enrollment in public school, positive household environments, and negative school environments.

Individuals in the transition from childhood to adolescence are susceptible to adoption risk behaviors due to neural reward sensitivity, hindering the effects of cognitive performance. Certain rewards and social contexts may intensify the activation or the connectivity of the affective-motivational system in youngsters, increasing the probability of risky behaviors and the influence of peers [29,30]. Changes in the individual's behaviors may be difficult to achieve without addressing the social context, considering that diverse determinants may influence the exposure to and adoption of risk behaviors, including individual characteristics, and household and school environments, in addition to incentives of public policies, economic scenarios, and others [31,32].

The results showed that Brazilian adolescents generally live in positive household environments marked by the constant supervision of adolescents' leisure activities by their parents and relatives, and frequent family meals during the week. However, the proportion of adolescents reporting the consumption of meals watching television and performing other tasks increased throughout the period of study. Concerning school environments, Brazilian students usually reported positive features (e.g., support from colleagues, and a feeling of security at school), although there was growth in the proportion of participants declaring bullying victimization and absence from school due to insecurity.

The results indicated a lower exposure to and adoption of multiple health risk behaviors among younger female teenagers living with both parents in positive household and school environments. Accordingly, other studies showed that older male adolescents experiencing family disruption were susceptible to the adoption of certain risk behaviors [33,34]. In addition, the incidence of multiple health risk behaviors was ~35% to ~40% among

Brazilian students between 2009 and 2015, similar to the patterns identified in the study investigating data from the Global School-Based Student Health Survey from 2007 to 2016, which showed that approximately one-third of students (34.9%) reported more than two risk factors, with males (36.3%) being more susceptible than females (33.5%). The prevalence of $\geq$3 risk factors increased according to age, being 29.4% among youngsters between 11 and 13 years old, and 46.4% among adolescents between 16 and 17 years old [35].

The findings of the present study showed a high exposure to and adoption of health risk behaviors related to the consumption of alcoholic beverages among Brazilian adolescents from 2009 to 2019. Furthermore, the proportion of youngsters reporting abusive alcohol consumption significantly increased throughout the period. Children and adolescents tend to initiate the consumption of alcoholic beverages through socialization with older individuals [36–38], and early experience with alcohol consumption increases the probability of alcohol dependence [39].

In addition, there was an increase in the incidence of risk behaviors related to driving without a permit, and unsafe traffic practices like the lack of the use of seatbelts in cars, riding motorcycles without a helmet, and being in vehicles driven by drunk drivers were also present among students interviewed in Brazilian schools. Recent evidence indicates an association between sensation-seeking among youngsters and road safety intentions, attitudes, and behaviors [40]. Sensation-seeking results in a higher propensity for the occurrence of road traffic injuries, especially in combination with alcohol consumption [33,34].

The results of the present study also pointed to a significant growth in early sexual initiation among adolescents, particularly the adoption of unsafe sex practices among Brazilian students between 2009 and 2019. Approximately 28% of Brazilian students experienced sexual relations between 2009 and 2019. The findings are consistent with data from the Brazilian Ministry of Health [41], showing that Brazilian boys usually start sexual experiences at 12 years and 9 months, whilst Brazilian girls tend to experience sex at 13 years and 7 months. However, the increasing adoption of risky sexual behavior among Brazilian students throughout the period differs from the results of a study with German adolescents [42]. Other studies present mixed evidence on the adoption of risky sexual behavior among youngsters, being associated with earlier sexual initiation in Australia [43], and older adolescent males in Canada [44], showing that sexual experiences comprise complex behaviors influenced by diverse personal, familial, and sociocultural factors [45].

Risk behaviors linked to tobacco use decreased in Brazil between 2009 and 2019. The reduction in tobacco use has been the focus of numerous public health campaigns in Brazil in recent decades. Furthermore, early smoking initiation increases the probability of the occurrence of chronic diseases and premature mortality [46]. In Brazil, specific legislation prohibits sales of tobacco products to individuals $\leq$18 years old. However, approximately 1.3 million adolescents aged 12 to 17 have already experienced cigarettes in their lifetime, an incidence of approximately 34% of the population [39], which was higher than the incidence identified in the present study.

The results of the present study also showed a significant rise in the occurrence of the exposure to and adoption of health risk behaviors linked to illicit drug utilization among Brazilian adolescents in the period from 2009 to 2019. A previous study indicated that experiences with drugs tend to occur among young individuals in the United States in 2019 [47], and the present findings indicate that the proportion of youngsters experiencing and frequently consuming illicit drugs has increased throughout the period of analysis.

Regarding interpersonal violence, it is important to highlight that Brazil is one of the countries with the highest mortality rates due to firearms and other weapons, particularly among adolescents and young adults [48]. Higher levels of violence have been reported in the literature among older male adolescents in minority groups (particularly black and brown skin color/ethnicity) in Brazil between 2001 and 2017 [49].

The analysis of inequalities showed that the exposure to and adoption of multiple health risk behaviors were significantly associated with socioeconomic strata, a positive household environment, and a negative school environment. Our findings corroborate previous evidence on the connections between the coexistence of multiple risk behaviors and the family and school contexts of youngsters [12,32,49–53].

Positive household environments, represented by the involvement of family members in child development (e.g., the family monitoring of leisure activities and the consumption of family meals) showed important effects on the inequalities related to the exposure to and adoption of multiple health risk behaviors between 2009 and 2019. Family support may include intermediate effects through the adoption of healthy lifestyle patterns (e.g., incentives to higher frequency in the consumption of fruits, vegetables and beans, and lower frequency in the consumption of candies, sweets, and soft drinks), according to the evidence from a previous study with Brazilian students [53]. Parental mediation theory indicates that the role of parents may mitigate the influence of others on children's and adolescents' behavior, reducing exposure and adherence to multiple health risk behaviors [54].

Concerning the school environment, negative experiences were associated with an increase in inequalities in the exposure to and adoption of multiple health risk behaviors among Brazilian students. Students who reported being victims of bullying by school colleagues, being absent from school due to a lack of security at school and on the way to school, and adolescents enrolled in public schools were more likely to engage in multiple risk behaviors. Previous evidence showed that adolescents experiencing school bullying victimization in the United States presented higher odds of suicidal ideation, in addition to a higher occurrence of suicidal ideation associated with alcohol abuse and illicit drug utilization [49].

There were increasing socioeconomic inequalities in the exposure to and adoption of multiple risk behaviors among Brazilian students throughout the period from 2009 to 2019. Furthermore, the coverage of the Family Health Strategy at the municipal level showed minor effects on socioeconomic inequalities in multiple health risk factors throughout the periods in Brazil. Yet, it is important to emphasize the lack of evidence in the literature regarding the role of public policies of health on socioeconomic inequalities related to multiple risk behaviors among youngsters in Brazil.

The only study investigating trends in socioeconomic inequalities related to health behaviors among Brazilian students focused on the isolated occurrence of certain risk behaviors, identifying a decrease in inequality referring to alcohol consumption, and an increase in inequality regarding behaviors associated with violence (domestic violence, fights with guns, and bullying) from 2009 to 2012 [18]. Nonetheless, the study from Azeredo et al. [18] presented limitations in the analysis of data, lacking an identification of determinants of inequalities in the exposure to and adoption of risk behaviors.

Therefore, the evidence in the present study contributes to the field by presenting and investigating the differences between the exposure to and adoption of multiple risk behaviors among youngsters throughout the 10 years from 2009 to 2019. There was an intensification of socioeconomic inequalities in the exposure to and adoption of multiple risk behaviors among students in Brazil, predominantly attributable to the effects of a positive household environment and a negative school environment, in addition to the effects of lifestyle choices [55].

Enrollment in public schools also presented important effects on socioeconomic inequalities in the exposure to and adoption of multiple risk behaviors among adolescents in Brazil. Public schools are financed by the government to provide education without charges to students or parents in Brazil; therefore, various studies explore the role of public schools on educational attainment, the quality of education, health behaviors, and nutrition. A previous study showed the influence of enrollment in public schools on adolescents' adoption of risk behaviors linked to unhealthy practices of weight control [56]. In addition to the factors identified in the study, changes in socioeconomic inequality regarding multiple risk behaviors were probably associated with changes in the economic situation of the country [57]. Families usually transfer their children from private to public schools during economic crises in Brazil; therefore, the influence of public schools on socioeconomic inequalities changes throughout time depending on the current contextual scenario [58].

This study has certain limitations. First, the study was based on the analysis of data from the National Student Health Survey (PeNSE), designed to comprise a system to monitor students' exposure to health risk and protection factors [18]. Thus, considering that the Brazilian survey has a cross-sectional design, the analyses lack conditions to establish causal relationships between risk behaviors and individual, environmental, and lifestyle characteristics.

Second, the information in the four editions of the survey was obtained through self-administered questionnaires, which may result in errors due to the misinterpretation of questions, underreporting, or a lack of response. Third, the changes introduced in the questionnaire throughout the four editions of the survey also represented an additional challenge for the analysis through the comparison of information across years, limiting the information available for the analyses. Fourth, the survey lacked information on students' religion, which may be an additional source of influence on adolescents' decisions in relation to their adherence to multiple health risk behaviors [59].

However, the selection of variables that were directly comparable throughout the four editions in the present study allowed the researchers to maintain consistency in the analysis for the estimation of models encompassing data from 2009 to 2019. Furthermore, the utilization of data representative at the population level provides robustness to the statistical analyses conducted, resulting in solid evidence that may support evidence-based decision-making processes in public policies of health in Brazil.

Finally, it is important to highlight that the sample represents individuals enrolled in Brazilian schools, and therefore, adolescents without enrollment in schools were excluded from the sample. Thus, despite comprising a methodology generally adopted in several countries due to the accessibility to the target population, school-based surveys neglect vulnerable individuals without access to schools. Yet, it is important to acknowledge that, since the 1980s, the population coverage of the Brazilian education system showed a substantial increase, approaching universality. Considering that the four editions of the survey were conducted in public and private schools, the data provide adequate representativeness of the target population at the national level.

5. Conclusions

The findings of the present study highlight the complex mechanisms involved in the exposure to and adoption of multiple risk behaviors during the transition into adolescence, including trends and determinants of inequalities between 2009 and 2019. There was a significant increase in inequalities in the exposure to and adoption of simultaneous risk behaviors among students in this period, which was concentrated among individuals in higher social strata. However, older male adolescents in minority groups (black and brown individuals) with lower educational attainment (repeat students) presented an increased probability of exposure to and adoption of multiple risk behaviors.

Contextual issues referring to lifestyle choices, household, and school environments showed an important role in the occurrence of inequalities towards adolescents' exposure to or adoption of multiple risk behaviors. Therefore, public health interventions for adolescents should focus on specific strategies based on the prevention of risky behaviors among youngsters through social assistance and school-based activities, particularly in public schools, to avoid the onset of negative health outcomes. In addition, programs targeting health education directed at households with lower socioeconomic status may comprise evidence-based strategies to reduce the exposure risk behaviors during critical life stages, targeting early intervention based on comprehensive support for the engagement of children and adolescents in activities designed to incentivize healthy behaviors at school and during leisure.

Author Contributions: Conceptualization, M.R.H. and F.M.S.; methodology, F.M.S.; formal analysis, M.R.H. and F.M.S.; investigation, M.R.H. and F.M.S.; writing—original draft preparation, M.R.H.; writing—review and editing, M.R.H. and F.M.S.; supervision, F.M.S.; funding acquisition, F.M.S. All authors have read and agreed to the published version of the manuscript.

Funding: The research was funded by the National Council for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico, CNPq), grant numbers 301109/2019-2 and 310368/2022-7.

Institutional Review Board Statement: The study was conducted following the Declaration of Helsinki, and approved by the Brazilian National Research Ethics Commission (opinions #11,537; #16,805; #1,006,467, and #3,249,268).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The study analyzed publicly available datasets that may be accessed in the public domain of the Brazilian Institute for Geography and Statistics (IBGE): https://www.ibge.gov.br/estatisticas/sociais/saude/9134-pesquisa-nacional-de-saude-do-escolar.html?=&t=microdados (accessed 10 October 2023).

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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European Journal of
Investigation in Health,
Psychology and Education

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Injury as a Result of Children and Adolescent Labor—An Association with Ethnicity and Peripherality: A Retrospective Cohort Study Based on the Israeli Trauma Registry

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Citation: Savitsky, B.; Radomislensky, I.; Katorza, E., on behalf of the ITG (Israel Trauma Group); Kaim, A. Injury as a Result of Children and Adolescent Labor—An Association with Ethnicity and Peripherality: A Retrospective Cohort Study Based on the Israeli Trauma Registry. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 133–147. https://doi.org/10.3390/ejihpe14010009

Academic Editor: María del Mar Molero Jurado

Received: 18 November 2023
Revised: 25 December 2023
Accepted: 28 December 2023
Published: 31 December 2023

Abstract: Background: Working children and adolescents face a heightened risk of work-related injuries. This research aimed to assess the rate of hospitalizations resulting from work-related injuries among children and adolescents in Israel, with a specific focus on disadvantaged populations. Methods: This nationwide retrospective cohort study utilized The Israeli National Trauma Registry (INTR). It included 642 children and adolescents aged 13–17 hospitalized due to work-related injuries from 2015–2022. Results: Arab children had over five times the risk of hospitalization due to work-related injuries compared to Jewish (RR = 5.5, 95% CI: 4.7–7.4). Despite the 2018 law prohibiting young people from entering this type of work, the most common type of work leading to hospitalization was construction, accounting for 40.2% of Arab and 11.9% of Jewish injuries ($p < 0.001$). After adjustment, road traffic accidents and falls presented the highest odds of at least severe injury. Arabs had three times significantly higher odds of at least moderate injury compared to Jews. Conclusions: Prioritizing the creation of safe job opportunities for Arab teenagers is imperative. Strict enforcement measures, particularly within the construction industry, especially among Arab youth and during night shifts, are essential. These initiatives should focus on establishing secure and sustainable employment opportunities for children and young individuals, effectively reducing the risks associated with hazardous labor practices. In addition, the implementation of educational programs in the school curriculum covering essential aspects of youth employment is vital.

Keywords: children; adolescents; employment; occupational; injury; work-related; hospitalization

1. Background

The International Labor Organization (ILO) describes children's or adolescents' participation in the workforce as generally positive when this activity does not affect their health and personal development or interfere with their schooling. This is in line with the human capital investment approach, which is defined as the process of developing and enhancing the knowledge, skills, and abilities of individuals, which in turn contributes to their productivity and earning capacity in the future [1,2]. Child labor is defined as work prior to the age of 14. Globally, 186.3 million children aged 5–14 work worldwide, mostly in developing countries [3]. In developed countries, employment under the age of 14 is forbidden [4,5]. ILO Convention No. 138 establishes that "employment of adolescents is allowed at the age of 15, with the possibility to temporarily set the general minimum age at 14 for countries whose economy and educational facilities are insufficiently developed" [1]. The main concern of public health practitioners is that most employed children and adolescents work under circumstances that jeopardize their health [4], where work-related injury is one of the potential consequences [6]. Scholars argue that engaging in work during adolescence can foster positive growth in young individuals when the work is of moderate intensity, consistent in duration, and balanced with their academic commitments according to the principles of the human capital approach [7,8]. Consistent employment can aid in cultivating time management abilities, which can be valuable as young individuals transition into college. This is especially relevant because many college students continue to work to sustain themselves and contribute to their tuition expenses, even if only partially [6].

Conversely, young employees face an elevated risk of work-related injuries due to several factors associated with their jobs, including workplace hazards, violations of child labor laws, the rapid pace of work, minority status, and a lack of skills, experience, supervision, and comprehensive safety training [9,10]. Additionally, young workers may be less likely to identify workplace hazards, speak up about safety concerns, and be knowledgeable about their legal protections [10]. As a result, national statistics from five Nordic countries demonstrate that young workers are nearly twice as likely to experience workplace accidents compared to their older counterparts. Furthermore, they are exposed to potentially harmful conditions and hazardous tasks to a greater extent than older employees [11].

In developed countries, special concern is associated with child labor among ethnic minorities. Gypsies in Europe, Aboriginal people in Australia, Inuits in Canada, Blacks and Latinos in the United States, and migrants represent populations at risk for children's employment [12].

In Israel, almost 10% of adolescents aged 15–17 worked during 2017, according to data from the Central Bureau of Statistics [13]. This data likely reflects a lower estimate of the actual percentage of employed adolescents. In a 2014 survey, 31% of adolescents aged 14–17 disclosed that they had been employed at some point during the year [14]. According to the survey conducted in 2014 by the Ministry of Economy, the most frequent place of work for adolescents was the food industry (waiting or kitchen work)—this sector employed 36% of working adolescents (43% of boys and 20% of girls); 15% worked supplying services of babysitting and baby care (39% of girls and 2% of boys), 12% worked in retail sector (as sellers or cashiers), 8% gave private lessons, almost 6% worked in delivery service and 6% worked in construction [14]. As indicated by 53% of the sample, the primary motivation for commencing work was the necessity to earn their own income. Additionally, 22% cited the need to assist their families, 14% expressed a desire to gain occupational experience, and 9% mentioned that they began working out of boredom [14].

Occupational opportunities are influenced by the geographical location of workers. In Israel, Arab communities are predominantly located in geographic peripheries. Being remote from economic hubs often results in fewer chances for these communities to blend into the broader job market. This scenario particularly affects the mobility of women and younger workers [15]. The scarcity of employment options in these outlying regions forces young workers to accept less favorable employment conditions, which employers may manipulate [13].

In Israel, the legislation aims to safeguard young workers from exploitation and potential health risks. One instance of such legislation is the Youth Employment Law, which prohibits the employment of individuals under the age of fifteen. Moreover, this law also restricts minors from engaging in specific work activities and certain work environments.

For instance, since 2018, employing young people in tasks related to building, construction, or construction activities on a construction site has been illegal. The law further prohibits a minor from engaging in night work between 8 p.m. and 8 a.m. for minors to whom the Compulsory Education Law applies and between 10 p.m. and 6 a.m. for those to whom it does not [16]. These limitations are frequently breached, primarily due to employers not obeying the law and partly also due to the significant number of young workers (44%) who are unaware of their rights. In the survey conducted among young workers, it was found that 72% of them did not receive any training related to occupational safety, and 27% reported experiencing injuries either during work or while commuting to work [17].

Regarding the prevalence of work-related injuries among adolescents in Israel, it is worth noting that nearly a thousand teenagers sought medical attention in the Emergency Department (ED) annually due to workplace injuries between 2011 and 2013 [18].

The aim of this research was to illuminate the extent of hospitalizations resulting from work-related injuries among children and adolescents in Israel, with a specific focus on disadvantaged populations like ethnic minorities. The study aimed to identify the group most vulnerable to severe injuries and evaluate how recent legislation has impacted trends in hospitalizations related to work-related injuries.

2. Methods

2.1. Study Design

This is a retrospective cohort study based on the Israeli National Trauma Registry (INTR) in the period between 1 January 2015 and 31 December 2022. The INTR provides comprehensive data on hospitalized trauma patients from all six Level I Trauma Centers (TC) and 14 of the 20 Level II TCs in Israel. All hospitalized trauma patients classified with an ICD-9-CM diagnosis code 800–989.9 who were admitted to the Department of Emergency Medicine (ER), hospitalized, died in the ER, or were transferred to or from another hospital are included in the database. The registry does not include poisoning, chemical asphyxiation, inhalation injuries, drowning, and choking; casualties who died at the scene of the event or on the way to the hospital; and admissions 72 or more hours following the event. The data is recorded by trained trauma registrars at each TC under the supervision of a trauma director. Electronic files are transferred to the INTR, where quality assurance is carried out prior to data analysis.

2.2. Study Population

The study population included 642 children and adolescents, Israeli citizens aged 13–17 hospitalized due to work-related injuries.

2.3. Study Variables

Age was used as a continuous variable. Gender: male/female. Population group: Jews/Arabs.

Peripherality index of local authorities: The peripherality index characterizes and classifies localities and local authorities in Israel according to their geographic location relative to population centers. The Central Bureau of Statistics (CBS) devised this index. It categorizes localities and local authorities into ten clusters based on their index value. These clusters range from cluster 1, which encompasses the most geographically remote units, to cluster 10, which includes the most centrally located units. The classification of peripheral clusters was determined using 25% percentiles as follows: clusters 1 to 4 are considered the most peripheral, cluster 5 is peripheral, clusters 6 and 7 are central, and clusters 8 and above are classified as very central [19].

Injury mechanisms were categorized as Road Traffic Crashes (RTC), falls, burns, cuts and lacerations, violence, struck by an object, and unknown.

The type of work was identified by searching the free text of the injury description and categorized: food industry, building and reconstruction, agriculture, delivery, garage, retail sector, and others. Hour of the work incident: night work (10 p.m.–6 a.m.)/non-night work.

Injury Severity Score (ISS)—the sum of the squares of the single highest Abbreviated Injury Scale score for each of the three most severely injured body regions [20] categorized 1–8 (mild injury); 9–14 (moderate injury); 16+ (severe injury) and 25+ (critical injury) [21]. Length of Hospital Stay (LOS) was used as a continuous variable. Intensive Care Unit (ICU) stay: yes/no. Operation during the hospitalization: yes/no.

2.4. Statistical Analysis

A univariate analysis examined the association between population group and injury characteristics using the χ^2 test and Mann–Whitney non-parametric test for differences in age and LOS, which is not normally distributed.

The risk of being hospitalized following work-related injury was calculated using the data on the Israeli population of children and adolescents in 2018, according to the Central Bureau of Statistics (2,130,700 Jewish and 650,660 Arab children aged 0–17 years) [22].

Multivariable analysis with a logistic regression approach was used, with the dependent variable being the occurrence of at least moderate injury (ISS 9+). The independent variables considered in the analysis included age, population group, peripherality index, trauma type, and the mechanism of injury. Multicollinearity between all variables included in the multivariable analysis was assessed using Variance Inflation Factors (VIF), and the maximum VIF was 1.2. Analyses were carried out using SAS V.9.4 statistical software. For all analyses performed, a value of $p < 0.05$ was considered statistically significant.

3. Results

3.1. Demographic Characteristics of the Study Population

During the study period, a total of 642 children and adolescents aged 13–17 were hospitalized due to work-related injury; of them, 38.0% (n = 244) were Jewish, and 62.0% (n = 398) were Arabs. The median age was similar among Arabs and Jews (17 years old). Most of the hospitalized were teens (14–17 years old). Out of the 13 children who were hospitalized while they were at the age of 13, eleven of them were of Arab ethnicity.

Boys accounted for the majority of those hospitalized (92.5%). However, among the Arab population, the proportion of boys was significantly higher compared to the Jewish population (96.7% vs. 85.7%, $p < 0.001$).

Arab individuals predominantly resided in more peripheral regions, with 58.3% living in the most peripheral areas, in contrast to 23.1% among Jewish individuals. In the case of Jewish children and adolescents, 37.6% lived in the most central areas, while only 13.3% of Arab children and adolescents did so ($p < 0.001$). See Table 1 for additional details.

Table 1. Demographic, injury, and hospitalization characteristics of children and adolescents injured at work, by population group, 2015–2022.

Characteristics	Jews	Arabs	Total
n	244	398	642
Demographic characteristics			
Proportion among the study population	38%	62%	100%
Age, median [IQR]	17.0 [16.0–17.0]	17.0 [16.0–17.0]	17.0 [16.0–17.0]
Sex **, % of males	85.7	96.7	92.5
Peripherality Cluster Percentile ** (%)			
Most peripheral (clusters 1–4)	23.1	58.3	44.4
Peripheral (cluster 5)	9.1	21.1	16.4
Central (clusters 6–7)	30.2	7.3	16.4
Very central (clusters 8+)	37.6	13.3	22.9

Table 1. *Cont.*

Characteristics	Jews	Arabs	Total
Accident characteristics			
Type of work ** (%)			
Food industry	24.2	10.1	15.4
Building and reconstruction	11.9	40.2	29.4
Delivery	29.9	1.3	12.1
Agriculture	4.5	3.8	4.0
Retail sector	4.5	4.5	4.5
Garage	0	2.8	1.7
Other and unknown	25.0	37.3	32.9
Injury Mechanism * (%)			
Road Traffic Crashes (RTC)	37.7	12.6	22.1
Cuts and lacerations	19.3	22.1	21.0
Fall	11.5	24.6	19.6
Strike by object	16.0	20.9	19.0
Burn	8.2	4.8	6.1
From machine	3.7	7.3	5.9
Violence	2.0	4.5	3.6
Unknown	1.6	3.3	2.6
Work at night ** (%)			
At night (10 p.m.–6 a.m.)	27.9	12.8	18.5
Other hours	72.1	87.2	81.5
Injury Characteristics			
Injury Severity Score (ISS) (%)			
Mild (ISS 1–8)	82.0	73.3	76.6
Moderate (ISS 9–14)	9.8	14.6	12.8
Severe (ISS 16–24)	4.5	4.8	4.7
Critical (25+)	3.7	7.3	5.9
Hospitalization Characteristics			
Hospitalization in ICU (%)	6.1	10.1	8.6
Length of Stay ***, median [IQR]	2.0 [1–5]	3.0 [1–5]	3.0 [1–5]
Operation during the hospitalization (%)	40.6	40.5	40.5

* *p* value of χ^2 test < 0.05. ** *p* value of χ^2 test < 0.001. *** *p* value of Mann–Whitney non-parametric test < 0.05.

Over the duration of the study, no significant demographic changes were observed among the hospitalized individuals.

Figure 1 illustrates the distribution of work types according to peripherality. Among children and adolescents hailing from peripheral regions, a greater percentage experienced injuries in the building and reconstruction sector (50.0% in the most peripheral areas and 56.5% in peripheral areas), as opposed to those from central and very central areas (24.6% and 32.4% respectively). Conversely, children and adolescents originating from more central areas had a higher proportion of injuries related to delivery (26.1% and 36.1%) and the food industry (33.3% and 25.0%) compared to the lower proportion of these work types in peripheral areas.

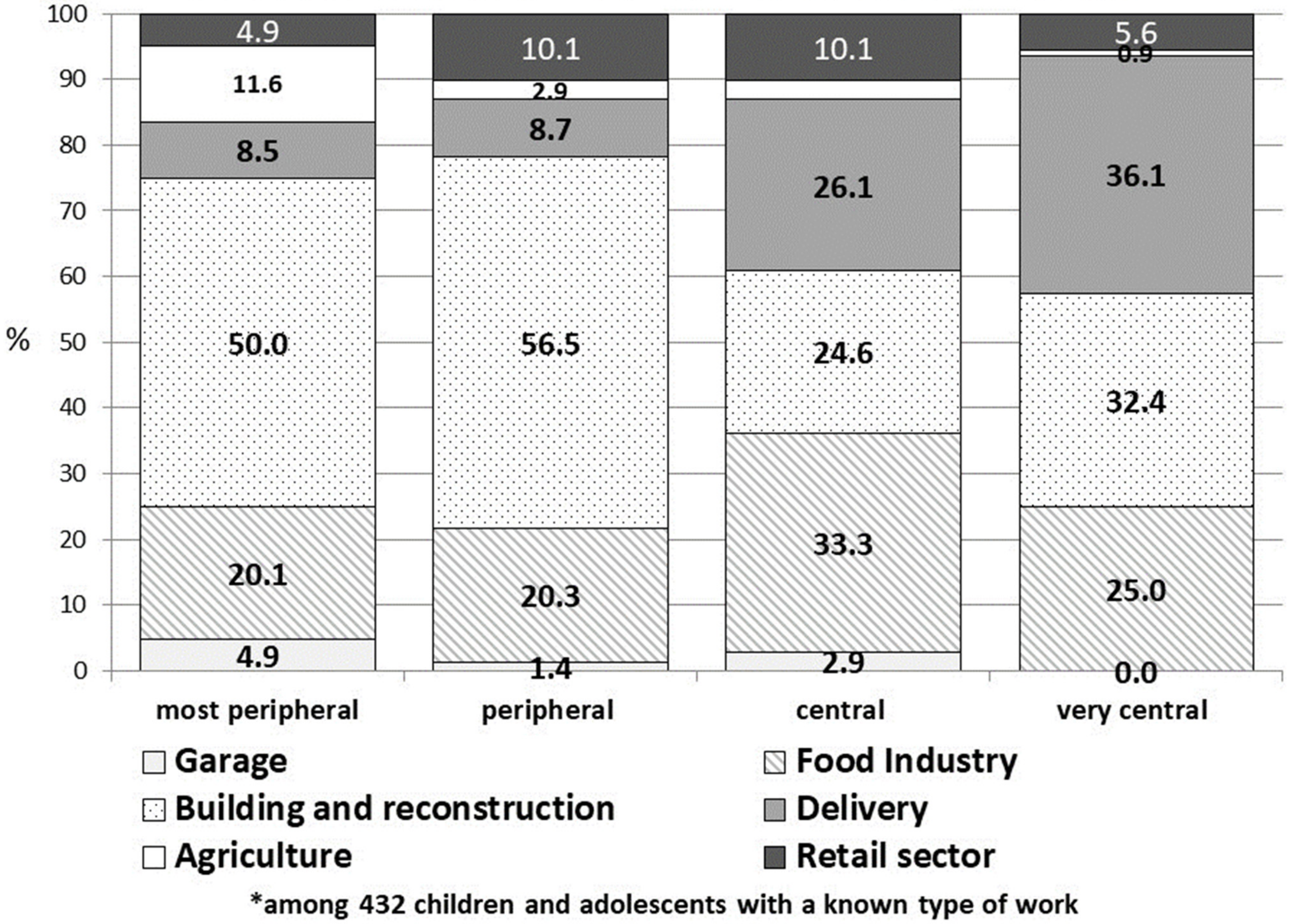

Figure 1. Distribution of work' types* by peripherality of the area.

3.2. Accident Characteristics

In 32.9% of instances, it was not possible to determine the type of work through free text analysis. The rate of unidentifiable work types was notably higher among girls, with 43.8% of cases lacking clear information regarding the specific type of work responsible for their injuries. There was no change in the proportion of unknown types of work during the study period. An upward trend was observed in the frequency of injury in the food industry (29.7% in 2022 vs. 16.7% in 2015), and the opposite trend was observed in the frequency of injury in building or construction (21.9% in 2022 vs. 34.3% in 2015) ($p = 0.011$). The severity of the injury by work type is depicted in Figure 2.

Among cases where the type of work could be identified, the most common type of work at the time of the accident resulting in hospitalization was building or reconstruction work, which accounted for injuries in 29.4% of children and adolescents (40.2% among Arabs and 11.9% among Jews, $p < 0.001$). The legislation prohibiting the employment of children in the building and construction sector was enacted in 2018 [23]. Prior to the year of legislation (2018), the number of hospitalizations resulting from work at building or reconstruction was as follows: 35 in 2015, 34 in 2016, and 37 in 2017. Subsequently, there was a significant drop in these numbers in 2018 and 2019, with 19 cases each year. This was followed by a gradual decline in the subsequent years, with the number of cases decreasing from 16 in 2020 to 14 in 2022.

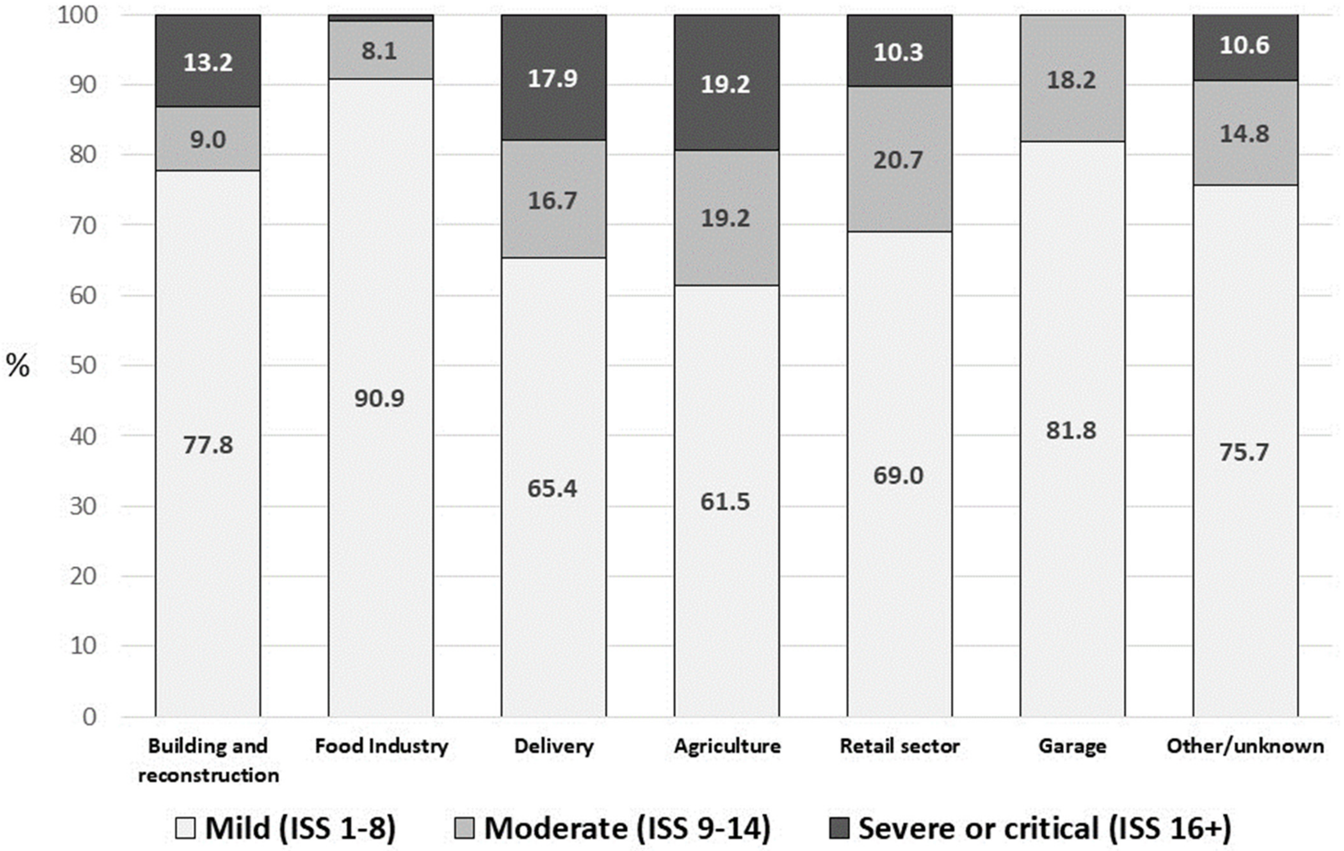

Figure 2. Injury severity by the work type.

A significant proportion of these children and adolescents sustained injuries as a result of falling from heights, accounting for 34.9% of the cases (50.0% among Arabs and 33.6% among Jews, $p < 0.001$). Those who were injured while engaged in building and reconstruction work exhibited a notable incidence of at least moderate injuries, with 9% experiencing moderate injuries (with an ISS score of 9–14) and 13.2% suffering severe injuries (with an ISS score of 16+).

The second most common type of work at the time of the injury was in the food industry, accounting for 15.4% of cases. Notably, this particular field of work was more prevalent among hospitalized girls, with 27.1% of girls in the sample being employed in the food industry. Among these young workers, 42.4% were injured due to cuts or lacerations, 21.2% were burned, and 12.1% were injured while using kitchen equipment. Injuries in the food industry were less severe (only 9.1% sustained at least moderate injuries with ISS 9+).

The third frequent type of work was delivery. These young workers were injured in 97.4% of cases of the Road Traffic Crashes (RTC) while using motorcycles, scooters, and electric bikes. The injury of these children and adolescents had moderate severity (ISS 9–14) in 16.7% of cases and in 17.9%—severe (ISS 16+) injury.

A small proportion (4.5%) of hospitalized children and adolescents were injured while working in the retail sector. The injuries primarily occurred due to incidents such as heavy objects falling within a warehouse or when individuals were loading items onto shelves. Additionally, 4.0% of injuries were associated with agricultural work, with the main causes being similar to those in the retail sector or involving falls from heights while carrying out tasks like tree pruning. The injury of these children and adolescents had moderate severity (ISS 9–14) in 19.2% of cases and in 19.2%—severe (ISS 16+).

A minority of individuals, all of whom were of Arab descent, sustained injuries while working in garages, primarily due to incidents involving objects striking them.

Arabs had a significantly higher prevalence of at least moderate injuries (ISS of 9 and above) in comparison with Jews (26.6% vs. 18.0%) ($p = 0.013$). All five children who died due to injuries were of Arab ethnicity.

The injury profiles of patients hospitalized over the course of the study did not show any significant differences.

3.3. Time of the Accident

Israeli legislation prohibits the employment of children and teenagers during the nighttime hours, specifically from 10 p.m. to 6 a.m. [24]. Nevertheless, 18.5% of the study sample (n = 119) experienced injuries during this period. A majority of the children and adolescents injured at night were of Jewish ethnicity (57.1% vs. 42.9%, $p < 0.001$). Among those injured during the night, 41.9% were employed in the food industry, 26.7% were engaged in food delivery, and 24.4% worked in the construction sector.

3.4. Probability of at Least Moderate Severity of Injury

This analysis was conducted only among 432 cases with identifiable types of work. Table 2 represents a univariate and multivariable model with at least moderate injury as a dependent variable.

In a multivariable logistic regression model (Model I, Table 2) with at least moderate injury as a dependent variable, the odds of Arabs sustaining at least moderate injury were almost three-fold higher than the odds of Jews (OR = 2.9, 95% CI: 1.4–6.3). Compared to the food industry, the highest odds for at least moderate injury had been among those engaging in delivery work (OR = 8.8, 95% CI: 3.3–22.9), followed by those partaking in work in the agriculture and retail sectors. Peripherality was not associated with the outcome. This model explained 12% of the variance in the probability of at least moderate injury.

After adding the mechanism of injury to the model (Model II, Table 2), the type of work was no longer associated with the outcome. In comparison with cuts and lacerations, those who were injured due to RTC or falls had more than fourteen-fold higher odds for at least severe injury. Injuries resulting from machinery were linked to over an eightfold increase in odds, while burns were associated with a fivefold higher likelihood, and incidents involving being struck by objects had odds of more than fourfold. Notably, in this model, the higher odds among Arabs compared to Jews remained consistent. This model explained 26% of the variance in the probability of at least moderate injury.

Sensitivity analysis was performed with all 642 cases, including hospitalized cases, whose type of work was unknown. This analysis yielded similar results.

The relative risk of being hospitalized during the study period was calculated using ordinary incidence rates of Jews and Arabs. During this period, 238 Jews and 398 Arabs were injured and hospitalized. As of 2018, which marked the midpoint of the study period, the population in Israel consisted of 2,130,700 Jewish children and adolescents, as well as 650,660 Arab children and adolescents. Thus, the risk of hospitalization stood at 11.2 per 100,000 for Jewish children and adolescents, while it was 61.2 per 100,000 for their Arab counterparts (RR = 5.5, 95% CI 4.7–7.4). Hence, Arab children and adolescents faced a risk of being hospitalized following a work-related injury that was five and a half times higher than that of Jewish children and adolescents.

Table 2. Odds for at least moderate injury, by demographic and injury characteristics.

Characteristics	**n**	**ISS 9+ (n, %)**	**Model I ***		**Model II ***	
	432	**99 (22.9%)**	**Odds Ratio (OR)**	**95% CI**	**Odds Ratio (OR)**	**95% CI**
Population Group						
Arabs	249	64 (25.7)	**2.9**	**1.4–6.3**	**2.8**	**1.2–6.4**
Jews	183	35 (19.1)	1	-	1	-
Peripherality Cluster Percentile						
Most peripheral (clusters 1–4)	164	37 (22.6)	0.8	0.4–1.6	1.0	0.5–2.0
Peripheral (cluster 5)	69	11 (15.9)	0.5	0.2–1.1	0.6	0.2–1.4
Central (clusters 6–7)	69	11 (15.9)	0.6	0.3–1.4	0.7	0.3–1.6
Very central (clusters 8+)	108	27 (25.0)	1	-	1	-
Type of work						
Building and reconstruction	189	42 (22.2)	1.8	0.8–4.3	1.1	0.4–3.1
Delivery	78	27 (34.8)	**8.8**	**3.3–22.9**	2.6	0.6–12.7
Agriculture	26	10 (38.5)	**4.8**	**1.5–15.3**	2.8	0.8–10.2
Retail sector	29	9 (31.0)	**4.1**	**1.3–12.6**	2.1	0.6–7.2
Garage	11	2 (18.2)	1.5	0.3–8.4	1.1	0.2–6.6
Food industry	99	9 (9.1)	1	-	1	-
Mechanism of Injury						
Road Traffic Crashes (RTC)	90	34 (37.8)	-	-	**14.4**	**2.5–81.6**
Fall	97	37 (38.1)	**-**	**-**	**14.8**	**4.1–53.0**
Burn	33	4 (12.1)	**-**	**--**	**5.0**	**1.1–24.5**
Strike by object	70	11 (15.7)	-	-	**4.1**	**1.1–16.8**
From machine	25	7 (28.0)	-	-	**8.5**	**1.8–39.8**
Other and unknown	16	3 (18.8)	-	-	4.5	0.6–31.7
Cuts and lacerations	101	3 (3.0)	-	-	1	-

* This analysis was conducted only among 432 cases with identifiable types of work. Bold values indicate statistical significance. Model I includes population group, peripherality cluster percentile, and type of work. Model II includes population group, peripherality cluster percentile, type of work, and mechanism of injury.

4. Discussion

The objective of this study was to study the phenomenon of work-related injuries among children and adolescents, particularly in disadvantaged populations characterized by their ethnic background and peripheral location. The findings indicated that the primary risk factor for experiencing a more severe injury is the mechanism of injury itself. Occupations with distinct injury mechanisms tend to result in a higher number of hospitalized children and adolescents. For instance, in the case of individuals working in building and reconstruction sites, the primary injury mechanism is falling from heights, which accounts for the elevated severity of the injuries observed.

The study revealed that the risk of Arab children and adolescents being hospitalized following work-related injury is more than five-fold higher than the risk of their Jewish counterparts. Interestingly, this heightened risk among Arab individuals does not appear to be directly correlated with higher rates of employment among children and adolescents in this demographic. Recent data reveals that the employment rate for teenagers in the Arab sector is actually six times lower than that among Jewish youth [25]. Consequently, this increased risk among Arab youth seems to be indicative of their greater likelihood of experiencing injuries that necessitate hospitalization. Notably, the research data also indicated that hospitalized Arab children predominantly reside in peripheral regions of the country. Conversely, children and adolescents in the Arab sector may engage in compensated work without formal employment status. This phenomenon is further highlighted by a significant income disparity, where the gap between actual earnings and income reported to the Israeli Tax Authority can reach up to 26% in the Arab population [26].

In Israel, Arabs comprise 23% of the Israeli population aged 0–17 years old [22]. The majority of the Arab children (96%) are Muslims [22]. Arabs and Jews differ in religion, culture, and language. The Arab population lives in mostly all-Arab communities located in rural areas in Northern and Southern Israel [27]. When compared to the Jewish population, Israeli Arabs have lower income, less access to education, and higher unemployment rates [28]. Most Arab localities are situated in the country's socioeconomic and geographic peripheries, factors that significantly impact their economic and social standing. According to data from the Central Bureau of Statistics, nearly all (95%) of Arab localities are categorized within Israel's lowest socioeconomic brackets, with 11% of them falling into the lowest cluster (cluster 1). In stark contrast, only 5% of Arab localities are classified within clusters 6 to 10 [29]. In peripheral areas, there exists a substantial disparity between the availability of job opportunities for teenagers and the actual demand for such positions. Consequently, in these areas, a pronounced compromise is often observed among young individuals regarding their wages and employment terms, while employers may also exploit this situation to their advantage [13]. The findings of this study indicate that within these regions, a notably large percentage of Arab children and adolescents have sustained injuries while engaged in building and reconstruction work, with falls from heights being a prevalent cause of such accidents. An analysis of workplace injuries in the construction and rebuilding sectors showed that a greater percentage of Arab workers sustained injuries from falls at height compared to Jewish workers, indicating a higher incidence of involvement in high-risk occupations. Accidents involving falls from heights at construction sites frequently result in traumatic injuries, leading to significant mortality rates and imposing a substantial financial burden on healthcare systems [30]. In Japan, for example, it has been documented that falls from elevated positions constitute the second highest cause of trauma-related fatalities, trailing only behind motor vehicle collisions, and they represent the leading cause of trauma-related deaths among young individuals [31]. Hospitalization cases, much like the visible tip of an iceberg, exclusively pertain to the most serious traumatic incidents. This research has revealed that despite legal prohibitions against employing underage individuals in the construction and building industry, this practice persists, leading to annual instances of young workers requiring hospitalization due to workplace injuries [23]. Construction in Israel is a sector where Arab workers are frequently employed, contributing significantly to the country's infrastructure development. However, it is also a field fraught with numerous safety challenges. Regrettably, Israel has witnessed alarmingly high rates of injuries and fatalities in the construction industry [32]. Annually, dozens of workers lose their lives as a result of hazardous working conditions. The mortality rate among workers on Israeli construction sites is 2.5 times higher than that in the European Union when considering fatalities per 100,000 workers, according to the Israeli Workers' Hotline [33]. Work environments prone to falls, like construction zones, necessitate rigorous safeguards to either prevent falls or lessen the impact should they occur. The issue is exacerbated by the underreporting of accidents, weak enforcement, inadequate safety regulations, the absence of appropriate gear and supervision, deficient training, and the employment of unlicensed workers [34]. Strengthening the enforcement of existing legislation is crucial to addressing this issue. This requires a robust system of oversight and accountability, increased resources for regulatory agencies, and stringent penalties for non-compliance. Effective enforcement will ensure that legal prohibitions against employing underage individuals in the construction industry are not merely symbolic but actively prevent exploitation and safeguard young workers from harm.

The current study highlighted that among the hospitalized, Arabs have higher odds for more severe injury, and this finding is independent of the work type and injury mechanism. This finding is in line with previous work published, which found that Arab children have a higher ISS; however, the odds ratio of proceeding directly to the hospital was lower for Arab children compared to Jewish children, controlling for injury severity [35].

Another occupation within the study population that exhibited a significant prevalence of injuries is employment in the delivery sector. Among this group of workers, two-wheeled food delivery drivers, including cyclists and scooter riders, emerge as the most susceptible and at-risk individuals on the road. The mode of transportation used in the delivery sector plays a pivotal role in understanding this higher susceptibility to injuries among its workers [36]. Two-wheeled food delivery drivers frequently navigate in close proximity to larger vehicles, which diminishes their visibility and increases their vulnerability to accidents. This heightened susceptibility is compounded by the fact that riders are in an exposed position, in stark contrast to the protection offered by enclosed vehicles. Moreover, the speed and agility of motorcycles and scooters, while essential for timely deliveries, can also result in more severe injuries in the event of a collision. Furthermore, a study from Australia indicated that engaging in delivery riding is an occupation fraught with notable road safety hazards, primarily driven by the pressures of the job (for example, time pressures), which often lead to the adoption of risky behaviors [37]. According to a University College London survey, 47% of delivery drivers reported driving above the speed limit, 30% reported driving through a red light being under time pressure, and 41% reported using a navigation app, which created a distraction [38].

In Israel, since 2016, it has been illegal for E-bikes/M-scooters to use sidewalks. These users should use specialized bike paths, but if such paths are unavailable, they should share the road with motorized vehicles [39]. Collisions between an e-tool and a motorized vehicle contributed to more severe injuries, higher rates of head trauma and severe head injuries, and poorer hospitalization outcomes [40–43]. Due to a quarter of injured children and adolescents working in delivery roles during the night, it becomes evident that breaching the law prohibiting nighttime employment for youth results in one of the most severe injury mechanisms—RTCs. Nighttime driving poses greater risks than daytime driving due to factors such as fatigue, decreased visibility, and changes in vision [44].

Helmet use must be made mandatory and enforced for these riders to reduce the risk of head injuries in the event of a collision [41,45]. Moreover, it is imperative for authorities to develop dedicated lanes for these travelers. In areas where such lanes are unavailable, it is crucial to enhance motor-vehicle drivers’ awareness of small electric devices on the road that may be challenging to detect visually or audibly [46]. In addition, tailored media campaigns should educate road users about the dangers of using headphones and mobile phones while riding [39].

In the food industry, where a significant number of children and teenagers are employed (the second largest employment industry of children), it is evident that the prevalence of severe injuries is comparatively lower, with most cases involving cuts. However, it is crucial to underscore the potentially life-altering nature of certain injuries, particularly burns in this industry, which have been identified in the literature as an “underappreciated public health hazard” [47]. Burns, though less frequent, can have profound and lasting consequences if not addressed promptly and effectively. It is worth highlighting that a significant presence in the group of those working at night, despite the prohibition on employing children and adolescents, was from the food industry. It is well-established that working in the evening and overnight hours exposes employees to an elevated risk of workplace accidents and subsequent injuries [48].

Assessing work environments is crucial to identifying potential hazards and preventing them, as each specific location within the food industry may have its unique risks. For instance, implementing simple and effective measures such as using cut-resistant mesh gloves and dedicated containers for broken glass can prevent cuts in the food industry. Providing non-slip, closed-toed shoes at no cost can reduce the risk of slips and falls. Additionally, using protective gloves when handling hot pots or working with hot, deep-frying oil, along with employing barriers, guards, or enclosures to prevent contact with hot surfaces, can help prevent burns in the food industry. Furthermore, here once more, the rigorous enforcement of child labor laws is imperative, particularly to ensure that children are not employed in nighttime work shifts. This demands vigilant monitoring and inspection by labor authorities to detect violations. Employers must be held accountable with swift and decisive penalties for non-compliance to deter the exploitation of child labor.

To cultivate a generation of safety-conscious workers, the groundwork must begin early by raising awareness among parents and communities. To ensure that young people understand potential workplace risks, education on workplace hazards, risks, and workers' rights should be introduced in schools and continue through vocational training and apprenticeship programs. Employers, including formal and informal enterprises and family businesses, should receive guidance on the specific risk factors that young workers face, as well as insights into work tasks and conditions suitable for various age groups. Lastly, the support and representation provided by workers' organizations become crucial as young individuals embark on their professional journeys, enabling them to assert their rights and voice their concerns.

5. Limitations

It is important to recognize the constraints of the present study. While the trauma registry encompasses all Level I trauma centers, it includes 14 out of 20 Level II trauma centers. These Level II trauma centers are not part of the registry and handle approximately 5% of severe trauma cases. Consequently, there is a potential for underestimating the true extent of trauma; however, this is considered acceptable since the majority of cases are accounted for.

The process of searching free-text responses to define work types proved to be less effective when applied to girls, primarily due to a significant proportion of work types that were challenging to categorize. Future research endeavors should prioritize the exploration of gender differences in defining work types to enhance the validity of findings for both sexes.

Additionally, it is important to note that the study lacked information regarding the specific rates of employment among Jewish and Arab children, rendering it impossible to calculate hospitalization risks based on the actual number of employed individuals. Consequently, our analysis relied on the total population of children and adolescents rather than the subset of those engaged in work activities, which may introduce a potential source of bias in the results.

6. Conclusions

In light of the findings presented in this study, several key recommendations emerge to address the critical issues surrounding youth employment safety. Creating secure employment opportunities for Arab young people and prohibiting the employment of children and adolescents in building and reconstruction within the Arab sector is of utmost importance. Secondly, for employers, it is vital to conduct stringent enforcement efforts, particularly at construction and reconstruction sites, to ensure strict compliance with regulations prohibiting the employment of children. Likewise, the enforcement against nighttime employment for children and adolescents should be pursued. Robust enforcement mechanisms will act as a deterrent and safeguard the well-being of young workers. Among policymakers, such as those within the Ministry of Labor and Welfare, there is a pressing need to develop and implement targeted initiatives in peripheral regions. These initiatives should aim to create safe and viable employment opportunities for children and youth, thus mitigating the risks associated with hazardous labor practices. Lastly, for the benefit of the children themselves, it is imperative to initiate educational programs within the school curriculum, beginning as early as high school, that encompass essential aspects of youth employment, including laws, safety regulations, rights, and basic first aid. This proactive approach will better prepare young individuals for future employment, equipping them with the knowledge and skills needed to navigate the workforce safely. By fostering a culture of safety, education, and compliance, we can collectively work towards a future where young workers are protected and empowered in their pursuit of meaningful employment.

Author Contributions: Conceptualization, B.S., I.R., E.K. and A.K.; methodology, B.S. and I.R.; validation, B.S., I.R. and A.K.; formal analysis, I.R.; investigation, B.S., I.R., E.K., ITG and A.K.; resources, E.K. and ITG; data curation, I.R.; writing—original draft preparation, B.S. and A.K.; writing—review and editing, I.R. and E.K.; project administration, B.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethical Committee of the Sheba Medical Center (SMC-18-5138) from 15 January 2023.

Informed Consent Statement: Not applicable-since no identifying information was available to the researchers as the research is based on an anonymized registry.

Data Availability Statement: All data supporting this study were obtained from the Israeli National Trauma Registry (INTR). Data cannot be shared following the restrictions defined by the Ethical Committee of the Sheba Medical Center.

Conflicts of Interest: All authors approve that they do not have any financial and personal relationships with other people or organizations that could inappropriately influence (bias) this research and this manuscript.

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European Journal of
Investigation in Health, Psychology and Education

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Health-Related Quality of Life and Injuries in Physical Education Students: A Multi-Group Model According to the Degree of Adherence to the Mediterranean Diet

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Abstract: The Mediterranean diet is considered a healthy eating pattern. It has been shown to improve people's quality of life. When a person suffers injuries, their quality of life suffers. This research aims to accomplish the following: (a) to study the differences in the effect of the health-related quality of life on injuries according to the degree of adherence to the Mediterranean diet, (b) to analyse the existing differences in the variables that make up the health-related quality of life according to the degree of adherence to the Mediterranean diet, and (c) to analyse the degree of adherence to the Mediterranean diet according to whether the participants have suffered any injury. The study was descriptive, cross-sectional, and exploratory in a sample of 556 physical education students. The PREDIMED questionnaire, the SF-36 questionnaire, and a self-administered questionnaire were used. The results showed that high adherence to the Mediterranean diet was associated with higher quality of life and lower injury rates. It was also observed that high adherence to the Mediterranean diet improved the effect of the quality of life on injuries. In conclusion, the Mediterranean diet is beneficial for the quality of life of young university students.

Keywords: health; social functioning; dietary adherence; emotional role; vitality

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Citation: Melguizo-Ibáñez, E.; Ubago-Jiménez, J.L.; Sanz-Martín, D.; Alonso-Vargas, J.M. Health-Related Quality of Life and Injuries in Physical Education Students: A Multi-Group Model According to the Degree of Adherence to the Mediterranean Diet. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 1140–1152. https://doi.org/10.3390/ejihpe14050075

Academic Editors: Keren Dopelt and María del Mar Molero Jurado

Received: 20 March 2024
Revised: 19 April 2024
Accepted: 21 April 2024
Published: 24 April 2024

1. Introduction

There is now a large body of research that supports the benefits of physical activity [1,2]. These benefits are independent of the age, sex, place of residence, and socioeconomic status of the practitioner [3]. Moreover, the practice of physical activity is easily accessible to different people [3]. The training of people related to the physical-sport field is vital [4]. Prospective physical education teachers are those who are most exposed to sporting activities [4]. This places this population at a critical point for sport injuries [4]. Goosens et al. [4] showed that students involved in physical education perform more than a 1000 h of physical activity. This increases the risk of injury in this population [4].

In order for physical sport practice to not be harmful, some basic criteria must be met [5]. The first of these is suitability [6]. This states that the physical activity proposed must be adapted to the physical conditions of the individual [6]. The second principle is continuity [6]. This states that physical activity should be carried out on a regular basis [6]. The third principle is that of globalisation [6]. This states that the practice of physical-sport activities produces improvements in the other dimensions of the individual [6]. The last principle is that of progression [6]. This states that physical exercise should begin at a low intensity and for a short duration [6]. Failure to comply with these recommendations can lead to impact injuries that temporarily make it impossible to carry out physical-sport activities [6].

Suffering from injuries causes the quality of life of young people to be affected [7]. The quality of life can be related as subjective [8]. It depends on the context in which the person is and how perceives it [9]. Quality of life is defined as an individual perception of the position of life in the socio-cultural context, and in relation to personal goals, expectations, norms, and interests [9]. The quality-of-life concept is based on a definition that comprises a sense of well-being and happiness [10]. It excludes the health problems or illnesses that a person may suffer from [10]. In response to this, the concept of health-related quality of life was proposed. Health-related quality of life is part of a multidimensional approach [10]. It encompasses physical, mental, and related social symptoms, as well as limitations caused by illness [10]. Elements have been found to positively affect the quality of life and health-related quality of life. These include physical activity and diet [10].

The university education stage coincides with the time when students leave their home environment and start living independently [11]. This causes young people to begin to have greater control over their diet [11]. The eating habits of the home environment are abandoned, and new dietary patterns are acquired [11]. It has been observed that the large supply of ready meals, convenience, or lack of time together with inexperience in shopping are the main reasons why the dietary pattern followed varies [12]. The Mediterranean diet is one of the healthiest dietary patterns currently available [13]. It is mainly based on the moderate consumption of foods originating from the Mediterranean area [13]. It includes a moderate intake of unsaturated fats, fish, lean meats, fruits, vegetables, nuts, legumes, and a low intake of red meat and saturated fats [13]. The Mediterranean diet ensures adequate calorie and nutrient intake in sufficient quantities and proportions [13]. In addition, it contributes to the prevention of cardiovascular diseases, diabetes, cancer, degenerative diseases and, in general, to a longer life expectancy [13]. All these benefits contribute to the university students' quality of life [13].

In addition to improvements in the quality of life, the Mediterranean diet helps prevent injuries [14]. Polyphenols (abundant in fruits, vegetables, and olive oil) and omega-3 fatty acids (abundant in fish) have been reported to protect musculoskeletal health [14]. It has been established that both low bone mass and low skeletal muscle mass increase susceptibility to low-impact fragility fractures [14]. The following research questions are proposed:

- Are there differences in the effect of health-related quality of life on injuries according to the degree of adherence to the Mediterranean diet?
- Are there differences in health-related quality of life according to the degree of adherence to the Mediterranean diet?
- Are there differences in adherence to the Mediterranean diet in injured versus non-injured people?

The aims of the study related to the research hypotheses are shown below:

O.1. To adjust and develop a multi-group education model according to the degree of adherence to the Mediterranean diet.

O.2. To study the differences in the effect of the health-related quality of life on injuries according to the degree of adherence to the Mediterranean diet.

- H.1. Participants showing high adherence to the Mediterranean diet will have a negative health-related quality of life effect on injuries.
- H.2. Participants who show high adherence to the Mediterranean diet will have higher scores on the variables that make up the health-related quality of life.

O.3. To analyse the existing differences in the variables that make up the health-related quality of life according to the degree of adherence to the Mediterranean diet.

- H.3. Participants who are injury-free will show a higher degree of adherence to the Mediterranean diet.

O.4. To analyse the degree of adherence to the Mediterranean diet according to whether the participants have suffered any injury.

- H.4. Participants who are uninjured will show greater adherence to the Mediterranean diet than those who are injured.

2. Materials and Methods

2.1. Design and Participants

This study is exploratory and comparative in nature. It presents a cross-sectional design. The sample is made up of 556 trainee physical education teachers from different grades of primary education in Andalusia. The age range was between 22 and 30 years (25.95 ± 2.768). All study subjects participated voluntarily after giving their informed consent. With respect to the sample reached, the sampling error was less than 3% for a confidence level of 95.0%.

2.2. Instruments and Variables

Various instruments were used to collect the data. The following is a list of the instruments that were used.

Own ad hoc questionnaire: This was used to collect the variables of gender (male/female) and age of the participants. In addition, it was used to collect the injuries of the participants. The categorisation of this variable was divided into four areas where injuries could have occurred, and they are as follows: arms (None, Numbness, Overload, contracture), legs (None, Calf, Hamstring, quadriceps, Overload), lower back (None, lower back pain, Overload, contracture), and cervical (None, Bursitis over Apophysis, cervical algia and Open neck burn). The recommendations followed by Gómez-Montón et al. [15] and Poyatos et al. [16] were used to develop this categorisation.

PREDIMED questionnaire: It was used to measure the degree of adherence to the Mediterranean diet. The original version was elaborated and developed by Schröder et al. [17]. Due to the typology and characteristics of the sample, the version by Álvarez-Álvarez et al. [18] has been used. This questionnaire is made up of a total of 14 questions [18]. Once answered and depending on the final score, the questionnaire offers three levels of categorisation: low adherence, medium adherence, and high adherence. Cronbach's alpha showed a value of $\alpha = 0.829$.

SF-36 questionnaire: To measure the health-related quality of life, the version adapted to Spanish by Alonso et al. [19] has been used. The instrument consists of 26 items rated on a Likert scale (1 = always; 5 = never). In addition, 10 items are rated on a 3-option Likert scale (1 = yes, it limits me a lot; 3 = it does not limit me at all). This makes a total of 36 items in the instrument. Finally, the health-related quality of life is measured through eight variables which are as follows: physical functioning (FF), physical role (RF), bodily pain (DC), general health (SG), vitality (VT), social functioning (FS), emotional role (RE), and mental health (SM). Cronbach's alpha obtained a value of $\alpha = 0.798$.

2.3. Procedure

Before starting the research, a sweep of questionnaires was carried out to check which were the most reliable. A Google Form questionnaire was then created to house the instruments. After this, the different departments were contacted and invited to collaborate in this study. Most of them agreed to share the questionnaire. Only two negative responses were obtained. The participants gave their written informed consent to participate in this study. In addition, all participants were assured that after signing the informed consent, their data would be treated anonymously and confidentially.

This study followed all the ethical aspects set out in the Declaration of Helsinki. In addition, to ensure greater ethical rigour, this research has been supervised and approved by an ethics committee (2966/CEIH/2022).

2.4. Data Analysis

IBM SPSS Statistics 25.0 software (IBM Corp., Armonk, NY, USA) was used for the relational analysis of the data. Before starting the data analysis, the distribution of the sample was studied. For this purpose, the Kolmogorov–Smirnov test was used. A significance value of less than 0.05 was obtained, so non-parametric tests were used to test the hypothesis. The Kruskal–Wallis test was used to compare more than two groups. When statistically significant differences ($p < 0.05$) were found, the Bonferroni test was used as a post hoc test to indicate differences between the groups. Cohen's standardised *d* [20] was used to calculate statistical power. The value obtained can be classified into four levels: null (≤ 0.19), small (0.20–0.49), medium (0.50–0.79), and large (≥ 0.80).

IBM SPSS Amos 26.0 (IBM Corp., Armonk, NY, USA) was used for structural equation modelling. This analysis was used to test the fit of the proposed theoretical model to the data obtained through its suitability for testing the hypotheses [21]. Initially, a theoretical model was developed to establish the direction of the effects between the variables (Figure 1). The proposed model consists of endogenous and exogenous variables. The exogenous variables are those that have an effect on other variables [21]. The theoretical model is formed by an exogenous variable (QoL). Endogenous variables are those that receive the effect of the endogenous variables [21]. The model consists of twelve endogenous variables. Due to the characteristics of the endogenous variables, causal explanations could be added. These are based on the reliability of the measures and the fit indices. The inclusion of causal explanations has allowed the inclusion of measurement process errors in the endogenous variables. Regarding the direction of the effects, this has a unidirectional character in such a way that the effect only occurs in one direction. With regard to the study of statistical differences, the level of significance was set at $p < 0.05$.

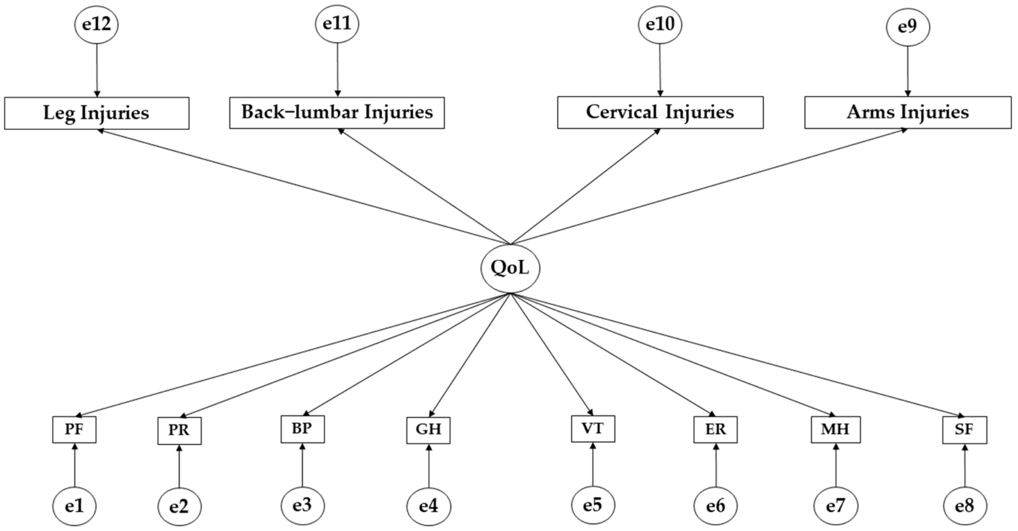

Figure 1. Theoretical model. **Note:** Health-related quality of life (QoL); physical function (PF); physical role (PR); bodily pain (BP); general health (GH); vitality (VT); Emotional Role (ER); mental health (MH); social functioning (SF).

The model fit was assessed through convergent validity and reliability or internal consistency. For this purpose, the mean variance extracted and the composite reliability were analysed. The values obtained for the mean variance extracted and composite reliability were adequate (VME = 0.60 and FC = 0.75). Also, Harman's test was used to evaluate the common method variance problem [22] The goodness of fit of the theoretical model and the multigroup model was evaluated through the following indices: (a) X^2, degrees of freedom (df), and *p*-values; (b) comparative fit index (CFI); (c) normalised fit index (NFI) analysis; (d) incremental fit index (IFI); (e) Tucker–Lewis index (TLI); (f) root mean square error of approximation (RMSEA). Following Hair et al. [23], an adequate model fit is obtained when X^2 *p*-value ≥ 0.05, CFI > 0.90, and RMSEA ≤ 0.07.

With respect to the values obtained in the theoretical model, the values obtained are given below. $X^2 = 3.160$; df = 16; $p = 0.079$; NFI = 0.935; IFI = 0.974; TLI = 0.988; CFI = 0.981; RMSEA = 0.039).

3. Results

Table 1 presents the descriptive analysis of the variables that make up the health-related quality of life according to the degree of adherence to the Mediterranean diet. Statistically significant differences ($p < 0.05$) were observed for physical function and vitality. For physical function, the participants with high adherence (7.80 ± 0.04) show higher recognition than those with medium adherence (7.62 ± 1.05) or low adherence (7.57 ± 0.63). For vitality, the students with high adherence (14.63 ± 1.93) show greater recognition than those with medium adherence (13.67 ± 2.03) or low adherence (12.89 ± 1.98).

Table 1. Descriptive analysis of the health-related quality of life as a function of adherence to the Mediterranean diet.

		M	SD	F	*p*	ES (*d*)	95% Confidence Interval
General Health	Low Adherence	14.83	1.82	1.944	0.144	NP	NP
	Medium Adherence	14.85	1.79				
	High Adherence	15.37	1.65				
Social Functioning	Low Adherence	6.90	0.54	1.630	0.196	NP	NP
	Medium Adherence	6.91	0.92				
	High Adherence	7.18	0.71				
Vitality	Low Adherence	12.89	1.98	4.246	0.015	0.493 [a]	[0.205–0.781] [a]
	Medium Adherence	13.67	2.03				
	High Adherence	14.63	1.93				
Mental Health	Low Adherence	19.67	1.84	0.269	0.764	NP	NP
	Medium Adherence	19.51	1.88				
	High Adherence	21.25	2.15				
Bodily Pain	Low Adherence	4.08	1.90	0.422	0.656	NP	NP
	Medium Adherence	3.93	1.97				
	High Adherence	3.85	2.24				
Emotional Role	Low Adherence	5.82	0.66	2.207	0.111	NP	NP
	Medium Adherence	5.58	0.91				
	High Adherence	5.75	0.70				
Physical Role	Low Adherence	5.75	1.13	0.640	0.527	NP	NP
	Medium Adherence	5.58	1.03				
	High Adherence	5.82	0.88				
Physical Function	Low Adherence	7.57	0.63	3.251	0.039	0.048 [a]	[0.239; 0.335] [a]
	Medium Adherence	7.62	1.05				
	High Adherence	7.80	0.04				

Note: [a] Differences between low adherence and medium adherence. Mean (M); standard deviation (SD); Fisher's test (F); effect size (ES).

For general health, the participants with high adherence (15.37 ± 1.65) show higher recognition than those with medium adherence (14.85 ± 1.79) or low adherence (14.83 ± 1.82). For social functionality, greater recognition is shown for the participants with high adherence (7.18 ± 0.71). It is also observed that a high adherence to the Mediterranean diet denotes a higher level of mental health (21.25 ± 2.15). For bodily pain, the participants with low adherence have a higher recognition of this variable (4.08 ± 1.90). The young people with low adherence have a higher emotional role (5.82 ± 0.66). Finally, the participants with a high adherence to the Mediterranean diet have a higher emotional role (5.82 ± 0.88).

Table 2 shows the injured areas with the type of injury according to the degree of adherence to the Mediterranean diet. For the arm area, differences ($p < 0.05$) were observed between the participants who had not suffered any injury (0.8014 ± 0.081) and those who had suffered contractures (0.7976 ± 0.082). For the lumbar–dorsal area, statistically significant differences are observed between those who have not suffered any injury (0.800 ± 0.082) and those who have suffered contractures (0.792 ± 0.900). For the legs, it was observed that the participants who had suffered quadricep injury had a greater adherence to the Mediterranean diet (0.8106 ± 0.084). Finally, for the cervical area, the participants who have presented cervical algia show a greater adherence to the Mediterranean diet (0.817 ± 0.072).

Table 2. Zones with the types of lesions according to the degree of adherence to the Mediterranean diet.

		M	SD	F	*p*	ES (*d*)	95% Confidence Interval
Arms	None	0.801	0.081	0.444	0.022	0.215 [a]	[0.193–0.642] [a]
	Numbness	0.794	0.084				
	Overload	0.785	0.002				
	Contracture	0.797	0.082				
Legs	None	0.799	0.083	0.508	0.730	NP	NP
	Calf	0.795	0.081				
	Hamstring	0.802	0.068				
	Quadriceps	0.810	0.084				
	Overload	0.797	0.081				
Back–lumbar	None	0.800	0.082	0.212	0.048	0.586 [a]	[0.345–0.708] [a]
	Lower back pain	0.801	0.077				
	Overload	0.798	0.065				
	Contracture	0.792	0.900				
Cervical	None	0.798	0.084	2.494	0.059	NP	NP
	Cervical algia	0.817	0.072				
	Contracture	0.805	0.075				

Note: [a] difference between no injury and contracture; mean (M); standard deviation (SD); Fisher's test (F); effect size (ES).

Tables 3–5 present the results of the structural equation models. Table 3 and Figure 2 show the standardised regression weights for the participants showing low adherence. For these participants, a positive effect of the health-related quality of life (QoL) on physical function (β = 0.825), physical role (β = 0.030), emotional role (β = 0.399; $p < 0.05$), bodily pain (β = 0.003), and mental health (β = 0.191) is observed. In contrast, a negative effect of the health-related quality of life (QoL) on vitality (β = −0.168), social functioning (β = −0.135), and general health (GH) (β = −0.086) was observed. Regarding injuries, a positive effect of the health-related quality of life (QoL) on leg injuries (β = 0.105) and back–lumbar injuries (β = 0.212) is denoted. In contrast, the health-related quality of life (QoL) has a negative effect on cervical injuries (β = −0.621; $p < 0.05$) and arm injuries (β = −0.057).

Table 3. Standardised regression weights for those with low adherence.

Associations between Variables	R.W.				S.R.W.
	Estimates	**S.E.**	**C.R.**	***p***	**Estimates**
PF ← QoL	1.000				0.825
PR ← QoL	0.064	0.357	0.181	0.857	0.030
ER← QoL	0.508	0.244	2.081	**	0.399
BP ← QoL	0.009	0.597	0.016	0.988	0.003
MH ← QoL	0.668	0.596	1.121	0.262	0.191
VT ← QoL	−0.638	0.643	−0.993	0.321	−0.168
SF ← QoL	−0.142	0.176	−0.806	0.420	−0.135
GH ← QoL	−0.272	0.523	−0.520	0.603	−0.086
Leg Injuries ← QoL	0.209	0.330	0.633	0.526	0.105
Back–Lumbar Injuries ← QoL	0.322	0.261	1.233	0.218	0.212
Cervical Injuries ← QoL	−1.286	0.512	−2.514	**	−0.621
Arm Injuries ← QoL	−0.047	0.137	−0.347	0.729	−0.057

Note: Quality of life (QoL); physical function (PF); physical role (PR); bodily pain (BP); general health (GH); vitality (VT); emotional role (ER); mental health (MH); social functioning (SF). ** $p \leq 0.05$.

Table 4. Standardised regression weights for those with average adherence.

Associations between Variables	R.W.				S.R.W.
	Estimates	**S.E.**	**C.R.**	***p***	**Estimates**
PF ← QoL	1.000				0.551
PR ← QoL	1.601	0.103	15.497	***	0.550
ER← QoL	0.605	0.060	10.093	***	0.900
BP ← QoL	−2.456	0.156	−15.750	***	−0.386
MH ← QoL	0.735	0.117	6.308	***	−0.726
VT ← QoL	−0.340	0.122	−2.781	0.005	0.227
SF ← QoL	−0.054	0.055	−0.980	0.327	−0.097
GH ← QoL	−0.281	0.108	−2.611	0.009	−0.091
Leg Injuries ← QoL	−0.055	0.065	−0.850	0.395	−0.030
Back–Lumbar Injuries ← QoL	0.005	0.051	0.105	0.916	0.004
Cervical Injuries ← QoL	0.170	0.072	2.368	0.018	0.083
Arm Injuries ← QoL	0.021	0.029	0.737	0.461	0.026

Note: Quality of life (QoL); physical function (PF); physical role (PR); bodily pain (BP); general health (GH); vitality (VT); emotional role (ER); mental health (MH); social functioning (SF). Regression weights (R.W.); standardised regression weights (S.R.W.); Estimation error (S.E.); Critical Ratio (C.R.). *** $p \leq 0.001$.

Table 5. Standardised regression weights for those with high adherence.

Associations between Variables	R.W.				S.R.W.
	Estimates	S.E.	C.R.	p	Estimates
PF ← QoL	1.000				0.969
RP ← QoL	8.041	18.822	0.427	0.669	0.226
R← QoL	2.385	5.877	0.406	0.685	0.082
BP ← QoL	5.977	14.789	0.404	0.686	−0.069
MH ← QoL	13.393	32.568	0.411	0.681	0.128
VT ← QoL	8.325	20.443	0.407	0.684	0.094
SF ← QoL	2.286	5.635	0.406	0.685	0.081
GH ← QoL	6.292	15.559	0.404	0.686	0.071
Leg Injuries ← QoL	0.708	1.950	−0.363	***	−0.016
Back–Lumbar Injuries ← QoL	−1.950	4.829	−0.404	***	−0.066
Cervical Injuries ← QoL	−0.933	2.464	−0.379	***	−0.021
Arm Injuries ← QoL	0.761	1.904	−0.400	***	−0.047

Note: Quality of life (QoL); physical function (PF); physical role (PR); bodily pain (BP); general health (GH); vitality (VT); emotional role (ER); mental health (MH); social functioning (SF). Regression weights (R.W.); standardised regression weights (S.R.W.); Estimation error (S.E.); Critical Ratio (C.R.); *** $p \leq 0.001$.

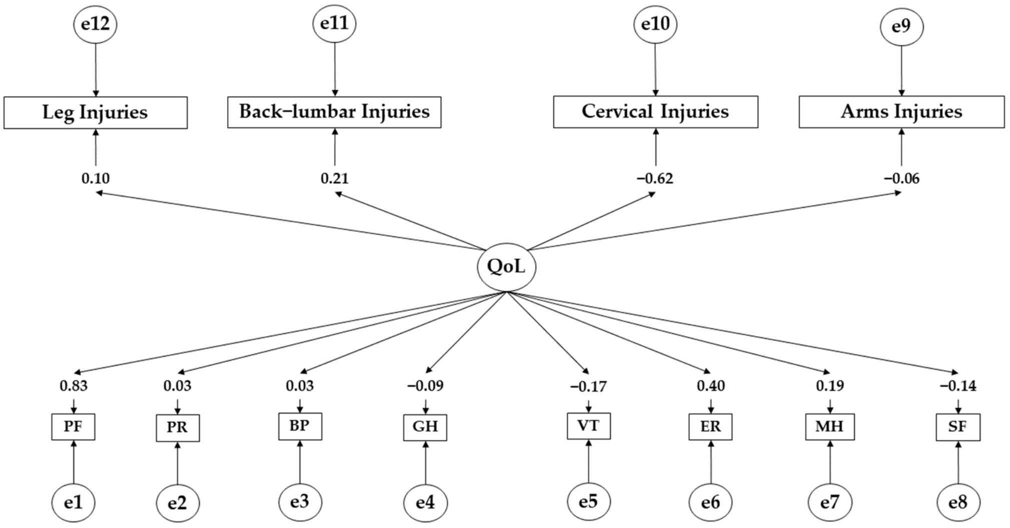

Figure 2. Theoretical model with regression weights for low adherers. **Note:** Quality of life (QoL); physical function (PF); physical role (PR); bodily pain (BP); general health (GH); vitality (VT); emotional role (ER); mental health (MH); social functioning (SF).

Table 4 and Figure 3 present the standardised regression weights for young people showing medium adherence. A positive effect of the health-related quality of life on physical function ($\beta = 0.551$), physical role ($\beta = 0.550$; $p < 0.001$), emotional role ($\beta = 0.900$; $p < 0.001$), bodily pain ($\beta = 0.386$; $p < 0.001$), and vitality ($\beta = 0.227$; $p < 0.05$) is observed. Conversely, a negative effect of the health-related quality of life (QoL) on social functioning ($\beta = -0.097$) and general health ($\beta = -0.091$; $p < 0.05$) is obtained. Continuing with the effect of the health-related quality of life (QoL) on injury areas, a negative effect on leg injuries (β = −0.030) is obtained. In contrast, a positive effect on back–lumbar injuries (β = 0.004), cervical injuries (β = 0.083), and arm injuries (β = 0.026) is observed.

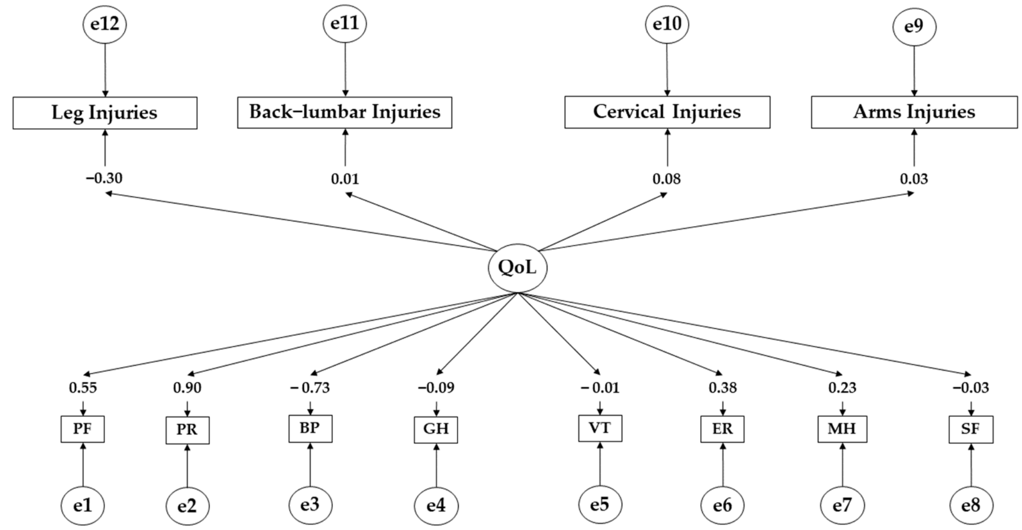

Figure 3. Theoretical model with regression weights for those with medium adherence. **Note:** Quality of life (QoL); physical function (PF); physical role (PR); bodily pain (BP); general health (GH); vitality (VT); emotional role (ER); mental health (MH); social functioning (SF).

Table 5 and Figure 4 present the results obtained for participants with high adherence to the Mediterranean diet. A positive effect of the health-related quality of life on physical function (β = 0.969), physical role (β = 0.551), emotional role (β = 0.082), mental health (β = 0.128), vitality (β = 0.094), social functioning (β = 0.081), and general health (β = 0.071) is denoted. In contrast, a negative effect of the health-related quality of life (QoL) on bodily pain (β = −0.069) was observed. The effect of the health-related quality of life (QoL) on leg injuries (β = −0.016; $p < 0.001$), back–lumbar injuries (β = −0.066; $p < 0.001$), cervical injuries (β = −0.021; $p < 0.001$), and arm injuries (β = −0.047; $p < 0.001$) was also observed.

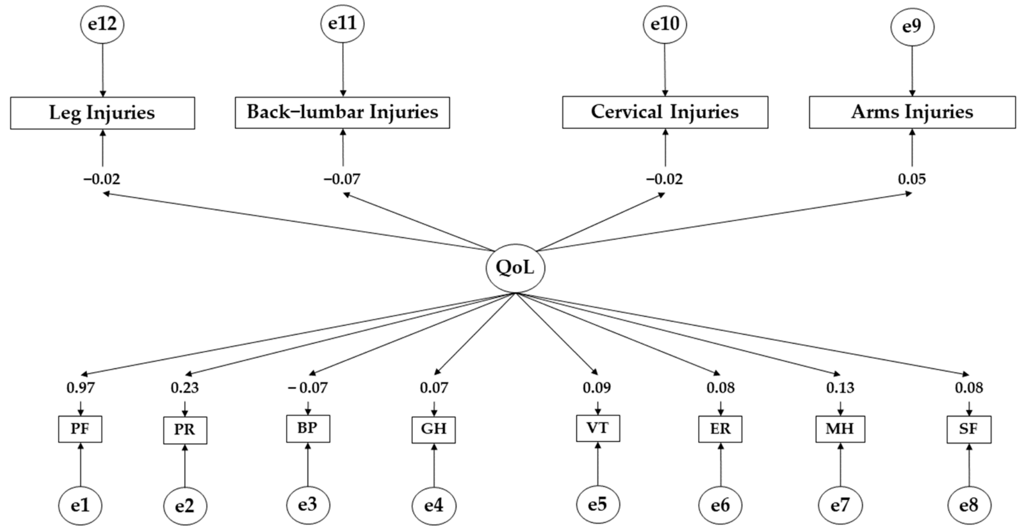

Figure 4. Theoretical model with regression weights for high adherents. **Note:** Quality of life (QoL); physical function (PF); physical role (PR); bodily pain (BP); general health (GH); vitality (VT); emotional role (ER); mental health (MH); social functioning (SF).

4. Discussion

Once the research questions, objectives, and research hypotheses have been answered, the results obtained are compared with those of another similar research.

The study shows that a high adherence to the Mediterranean diet has a positive impact on different areas of the health-related quality of life. Higher adherence to the Mediterranean diet reported higher scores on general health, social functioning, vitality, mental health, physical role, and physical function. The Mediterranean diet has reported benefits in the different areas that make up the human being [24]. High adherence to the Mediterranean diet is reported to reduce cardiovascular disease by 40% [25]. The Mediterranean diet benefits have also been found to reduce negative emotional states [26]. In the physical area, it has been reported that young people who show a high adherence to this dietary pattern show better physical fitness outcomes [27]. High adherence to the Mediterranean diet has shown improvements in musculoskeletal fitness and overall physical fitness [26]. All the above highlight the health benefits of positive adherence to the Mediterranean diet. This analysis indicates that the young people with a low adherence show higher emotional role and bodily pain. It has been shown that in populations with osteoarthritis, the Mediterranean diet helps to reduce bodily pain [28]. Furthermore, a reduction in chronic pain has been observed with a high adherence to the Mediterranean diet [29]. For the emotional role, it is noted that the young people with a high adherence show worse results. It has been observed that a process of emotional overeating is taking place in the adolescent and adult population [30]. This consists of eating unhealthy foods to reduce negative emotional states [31].

The study related to injuries and Mediterranean adherence has reported that for some body segments, participants who have not had any injuries have shown a higher adherence to the Mediterranean diet. High adherence to the Mediterranean diet has reported benefits at the bone and muscle level [32]. This strengthening of the musculoskeletal system helps to prevent possible injuries sustained during sport [33]. At a competitive level, it has been reported that the Mediterranean diet provides the intake of macronutrients and micronutrients to boost muscle contraction [34]. The diet followed has been shown to play an important role in preventing injury [35]. There are other elements to consider in injury prevention such as internal factors and external factors [35]. Internal factors refer to factors within the body such as age, gender, and fitness [35]. External factors refer to training planning, adequate warm-up, previous fatigue, and overtraining [35].

The results obtained in the multi-group model reveal that there are differences between the health-related quality of life and injury site. The effect of the quality of life on leg injuries shows a positive effect for the young people with low adherence. A negative effect is denoted for the young people with medium and high adherence. Nutrition together with the rehabilitation process helps to improve the mental and physical function of the person [36]. Post-injury is the best time to improve eating attitudes and behaviours [37]. This process of change leads to an improvement in people's health-related quality of life [35]. This leads to the healing process and/or improves the subsequent performance of the affected area [34]. It has been shown that a high adherence to the Mediterranean diet was associated with an increase in muscle mass and explosive leg power [38]. This is positively associated with increased lower body strength, which reduces the risk of leg injuries [39].

The effect of the health-related quality of life on lower back and hip injuries is positive for the young people who show low or medium adherence to the Mediterranean diet. In contrast, a negative effect of the health-related quality of life on injuries in this area is denoted. High adherence to a high-protein diet has been found to be inversely associated with the prevalence of chronic lower back pain [40]. The beneficial effects of the Mediterranean diet on cardiovascular disease, diabetes, obesity, and bone fragility have been widely recognised [41]. These conditions are, in turn, associated with an increased risk of injury [42]. For back injuries, it has been observed that asthma, diabetes, and osteoarthritis were associated with an increased number of lower back injuries [43].

The effect of the health-related quality of life on neck injuries shows a positive effect for medium adherence. Negative effects between these variables are denoted for the participants with low and high adherence to the Mediterranean diet. This effect is larger for the participants with low adherence. It has been found that the Mediterranean diet by promoting the intake of bioactive antioxidant and anti-inflammatory components may have a protective effect on muscular and skeletal health [7]. In order to strengthen muscles in a particular area, this must be combined with training [38].

The effect of the health-related quality of life shows a greater negative effect for the young people with low adherence to the Mediterranean diet. Different results were found by Julián et al. [44]. In their study, it was found that the Mediterranean diet helps muscle strengthening [44]. This helps to prevent possible injuries sustained during physical activity [44].

This research has responded to the objectives, hypotheses, and research questions. The study has several limitations. This research is cross-sectional. This reflects the fact that data were only collected at a single point in time. In addition, due to the type of study, other variables that directly influence the research variables have been left out. The instruments used are another limitation. Instruments have been used that have shown a high degree of reliability. Despite this, these instruments have an intrinsic error related to the measurement process. Another limitation is the decline in this diet due to local or traditional culinary habits in the area where the data were collected. The last limitation relates to the fact that the study lacks objective observations such as the participants' body synthesis (fat mass, lean mass) and clinical measurements.

As a future study, an intervention programme could be carried out with a control group and an experimental group. In this, the control group could be assigned the intake of healthy foods that help to strengthen muscles and bones in physical education students. In addition, most of the research on this subject has been carried out on elite athletes. It would be interesting to know the state of the art in university students from various branches of university study.

5. Conclusions

The main conclusions found in this research highlight that a high adherence to the Mediterranean diet brings greater benefits in the different areas that make up the health-related quality of life. It is noted that with respect to the areas of injury, there are differences in the type of injury and adherence to the Mediterranean diet. It is concluded that there are differences according to the degree of adherence to the health-related quality of life in relation to injuries. The participants with a high degree of adherence to the Mediterranean diet were found to have a negative effect of the health-related quality of life on injuries. As a general assessment, it is observed that a high adherence to the Mediterranean diet brings health benefits to individuals.

Derived from these conclusions, the need arises to seek their applicability. The importance of positive adherence to the Mediterranean diet should be conveyed in the educational sphere. Through the discipline of physical education, habits that have a positive impact on the quality of life should be encouraged, as this prevents injuries and illnesses.

Author Contributions: Conceptualization, E.M.-I., J.L.U.-J. and D.S.-M.; data curation, E.M.-I., J.L.U.-J. and D.S.-M.; formal analysis, E.M.-I., J.L.U.-J., D.S.-M. and J.M.A.-V.; investigation, E.M.-I. and J.L.U.-J.; methodology, E.M.-I., J.L.U.-J., D.S.-M. and J.M.A.-V.; project administration, E.M.-I.; software, E.M.-I. and J.M.A.-V.; supervision, D.S.-M.; validation, E.M.-I.; visualization, E.M.-I., J.L.U.-J., D.S.-M. and J.M.A.-V.; writing—original draft, E.M.-I., J.L.U.-J., D.S.-M. and J.M.A.-V.; writing—review and editing, E.M.-I., J.L.U.-J., D.S.-M. and J.M.A.-V. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and was approved by the Research Ethics Committee of the University of Granada (2966/CEIH/2022). The approval date was 27 September 2022.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data used to support the findings of the current study are available from the corresponding author upon request.

Conflicts of Interest: The authors declare no conflicts of interest.

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European Journal of
Investigation in Health, Psychology and Education

Article

Disparity in the Burden of Caring for Older Persons between Families Living in Housing Estates and Traditional Communities in Thailand

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Abstract: Thailand's rapid population aging and reliance on family-based long-term care requires research into disparities in family caregiver burden. Since the type of residence matters to the caregiving outcome, this research aimed to examine the difference in caregiver burden between residents of private housing estates and traditional village communities. This cross-sectional study was conducted with 1276 family caregivers of community-dwelling Thai older adults, in Chiang Mai province, Thailand. The caregiver burden was examined using the Caregiver Burden Inventory (CBI), and the care recipients' dependency status was examined using Barthel's Activity of Daily Living (ADL). Descriptive analysis, multivariate analysis of variance test, and multiple logistic regression analysis were performed. Family caregivers living in a traditional village community were 1.607 times more likely to experience emotional burden (adj. OR 1.607, 95% CI: 1.049, 2.462) and 2.743 times more likely to experience overall caregiver burden (adj. OR: 1.163, 95% CI: 1.163, 6.471) compared to those in the private housing estate group. Our findings showed significant differences in caregiver burden based on residential area, contributing with insights to evidence-based policies, interventions, and programs to minimize disparities and promote family caregivers' health and well-being.

Keywords: population aging; family caregiver; long-term care system; residential environment; caregiver burden; health disparity

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Citation: Mulati, N.; Aung, M.N.; Moolphate, S.; Aung, T.N.N.; Koyanagi, Y.; Supakankunti, S.; Yuasa, M. Disparity in the Burden of Caring for Older Persons between Families Living in Housing Estates and Traditional Communities in Thailand. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 1514–1526. https://doi.org/10.3390/ejihpe14060100

Academic Editors: Keren Dopelt and María del Mar Molero Jurado

Received: 27 April 2024
Revised: 20 May 2024
Accepted: 24 May 2024
Published: 28 May 2024

1. Introduction

Thailand is experiencing a fast pace of population aging and is expected to rank among the top ten countries globally in terms of its older population [1,2]. The country has successfully implemented universal health coverage (UHC), but due to the high cost, it does not cover the cost of any institutional long-term care [3]. The long-term care (LTC) program is not institution-based. It focuses on community-based and home care services, and most Thai older adults still rely on family members for support [3,4].

Like most developing countries, in Thailand, taking care of loved ones and parents is deeply ingrained in Thai tradition and cultural values. It serves as a means of expressing gratitude to those who have supported and assisted them throughout their lives [5]. According to a national survey, one in ten older Thai people has a caregiver, and the demand for caregivers tends to increase with age [2]. The percentage of older people in Thailand who have caregivers is 4% among the young-old (60 to 69 years), 11.4% among the middle-old (70 to 79 years), and 35.6% among the old-old adults (80 years or older) in 2021, and nearly 60% of the caregivers are the child of the older person [2].

The aging population, coupled with a declining birth rate and a shrinking working-age population, has led to a projected decline in Thailand's potential support ratio; from 5.4 working-age adults per elderly person in 2020, this ratio is expected to decrease to 1.9 by the year 2050. This significant shift highlights a substantial reduction in the number of working-age individuals available to provide support and care for older adults [3]. Therefore, exploring the determinants of various caregiving outcomes is an essential topic for designing evidence-based programs, and interventions to promote the health and well-being of the family caregivers, as they remain indispensable in this context.

Caregiving burden, which is one of the common caregiving outcomes, can be defined as "the level of multifaceted strain perceived by the caregiver from caring for a family member and/or loved one over time" [6]. Family caregivers experience physical, psychological, emotional, social, and financial burdens due to providing care [7,8]. Scholars examined the wide range of factors correlated with the family caregiver burden, for instance, family caregiver characteristics, socio-economic status, the context, duration, and intensity of caregiving, the timing of entry into the caregiving role, relationship quality with care recipients, and the social and cultural context, and little is known about the effect of the physical environment on the family caregiver burden [9–12].

In Thailand, traditionally, people live in the *Muban* or village communities. Gradually, people have begun occupying *Mubanchatsan,* or gated housing estate, developed by private housing developers since the 1960s [13]. The structural factors, including the globalization of the economy, and the privatization of security, as well as the subjective factors (for instance, the desire for privacy, status, social homogeneity, the fear of crime, and investment potential) contributed to the rise in private housing estate communities [14,15]. While the political, social, and spatial effects of living in private housing estate communities are well explored, there is a gap in the literature examining its effect on health [13,15–18]. Residential environments, whether private housing estates or traditional village communities, offer distinct social and structural contexts that can influence the caregiving experience. Exploring caregiver burden across diverse residential types allows for a more comprehensive understanding of the complex interplay between socio-environmental factors and caregiving burden.

Therefore, this study aims to examine the differences in family caregivers' burdens residing in traditional village communities and private housing estate communities.

2. Materials and Methods

2.1. Study Design and Setting

This is a cross-sectional study aiming to examine the caregiver burden of family caregivers residing in different neighborhoods. The study setting was Maehia City, Chiang Mai Province, Northern Thailand. The older population (age $\geq$ 60) consisted of more than 20% of the population in the study site [19].

2.2. Data Source

The data of this study originated from the baseline data of "Community-Integrated Intermediary Care (CIIC) Service Model to Enhance Family-Based, Long-Term Care for Older People: A Cluster Randomized Controlled Trial in Thailand: TCTR20190412004" [20]. This two-arm parallel intervention study consisted of 6 intervention clusters and 6 control clusters in Chiang Mai province, Thailand, that aimed to reduce the caregiver burden and promote the health of Thai community-dwelling older adults by designing a novel aging care model consisting of care capacity building for family caregivers, respite care services in the community and an exercise program for community-dwelling older adults. The baseline survey applied led to data collection and this study analyzed the response of the caregivers.

STATA version 11SE (Stata Corporation, College Station, TX, USA) was utilized for sample and power estimations. The estimated sample consisted of 1500 participants in each arm to determine the size difference of 0.5 units with a standard deviation (SD) of 4 between the two arms [21]. The precision levels applied are a p-value of 0.05 with a 95% confidence interval. The sample size was inflated by up to 20% for design effect of cluster randomized design application, and compensation of potential non-responses and drop-outs during the recruitment and study [21].

A total of 1276 family caregivers and their care recipients were randomly selected both from the intervention arm and the control arm. The inclusion criteria were as follows: care recipients over 60 years of age and their family caregivers (both male and female) who are taking care of the older adults at home and residing in the study site for at least one year with written informed consent. The exclusion criteria were persons who had cognitive impairment and were unable to understand informed consent, or who did not consent. Data were collected from August to December 2019 by a well-trained public health research assistant following the research protocol [20].

2.3. Measurement

The instruments used in this study are validated instruments commonly used in research on aging and long-term care. They have been translated into the Thai language and validated in previous studies and programs in Thailand.

2.3.1. The Caregiver Burden

The caregiver burden inventory (CBI) is a multidimensional measure used to assess the burden of family caregivers [22]. It is an internally validated, 5-point Likert scale which encompasses five dimensions: time-dependent burden (5 items), developmental burden (5 items), physical burden (4 items), social burden (5 items), and emotional burden (5 items). The time-dependent burden pertains to the limitations placed on the caregiver's time. The developmental burden reflects caregivers' feelings of being out of sync with their peers in terms of personal development. The physical burden encompasses caregivers' experiences of chronic fatigue and physical health deterioration. Social burden encompasses caregivers' feelings of role conflict. Lastly, the emotional burden captures caregivers' negative emotions toward the individuals they care for [22]. The total score of CBI equals the sum of the 24-item scale. The application of the total score alone cannot portray the unique difference in the burden the caregiver experienced. Therefore, by using both the five dimensions and the total burden score, we can gain a clearer understanding of the caregivers' experiences. To achieve this, we categorized the responses as follows: "Never" was coded as 0 = no burden, while "Rarely", "Sometimes", "Quite Frequently", and "Nearly Always" were combined and coded as 1 = rarely to always burden across the five dimensions (time dependence, developmental burden, physical, social, and emotional burden). Moreover, the total score of CBI was categorized into two groups; (1) the total score lower than 24 group (coded as 0); and (2) the total score equal to or more than 24 group (coded as 1), indicating high burden.

2.3.2. Independent Variable: Residential Type

The participants were asked if they resided in private housing estate communities (coded as 0) or traditional village communities (coded as 1).

2.3.3. Caregiver and Care Recipient Characteristics

The caregiver and care recipients' characteristics included socio-demographic information, relationships, health conditions, and lifestyle factors.

Caregivers' socio-demographic information included age, sex (coded male as 0, female as 1), and marital status (which was categorized as a not married group (including single, separated, divorced, and widowed, (coded as 0), and married group (coded as 1)), educational background (no formal education (coded as 0), primary school completed (coded as 1), secondary school and above completed (coded as 2, including secondary school, the vocational school completed, bachelor degree or above completed)), and working status (not working coded as 0, working coded as 1). Monthly income was asked, and the answer ranged from no income to THB 300,000; since it was scattered, we categorized it using the median value, ≤10,000 group (coded as 0), and >10,000 group (coded as 1). Whether they were the main income supporter of the family or not was also asked (yes coded as 0, no coded as 1). Moreover, the relationship of the caregiver with their care recipients was categorized into spouse (coded as 0), children or son/daughters-in-law (coded as 1), sibling (coded as 2), and others (relative, maid, etc., coded as 3). Willingness to send the care recipients to short-term aging care facility were asked (yes = 0, no = 1). Lifestyle factors included smoking habits, alcohol consumption, and exercise habits. Smoking and drinking alcohol were categorized into yes (including occasional and currently smoking or drinking, coded as 0), and no groups (including never smoked or drank or quit, coded as 1). Exercise behavior includes participants who do not exercise (coded as 0), who exercise but not regularly (coded as 1), and who exercise regularly (coded as 2). The underlying diseases of the study participants included hypertension and diabetes (no coded as 0, yes as 1) were included as the indicator of the health state of the family caregivers.

Care recipients' socio-demographic information consisted of age (completed years), and sex (male coded as 0, female as 1). Variables regarding health condition were whether they had diabetes mellitus or hypertension (yes = 0, no = 1), and the dependency status. The dependency status was measured using the Barthel Index of Activity of Daily Living (ADL). It is a standard measure used and validated in Thailand to assess the dependency status of older adults. It examines the ability to perform ten daily basic activities, consisting of bathing, feeding, dressing, toilet use, transfer, indoor mobility, grooming, stairs, bowel control, and bladder control. The total possible scores range from 0 (maximal disability) to 20 (maximal independence). We categorized functional ability as mildly dependent to independent (total ADL score ≥12, coded as 0), moderately dependent (total ADL score = 5~11, coded as 1) and severely dependent groups (total ADL score = 0~4, coded as 2) [23]. Finally, we asked their willingness to use the respite care center provided by the municipality (yes = 0, no = 1), to explore the cultural norms in this matter.

2.4. Statistical Analysis

The data were analyzed using the STATA version SE17 (Stata Corp 4905, Lakeway Drive, College Station, TX 77845, USA). Descriptive analysis was performed to understand the study participants' characteristics. Frequency and percentage were used for categorical variables, and mean, standard deviation (SD) for continuous variables.

To assess whether there were statistically significant differences in caregiver burden dimensions between two residential types, the Multivariate Analysis of Variance (MANOVA) test for the total score of time dependence, developmental, physical, emotional, and social burden dimensions, and the Wilcoxon sign-rank test for the total caregiver burden were conducted.

Then, binary logistic regression analysis was conducted to identify an association between dependent variables (time dependence, developmental burden, physical, social, and emotional burden), categorized as (0 = no burden, 1 = rarely to almost always burden), total CBI burden (coded 0 as a score <24 no burden and ≥24 high burden) and independent variable (residential type) as odds ratio and 95% confidence interval.

Since the binary logistic regression analysis results showed statistical significance on the emotional burden and the CBI total burden, we conducted multiple logistic regression analyses to identify the adjusted odds ratio and 95% confidence interval as a measure of association between the independent variables, type of the houses, and dependent variables, which are emotional burden categorized into two groups (0 = no burden, 1 = rarely to always burden), and total caregiver burden (coded 0 as a score < 24 no burden and ≥24 high burden). A *p*-value of less than 0.2 in binary analysis and conceptually related factors were included in the model. The dependent variables (caregiver emotional burden and overall burden) were adjusted for age, sex, marital and education status, work status of the family caregiver, and age and sex of care recipients, separately. Statistical significance was defined as $p < 0.05$ with a 95% confidence interval (CI). The fit of each multiple logistic regression model was checked applying Hosmer–Lemeshow goodness-of-fit test.

3. Results

3.1. The Characteristics of the Study Participants

The characteristics of the family caregivers and their care recipients are shown in Table 1. A total of 1276 family caregivers of community-dwelling older adults participated in this study, with a mean age of 54.87 (SD = 13.94) years. Most of the participants were female (62%), married (71.5%), and working (71.6%) at the time the study was conducted. Among them, 81.6% were residents of traditional village communities, while 18.4% resided in private housing estates. Notably, residents of traditional village communities were older, with a mean age of 55.73 (SD = 13.91) years, compared to residents of private housing estates, who had a mean age of 51.05 (SD = 13.44) years, and this difference was statistically significant ($p < 0.001$). Moreover, the family caregivers of the private housing estate community had a higher educational background, with 80.4% of them completing secondary school or above; this percentage was 59.8% for the family caregivers of the traditional village community ($p < 0.001$). As for the relationship of the family caregivers and their care recipients, spouses were most common in the traditional village community, accounting for 49.2%. In contrast, in the private housing estate group, children and son/daughter-in-law were the most prevalent caregivers, representing 50.9%. More than half (57.4%) of the study participants' monthly income was > THB 10,000, and they were the main income supporter of the family (52.8%). The willingness of family caregivers in the traditional village community (30.5%) to send older adults to the municipality-provided short-term care center was significantly higher compared to those in the private housing estate group (6.0%).

In terms of lifestyle factors, most study participants did not smoke (91.8%) or consume alcohol (73.7%). Only 12.1% of family caregivers reported regular exercise, with a slightly higher percentage observed among the traditional village community group (12.5%) compared to the housing estate group (10.2%). Regarding health status, family caregivers in the traditional village community group had a higher percentage of individuals with diabetes (11.9%) and hypertension (27.7%), whereas these figures were 4.3% and 21.7%, respectively, for caregivers of the private housing estate group (Table 1).

The mean age of the care recipients was 69.34 (SD = 8.26) years, with most of them being female (57.5%), and able to independently perform basic daily activities (96.8%) by themselves (ADL mean score of 19.15 (SD = 2.81)). Care recipients of the original village community were slightly older, 69.59 (SD = 8.42) years, than those in the private housing estate, 68.21 (SD = 7.42) years (Table 1). Moreover, the prevalence of hypertension and diabetes among the care recipients was also higher in the traditional village community group (48.9% and 20.3%, respectively) compared to that in the private housing estate group (46.0% and 11.5%, respectively). When asked about their willingness to use short-term aging care facilities in their municipality, a higher proportion of care recipients in the traditional village community (32.1%) answered yes compared to those in the private housing estate community group (12.1%). This difference was statistically significant ($p < 0.001$).

Table 1. Socio-economics, lifestyle, and health status of family caregivers and their care recipients in Chiang Mai, Thailand (N = 1276).

	Residential Type			
	Traditional Village Community	**Private Housing Estate Community**	**Total**	***p*-Value**
Total Participants	1041 (81.6%)	235 (18.4%)	1276 (100.0%)	
Socio-demographics				
Age, Mean (SD)	55.73 (13.91)	51.05 (13.44)	54.87 (13.94)	<0.001
Sex				
Male	384 (36.9%)	101 (43.0%)	485 (38.0%)	0.082
Female	657 (63.1%)	134 (57.0%)	791 (62.0%)	
Marital status				
Not married	270 (25.9%)	94 (40.0%)	364 (28.5%)	<0.001
Married	771 (74.1%)	141 (60.0%)	912 (71.5%)	
Educational background				
No formal education	21 (2.0%)	3 (1.3%)	24 (1.9%)	<0.001
Primary school completed	398 (38.2%)	43 (18.3%)	441 (34.6%)	
Secondary school and above completed	622 (59.8%)	189 (80.4%)	811 (63.6%)	
Working status				
Not working	294 (28.2%)	68 (28.9%)	362 (28.4%)	0.831
Working	747 (71.8%)	167 (71.1%)	914 (71.6%)	
Income				
≤10,000	408 (42.5%)	87 (43.1%)	495 (42.6%)	0.882
>10,000	552 (57.5%)	115 (56.9%)	667 (57.4%)	
Main income supporter for the family?				
Yes	549 (52.7%)	125 (53.2%)	674 (52.8%)	0.900
No	492 (47.3%)	110 (46.8%)	602 (47.2%)	
Relationship with their care recipients				
Spouse	296 (49.2%)	75 (33.2%)	371 (44.9%)	<0.001
Children, son/ daughter in law	247 (41.1%)	115 (50.9%)	362 (43.8%)	
Siblings	34 (5.7%)	16 (7.1%)	50 (6.0%)	
Others (relatives, grandchildren)	24 (4.0%)	20 (8.9%)	44 (5.3%)	
Willingness to send the care recipients to short-term aging care facility				
Yes	194 (30.5%)	14 (6.0%)	208 (24.0%)	<0.001
No	441 (69.5%)	218 (94.0%)	659 (76.0%)	
Lifestyle factor				
Exercise behavior				
Do not exercise	166 (15.9%)	43 (18.3%)	209 (16.4%)	0.480
Exercise, but not regularly	745 (71.6%)	168 (71.5%)	913 (71.6%)	
Regularly exercise	130 (12.5%)	24 (10.2%)	154 (12.1%)	
Smoking				
Yes	77 (7.4%)	27 (11.5%)	104 (8.2%)	0.038
No	964 (92.6%)	208 (88.5%)	1172 (91.8%)	
Alcohol consumption				
Yes	256 (24.6%)	80 (34.0%)	336 (26.3%)	0.003
No	785 (75.4%)	155 (66.0%)	940 (73.7%)	
Health status				
Hypertension				
Yes	288 (27.7%)	51 (21.7%)	339 (26.6%)	0.062
No	753 (72.3%)	184 (78.3%)	937 (73.4%)	
Diabetes				
Yes	124 (11.9%)	10 (4.3%)	134 (10.5%)	0.001
No	917 (88.1%)	225 (95.7%)	1142 (89.5%)	

Table 1. *Cont.*

	Residential Type			
	Traditional Village Community	**Private Housing Estate Community**	**Total**	***p*-Value**
Care recipients' characteristics				
Age, Mean (SD)	69.59 (8.42)	68.21 (7.42)	69.34 (8.26)	0.031
Sex				0.680
Male	445 (42.7%)	97 (41.3%)	542 (42.5%)	
Female	596 (57.2%)	138 (58.7%)	734 (57.5%)	
Diabetes				0.002
yes	211 (20.3%)	27 (11.5%)	238 (18.7%)	
no	830 (79.7%)	208 (88.5%)	1038 (81.3%)	
Hypertension				0.416
Yes	509 (48.9%)	108 (46.0%)	617 (48.4%)	
No	532 (51.1%)	127 (54.0%)	659 (51.6%)	
Dependency status, Mean (SD)	19.17 (2.81)	19.09 (2.79)	19.15 (2.81)	0.112
Dependency status in three categories				0.902
Mildly dependent to independent	227 (96.6%)	1008 (96.8%)	1235 (96.8%)	
Moderately dependent	5 (2.1%)	18 (1.7%)	23 (1.8%)	
Severely dependent	3 (1.3%)	15 (1.4%)	18 (1.4%)	
Willingness to stay at short-term aging care facility				<0.001
Yes	204 (32.1%)	28 (12.1%)	232 (26.8%)	
No	431 (67.9%)	204 (87.9%)	635 (73.2%)	

Note: SD: standard deviation, *p*-value calculated from Chi-square test and Mann–Whitney *U* test.

3.2. The Difference in the Burden Experienced by the Family Caregivers in Two Residential Types

The burden of the family caregiver is multidimensional. Family caregivers residing in traditional village communities experience a greater burden across the dimensions of time dependence (26.61%), developmental (15.56%), physical (22.12%), and emotional (19.69%) burden compared to those in private housing estate communities. The social burden was slightly higher in the private housing estate community group (13.62%). Overall, the high total burden was experienced more among the family caregivers of the traditional village community group (6.92%) compared to those in the private housing estate group (Figure 1).

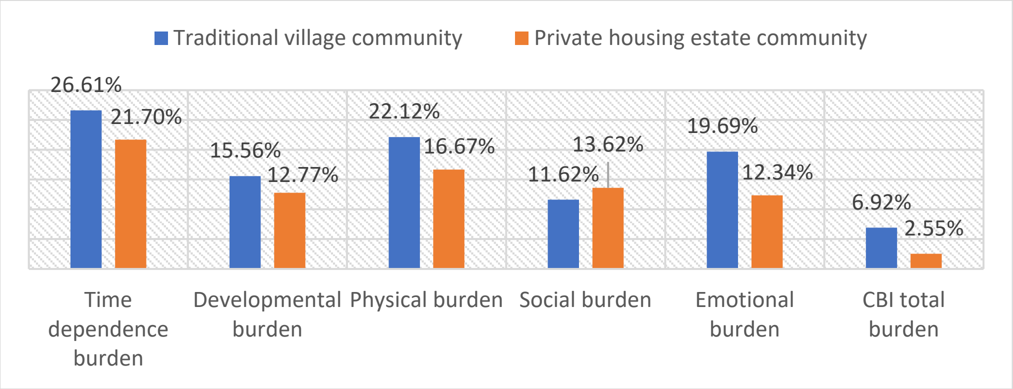

Figure 1. Percentage of family caregivers who experienced high burden (score > 24) by residential type in Chiang Mai, Thailand (N = 1276).

Moreover, the type of residential community significantly influences the overall caregiver burden experienced by family caregivers. Table 2 shows the MANOVA test results, which indicate the statistically significant differences in caregiver burden dimensions (time dependence, developmental, physical, emotional, and social burden) between the two types of residential areas (private housing estate and original village community). Additionally, adjusting for the age and sex of both caregivers and care recipients confirms that the observed differences are not solely due to demographic factors but are related to the type of residential area (Table 2).

Table 2. Difference in the caregiver burden experienced by the family caregivers of traditional village and private housing estate communities (N = 1276).

	Traditional Village Community	**Private Housing Estate Community**	**Total**	***p*-Value**
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
Time dependence burden	1.413 (3.430)	1.362 (3.779)	1.404 (3.495)	* <0.0001
Developmental burden	0.681 (2.036)	0.434 (1.317)	0.636 (1.926)	
Physical burden	1.112 (2.909)	0.686 (2.035)	1.034 (2.773)	
Emotional burden	0.812 (2.164)	0.545 (1.814)	0.763 (2.106)	
Social burden	0.505 (1.645)	0.532 (1.639)	0.510 (1.643)	
Total burden	4.523 (9.791)	3.559 (8.206)	4.345 (9.524)	# 0.015

Note: * MANOVA (adjusted for the age and sex of family caregivers and care recipients), # *p*-value from Mann–Whitney *U* test.

Additionally, the total caregiver burden was also statistically significantly different among family caregivers residing in the original village community and those in the private housing estate community ($p < 0.05$) (Table 2).

3.3. Association of Residential Type and Caregiver Burden

Context matters to the caregiving outcome. The binary logistic regression analysis showed that there is a statistically significant association between residential type and the likelihood of experiencing overall caregiver burden and emotional burden ($p < 0.05$) (Table 3).

Table 3. Association between housing type and family caregiver burden (N = 1276).

		Private Housing Estate Community	**Traditional Village Community**
Time dependence burden	OR (95% CI)	1	1.308 (0.932, 1.836)
Developmental burden	OR (95% CI)	1	1.259 (0.829, 1.913)
Physical burden	OR (95% CI)	1	1.420 (0.977, 2.060)
Social burden	OR (95% CI)	1	0.834 (0.549, 1.267)
Emotional burden	OR (95% CI) Adj. OR (95% CI)	1 1	1.742 (1.147, 2.645) * 1.607 (1.049, 2.462) *
Total burden	OR (95% CI) Adj. OR (95% CI)	1 1	2.836 (1.218, 6.603) * 2.743 (1.163, 6.471) *

Note: Adj. OR: Adjusted Odds Ratio. 95%CI: 95% confidential interval. The multiple logistic regression models for each outcome were adjusted for age, sex, educational background, marital status, the working status of the family caregiver, and age, and sex of the care recipients. * *p*-value < 0.05.

The emotional burden of family caregivers often refers to caregivers' negative feelings towards their care recipients. After adjusting for the confounders, family caregivers of the original community group were 1.607 times more likely to experience emotional burden (adj. OR 1.607, 95% CI: 1.049, 2.462) compared to those in the private housing estate group. Moreover, regardless of the socio-economic status of the family caregiver, and age and sex of the care recipients, they were 2.743 times more likely to experience overall caregiver burden (adj. OR: 1.163, 95% CI: 1.163, 6.471) (Table 3).

4. Discussion

The caregiving experience is intricately linked to its contextual surroundings [24]. While the literature extensively examines the social, cultural, and policy contexts, there is a noticeable gap in the exploration of the neighborhood context [25–28]. Residential settings can vary widely, from private housing estates to traditional village communities, each presenting unique challenges and resources for the family caregivers.

Our study results showed a statistically significant difference in the burden experienced by the family caregivers residing in different residential contexts (Table 2). Although most of the care recipients in this study were able to perform daily activities independently (Table 1), caregivers still experience burden at various levels and in different aspects (Table 2). Moreover, even accounting for potential confounding factors, caregivers residing in original village communities showed a significantly higher likelihood of experiencing a high caregiver burden compared to those in private housing estates (Table 3). This disparity highlights the complex interplay between residential environments and caregiver experiences, suggesting that factors essential to traditional village communities may contribute to increased caregiver burden. Socio-economic factors contribute to the informal caregiving outcome [29]. In this study, these factors could include the socio-demographic disparity among the family caregivers of traditional village communities, including older age, lower educational background, and higher prevalence of non-communicable disease (Table 1).

On the one hand, Bronfenbrenner's Theory of Human Ecology emphasizes reciprocal interaction between individuals and their environment [30]. The development and functioning of an individual are the result of the interaction between its micro (immediate surroundings), meso (neighborhood and institutional level and the physical environment), exo (the economic, political, and educational systems), macro (cultural and political ideologies) and chrono (socio-historical conditions and patterns of events and transitions over a life course) systems [30]. The caregiving outcome and experience are also the product of the interaction of all the above systems. On the other hand, according to Pearlin et al.s' stress process model, the caregiver burden is the subjective primary stressor, and it is influenced by the caregivers' socio-economic characteristics. The burden then directly and indirectly affects the physical and psychological health outcome of caregiving. And these can be mediated by the coping and social support of caregivers [31].

A supportive physical and social environment has a positive impact on caregivers [32,33]. The physical characteristics of the private housing estates in Thailand include security guards and walls, club services and amenities (vending machines, convenience store, laundromat, swimming pool, gym, and garden), and the economic status of its residents varied from low- to high-income class [13,17]. Studies showed that the burden experienced by family caregivers can be modified by access to leisure facilities [34]. Participation in leisure activities, for example, hobbies, and socializing, is a form of self-care that is important for the well-being of family caregivers by contributing to the coping capacity, and stress relief [35]. Private housing estate communities are equipped with a range of facilities and amenities that are not available in traditional village communities, and this can be one of the factors contributing to the lower burden experienced by family caregivers in private housing estate groups [36].

In this study, the family caregivers and the care recipients of the traditional village community were older (Table 1). The burden increases with age [7,37]. The age factor can contribute to the higher burden experienced by family caregivers of the original village community [38]. Marital status can also serve as a predictor of caregiver burden, with married caregivers often facing a higher likelihood of experiencing an elevated burden compared to those who are unmarried [39]. In this study, the proportion of married family caregivers was higher in the traditional village community group (Table 1). Drawing from role theory, which posits that individuals juggle various societal roles, the absence of adequate support and time for caregiving can lead to role overload and conflict [40]. Married caregivers may find themselves navigating the dual roles of spouse and caregiver, potentially increasing the burden they experience. The correlation between educational background and caregiver burden is varied. However, a lower educational background may pose a risk of experiencing a higher burden [41]. Some studies suggest that caregivers with higher education levels are also susceptible to experiencing higher burden [42]. The family caregivers in the private housing estate community had higher educational backgrounds, which might contribute to their coping capacity. The health state of the caregiver and care recipients is associated with the caregiving outcome as well [43,44]. The prevalence of diabetes and hypertension among the family caregivers and care recipients was higher in the traditional community group (Table 1). Managing their health while taking care of others can contribute to the higher burden. The above-mentioned socio-demographic factors have proven to be determinants of caregiver burden in the same study context in another study [7,12,45].

Another important factor is the cultural practice of hiring domestic workers (housekeepers, helpers, maids) in Thailand [46]. Although this study did not specifically investigate the role of domestic workers, it is common for affluent households to engage with their services. This is particularly prevalent in private housing estate communities. Moreover, caregivers of the original village community were more willing to use the short-term stay facility in the municipality (Table 1). Studies showed that the high burden of family caregivers and lower social resources contribute to the increased willingness to use respite care facilities [47,48]. These phenomena further demonstrate the disparities in accessible resources. Such disparities may potentially widen health inequalities among caregivers across various residential types, especially in countries with limited access to universally available formal long-term care systems. Therefore, innovative ideas for strengthening the existing family-based long-term care are necessary, like the "Community-Integrated Intermediary Care (CIIC) Service Model" to minimize the disparity of burden, and promote equity, fostering an environment where all caregivers receive equitable support, regardless of their residential setting [21].

The multidimensionality of the burden was observed among the study participants. High burden in time dependence, developmental, physical, emotional, and social burdens were observed among the family caregivers of traditional village community participants (Table 2, Figure 1), which highlighted the necessity for the support of family caregivers in multiple aspects. Common programs and interventions to reduce the caregiver burden include general education, support groups, behavior therapy, psychotherapy and counseling, and respite care [8]. Van Houtven CH et al. developed an organizational framework for caregiver interventions, which highlights major components including caregiver and care recipient characteristics (demographics, health, economics, insurance, relationship, and cultural norms), caregiving activities (skills, knowledge, psychological coping, support seeking, and time spent caregiving), caregiver outcomes (psychological and physical health, healthcare usage, and economic status), and care recipient outcomes (disease management, psychological and physical health, healthcare usage, respite care, and economic status) [49].

The strength of the study is the huge sample size and measurement of caregivers' burden by applying an internationally validated instrument. Sampling bias was prevented by inflating the sample size to compensate possible non-response by 20%. Possible confounders such as age and education were adjusted in multiple logistic regression analysis. However, this study is not without limitations. Firstly, due to the nature of the cross-sectional study design, a causal relationship between residential type and caregiver burden should be interpreted by the reader carefully. And the use of a binary variable for household income may not fully capture the economic realities of caregivers. Secondly, further research should explore factors such as available neighborhood resources and the social networks of older adults to better understand factors contributing to the disparity of burden experienced by the original village community and private housing estate communities. Moreover, as the prevalence of frailty and dementia increases with aging, future research aiming to assess the caregiver outcome and presence of frailty, cognitive impairment, and behavioral problems of the care recipients in different types of housing is also necessary. However, given the rapid demographic change of the aging population and the lack of a sustainable formal long-term care system, our study results provide valuable insights into the underlying mechanisms driving caregiver burden disparities and informs targeted interventions to reduce the burden on family caregivers.

5. Conclusions

Minimizing disparities in family caregiver burden is crucial for ensuring equitable access to care resources and promoting the well-being of both caregivers and older adults. Thailand, a country with universal health coverage for more than twenty years, is still preparing to establish long-term care services and a system to face the challenge of a forthcoming super-aging society very soon. The results of our study showed that caregivers of traditional village communities were more likely to experience a higher caregiver burden. When there are significant differences in the level of burden experienced by caregivers in different residential settings, these can intensify existing inequalities in health outcomes and access to support services. Caregivers' burnt-out and job losses challenge the sustainability of family-based long-term care. Moreover, older adults receiving care may also experience varying levels of quality and continuity of care depending on their caregivers' level of burden. The results of this study contribute insights to make evidence-based policies, interventions, and programs to lessen the disparities of burden experienced by the family caregivers, building a more equal and inclusive caregiving environment.

It is urgent to systematically introduce caregiver support through holistic approaches such as respite care, care competency training, financial support, social support, legislation for caregiver leave, psychological support for family caregivers and health promotion.

Author Contributions: N.M.: Conceptualization, Methodology, Formal Analysis, Writing—Original Draft, Visualization, Data Curation; M.N.A.: Conceptualization, Methodology, Validation, Investigation, Writing—Review and Editing, Supervision, Project Administration, Resources, Funding acquisition; S.M.: Resources, Writing—Review and Editing, Investigation; T.N.N.A.: Resources, Writing—Review and Editing, Investigation; Y.K.: Writing—Review and Editing; S.S.: Writing—Review and Editing; M.Y.: Conceptualization, Validation, Investigation, Writing—Review and Editing, Supervision. All authors have read and agreed to the published version of the manuscript.

Funding: This work "the Community Integrated Intermediary Care (CIIC) research project", TCTR20190412004, was supported by the WHO Centre for Health Development (WHO Kobe Centre—WKC: K18020).

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of The World Health Organization Ethical Review Committee: WHO/ERC ID; ERC. 0003064, dated 7 March 2019; and Ethical Review Committee for Research in Human Subjects: Boromarajonani College of Nursing Nakhon Lampang: Praboromarajchnok, Institute for Health Workforce Development, Ministry of Public Health, Thailand (approval number E 2562/005, dated 4 March 2019). It has been registered at the Thailand Clinical Trial Registry, trial registration number TCTR20190412004.

Informed Consent Statement: Written informed consent was obtained from all participants. The nature and purpose of this research were carefully explained to the participants, who were interviewed after their permission.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy reason.

Acknowledgments: The Juntendo Research Branding Project is acknowledged.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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European Journal of
Investigation in Health,
Psychology and Education

Article

Temporal Fluctuations of Suicide Mortality in Japan from 2009 to 2023 Using Government Databases

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Abstract: In Japan, suicide mortalities consistently decreased before the COVID-19 pandemic (from 2009 to 2019) but, conversely, increased after the pandemic outbreak from 2020 to 2022. To provide up-to-date suicide statistics in Japan, this study determined the temporal fluctuations of standardized suicide mortalities (SMRs), disaggregated by sex and age, by joinpoint regression analysis using the government suicide database, named the "Basic Data on Suicide in Region". From January 2009 to December 2023, three temporal fluctuation patterns of SMRs pertaining to working age and older adults were detected, such as attenuations of decreasing trends before the COVID-19 pandemic (from around the mid-2010s), a sharply increasing trend that coincided with the pandemic outbreak, and gradually decreased during the pandemic, but no changes at the end of the COVID-19 pandemic. In particular, the SMRs of working-age females sharply increased concurrently with the pandemic outbreak, whereas those of males did not change. However, before the pandemic, decreasing trends of the SMRs of working-age males diminished in the mid-2010s, but those of females consistently decreased. The SMRs of working-age males indicated non-significant but sharply increasing trends in early 2022, a trend that was not observed for females. In contrast to working-age adults, the SMRs of adolescents already began to increase in the mid-2010s and also indicated consistently increasing trends between the periods during and after the pandemic. These results suggest, contrary to our expectations, that the impacts of both the outbreak and end of the COVID-19 pandemic were limited regarding the increase in SMRs from 2020. Therefore, when revising suicide prevention programs in the post-COVID-19 era, it should be noted that focusing on pandemic-associated factors alone is not sufficient.

Keywords: suicide mortality; COVID-19; Japan; gender

Citation: Matsumoto, R.; Motomura, E.; Okada, M. Temporal Fluctuations of Suicide Mortality in Japan from 2009 to 2023 Using Government Databases. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 1086–1100. https://doi.org/10.3390/ejihpe14040071

Academic Editors: Nicola Magnavita and Keren Dopelt

Received: 29 March 2024
Revised: 15 April 2024
Accepted: 19 April 2024
Published: 21 April 2024

1. Introduction

From 2009 to 2019, suicide mortality in Japan consistently decreased [1–7]. The World Health Organization (WHO) developed the "Comprehensive Mental Health Action Plan" with the goal of reducing the global suicide mortality rate by 10% from 2012 to 2020 [8]. Japan successfully achieved a 20% reduction in standardized suicide mortality rates (SMRs) per 100,000 population, decreasing from 21.99 (2012) to 16.58 (2020) [9–13]; however, several time series analyses reported that SMRs in Japan began increasing from 2020 [14–17]. These reports speculated that the recent increase in SMRs in Japan might be caused by factors associated with the COVID-19 pandemic, since this increase was observed to coincide with the COVID-19 pandemic outbreak [18–25].

In the early phase of the COVID-19 pandemic, various reports concerned the possibility that suicides would increase due to socioeconomic and/or psychosocial deteriorations induced by the COVID-19 pandemic itself or several restriction measures for the prevention of spreading the COVID-19 [26–28]. Many findings have been considered to reflect these concerns, and, as such, increasing SMRs in Japan from 2020 have been accepted as a phenomenon caused by the COVID-19 pandemic. However, to date, the majority of studies have reported that suicide rates decreased or remained unchanged in major Organization for Economic Co-operation and Development (OECD) countries during the pandemic, except for Japan, South Korea and Spain [16,17,29–35].

It has been reported that the impacts of the COVID-19 pandemic were not uniform, with specific vulnerable groups being uniquely affected [14,15,36–39]. In particular, lifestyle changes, including opportunities for education, coping with stress and the lack of recreation opportunities caused by social restriction measures and the rise in unemployment induced by economic deterioration could have contributed to increasing suicidal risks for some vulnerable individuals, such as the elderly/younger generation, psychiatric patients, unemployed individuals and healthcare workers [36–38]. The high-risk groups for suicides during the COVID-19 pandemic in Japan have been identified to be males <30 and females <60 years [14–17,23,40,41]. In particular, temporal fluctuations in the SMRs of these high-risk groups sharply increased with the COVID-19 pandemic outbreak, and SMRs increased up to 2021 [14,15,38]. Similar to Japan, the increasing suicide rates of working-age females during the initial stage of the COVID-19 pandemic were also reported in Spain and South Korea [33–35]. The actual mechanisms underlying the increasing SMRs of high-risk groups in Japan remain to be clarified; however, a number of reports concluded that this increase during the COVID-19 pandemic involved some factors associated with the pandemic itself, such as socioeconomic or psychosocial deteriorations [13,19–22,42–45].

In May 2023, the WHO and Japanese government declared the end of the COVID-19 pandemic [46,47]. Analyzing fluctuations in SMRs, disaggregated by age and sex, can provide important findings to help plan suicide prevention programs after the COVID-19 pandemic era. The actual causes of increasing SMRs from 2020 in Japan remain to be clarified. Although the actual causes of increasing SMRs from 2020 in Japan remained to be clarified, where SMRs recovered after the end of the COVID-19 pandemic, we should explore the specific factors that exacerbated and improved respective during and after the pandemic, for evidence-based planning for suicide prevention programs for the post-COVID-19 pandemic era. Conversely, where the high levels of SMRs during the pandemic persisted after the end of the pandemic, the recent increasing SMRs in Japan might be induced by the other factors that coincidentally developed with the pandemic outbreak. Furthermore, we should also pay attention to the possibility that the suicidal risk which developed with the COVID-19 pandemic outbreak could not be improved after the end of the pandemic. Based on these possibilities, in order to clarify the fluctuations of SMRs disaggregated by age and sex before, during and after the COVID-19 pandemic, the present study determined the temporal fluctuations of SMRs disaggregated by sex and age from January 2009 to December 2023 in Japan using joinpoint regression analysis.

2. Materials and Methods

2.1. Data Sources

The Japanese government has two national suicide databases, the "Vital Statistics Registration" (VSR), collected by the Ministry of Health, Labor and Welfare (MHLW) [9,48,49], and the "Suicide Statistics" (SSNPA), collected by the National Police Agency (NPA) [50]. The VSR publishes a complete coverage of all Japanese deaths that have occurred in Japan, with the cause of death coded by ICD-10, and it has currently published suicide statistics up to 2019. In Japan, only medical doctors can prepare death certificates, and the Medical Practitioners Law stipulates that abnormal deaths, including probable suicides, must be reported to the NPA within 24 h. The NPA must examine all corpses with abnormal causes of death to determine the cause of death by conducting physiological examinations [50]. The SSNPA provides data on the number of individuals who have died by suicide in each region under the jurisdiction of local police stations. The judicial police investigate the personal characteristics and background factors of each suicide case [50]. The MHLW provides the "Basic Data on Suicide in Region" (BDSR) for public access, which is a compilation of SSNPA data organized into detailed categories, such as sex, age, nationality and dwelling place [51]. The monthly suicide numbers from January 2009 to December 2023, disaggregated by sex (males and females) and age (<20, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79 and >80 years old), were obtained from the BDSR provided by the MHLW [51]. Populations disaggregated by sex and age were obtained from the "Surveys of Population, Population Change and the Number of Households based on the Basic Resident Registration" published in e-Stat (Ministry of Internal Affairs and Communications) [52].

Monthly SMRs disaggregated by sex and age were calculated by dividing the monthly suicide numbers by the population of the corresponding groups in the same year [40]. Finally, the monthly SMRs were converted to annualized values for 365 days.

2.2. Statistical Analyses

Joinpoint regression and interrupted time series analyses are well-established time series statistical methods used for analyzing temporal fluctuations in SMRs. As has been noted, suicide is a temporally and fundamentally complicated phenomenon comprising various risk factors [16,20,23,32,40,41,53]. Interrupted time series analysis is known as one of the most effective/powerful statistical methods for detecting the impacts of the COVID-19 pandemic outbreak on SMRs via the correlation between the periods before and after the pandemic outbreak [13,22,54–56]. Interrupted time series analysis can incorporate various options, including parametric/non-parametric regressions, seasonal variation and panel data analyses [15,54–56], but it cannot detect unknown joinpoints (changing trends periods) during observation periods. Indeed, previous reports have suggested, when the intervention is set at the COVID-19 pandemic outbreak alone, interrupted time series analysis tends to overestimate the positive impacts of the pandemic outbreak on SMRs due to the attenuation of decreasing trends of male SMRs before the pandemic (in the late 2010s) [15,23,39,41]. In contrast, joinpoint regression analysis has been evaluated to be an appropriate statistical method, which can detect unknown joinpoints, where trends change via fitting the simplest joinpoint model that the trend data allow [57,58]. Based on these statistical backgrounds, to analyze the temporal fluctuations in SMRs in Japan from January 2009 to December 2023, this study adopted Joinpoint Regression Program ver4.9.1.0 (the National Cancer Institute, Bethesda, Maryland) [16,17,40,58]. A detailed description of the methods used in the Joinpoint Regression Software is given in the user manual published by the National Cancer Institute (NCI).

2.3. Ethics

The funding source of this study helped to define the research questions and assisted with data interpretation, but it had no role in the model development, parameterization or the methodological aspects of the study. Although the Medical Ethics Review Committee of Mie University waived the need for ethical approval due to the use of publicly available governmental data, this study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. There are no missing data in this study.

3. Results

3.1. Fluctuation in SMRs from 2009 to 2023

Two joinpoints were detected in the temporal fluctuations in the SMRs of males + females between January 2009 and December 2023. The SMRs of males + females decreased significantly from January 2009 to January 2017, but this reversed from February 2017 to September 2022. From October 2022 to December 2023, the SMRs of males + females began to significantly decrease again (Figure 1 and Table 1).

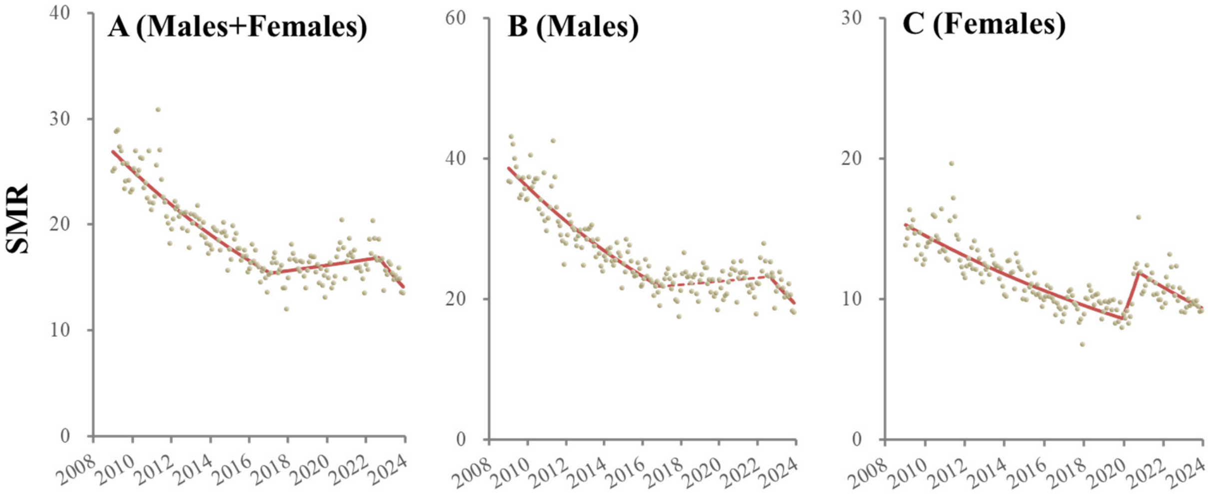

Figure 1. Temporal fluctuation of SMRs of males + females (**A**), males (**B**) and females (**C**) from January 2009 to December 2023 in Japan analyzed using joinpoint regression analysis. Ordinate and abscissa indicate the annualized monthly SMRs (per 100,000 population) and years, respectively. Grey circles indicate the observed monthly SMR values. Red lines indicate the results calculated by joinpoint regression analysis. Solid and dotted red lines indicate the significant and non-significant trends of SMRs, respectively.

Table 1. Summary of temporal fluctuation of SMRs of males + females, males and females.

	Lower Endpoint	Upper Endpoint	MPC	*p*	
Male + Female	2009/1	2017/1	−0.57	<0.01	**
	2017/2	2022/9	0.14	0.01	*
	2022/10	2023/12	−1.19	0.02	*
Male	2009/1	2016/12	−0.60	<0.01	**
	2017/1	2022/9	−0.01	0.07	
	2022/10	2023/12	−1.15	0.02	*
female	2009/1	2019/12	−0.43	<0.01	**
	2020/1	2020/10	3.24	<0.01	**
	2020/11	2023/12	−0.62	<0.01	**

MPC: estimated Monthly Percent Change by joinpoint regression analysis, * $p < 0.05$, ** $p < 0.01$.

Two joinpoints of male SMRs during the observation period were also detected. Male SMRs decreased from January 2009 to December 2016 but did not significantly change from January 2017 to September 2022. Similar to the SMRs of males + females, after October 2022 to December 2023, male SMRs significantly decreased (Figure 1 and Table 1).

Two joinpoints of female SMRs that were, critically, dissimilar to those of males, were also detected. Female SMRs decreased from January 2009 to December 2019, but they significantly and sharply increased from January 2020 to October 2020 and significantly decreased from November 2020 to December 2023 (Figure 1 and Table 1).

3.2. Fluctuations in Male SMRs Disaggregated by Age from 2009 to 2023

The male SMR for those aged <20 did not change until March 2016, but after April 2016, it consistently increased (Figure 2 and Table 2). The SMR for males aged 20–29 decreased from January 2009 to November 2019, but it significantly and sharply increased from December 2019 to September 2020 and significantly decreased from October 2020 to December 2023 (Figure 2 and Table 2). The SMR for males aged 30–39 decreased from January 2009 to October 2016 but reversed to significantly increase from November 2016 to April 2021 and then significantly decreased from May 2021 to December 2023 (Figure 2 and Table 2). The SMR for males aged 40–49 decreased from January 2009 to November 2016. It did not significantly change from December 2016 to December 2021 but non-significantly sharply increased (from January 2022 to March 2022) and significantly decreased from April 2022 to December 2023 (Figure 2 and Table 2). The SMR for males aged 50–59 consistently decreased from January 2009 to November 2013, but the decreasing trends attenuated from December 2013. Non-significant but sharply increasing trends from January 2022 to April 2022 were observed followed by a significant decrease from May 2022 to December 2023 (Figure 2 and Table 2). The SMR for males aged 60–69 also consistently decreased from January 2009 to January 2022, but the decreasing trends attenuated from October 2016. A non-significant but sharp increase from February 2022 to April 2022 was also observed, followed by a significantly decreasing trend from May 2022 to December 2023 (Figure 2 and Table 2). The SMR for males aged 70–79 consistently decreased during the observation period, but the decreasing trends attenuated from March 2017 (Figure 2 and Table 2). The SMR for males over 80 consistently decreased from January 2009 to January 2022. A non-significant but sharp increase from February 2022 to July 2022 was observed, followed by a significantly decreasing trend from August 2022 to December 2023 (Figure 2 and Table 2).

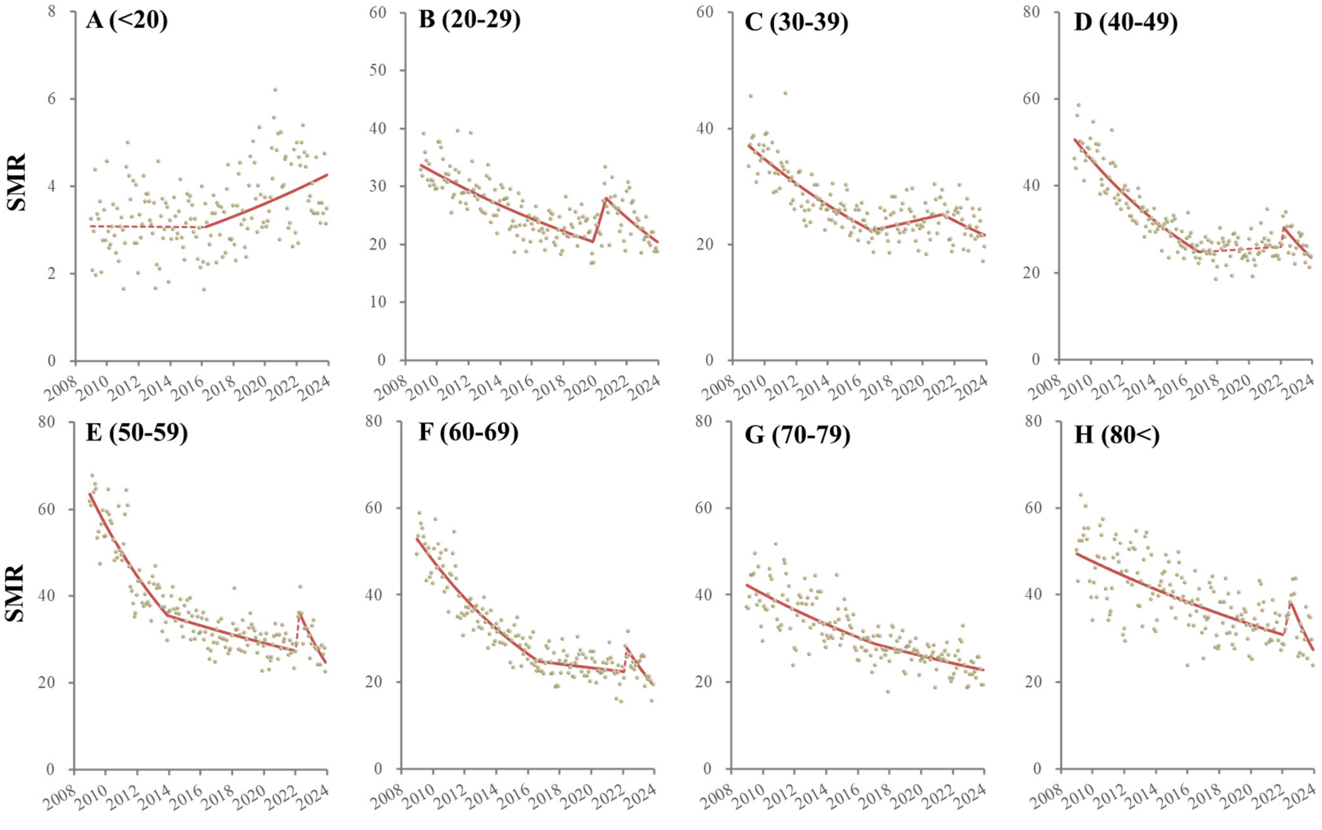

Figure 2. Temporal fluctuation of males SMRs disaggregated by age, such as younger than 20 (<20: (**A**)), 20–29 (**B**), 30–39 (**C**), 40–49 (**D**), 50–59 (**E**), 60–69 (**F**), 70–79 (**G**) and over 80 years (80<: (**H**)) from January 2009 to December 2023 in Japan analyzed using joinpoint regression analysis. Ordinate and abscissa indicate the annualized monthly SMRs (per 100,000 population) and years, respectively. Grey circles indicate the observed monthly SMR values. Red lines indicate the results calculated by joinpoint regression analysis. Solid and dotted red lines indicate the significant and non-significant trends of SMRs, respectively.

Table 2. Summary of temporal fluctuation of SMRs disaggregated by age and sex.

Age	(Males)	Lower Endpoint	Upper Endpoint	MPC	*p*		(Females)	Lower Endpoint	Upper Endpoint	MPC	*p*	
<20		2009/1	2016/3	−0.01	0.93			2009/1	2014/12	−0.45	0.01	*
		2016/4	2023/12	0.35	<0.01	**		2015/1	2023/12	0.07	<0.01	**
								(2020/4)		0.27 (jump)	<0.01	**
20–29		2009/1	2019/11	−0.38	<0.01	**		2009/1	2016/8	−0.65	<0.01	**
		2019/12	2020/9	3.16	0.04	*		2016/9	2019/12	0.41	009	
		2020/10	2023/12	−0.80	<0.01	**		2020/1	2020/11	4.38	0.04	*
								2020/12	2023/12	−0.66	<0.01	**
30–39		2009/1	2016/10	−0.54	<0.01	**		2009/1	2019/12	−0.55	<0.01	**
		2016/11	2021/4	0.22	0.04	*		2020/1	2020/10	4.72	0.02	*
		2021/5	2023/12	−0.48	0.03	*		2020/11	2023/12	−0.83	<0.01	**
40–49		2009/1	2016/11	−0.76	<0.01	**		2009/1	2019/12	−0.47	<0.01	**
		2016/12	2021/12	0.08	0.29			2020/1	2020/10	4.00	0.03	*
		2022/1	2022/3	8.17	0.48			2020/11	2023/12	−0.88	<0.01	**
		2022/4	2023/12	−1.23	<0.01	**						
50–59		2009/1	2013/11	−0.98	<0.01	**		2009/1	2020/4	−0.32	<0.01	**
		2013/12	2022/1	−0.27	<0.01	**		2020/5	2020/8	16.59	<0.01	**
		2022/1	2022/4	9.81	0.56			2020/9	2023/12	−0.47	0.01	*
		2022/5	2023/12	−1.90	<0.01	**						
60–69		2009/1	2016/9	−0.82	<0.01	**		2009/1	2020/2	−0.59	<0.01	**
		2016/10	2022/1	−0.16	0.05	*		2020/2	2020/9	3.02	0.14	
		2022/2	2022/4	11.44	0.44			2020/9	2023/12	−0.64	<0.01	**
		2022/5	2023/12	−1.78	<0.01	**						
70–79		2009/1	2017/2	−0.39	<0.01	**		2009/1	2020/5	−0.43	<0.01	**
		2017/3	2023/12	−0.28	<0.01	**		2020/7	2020/7	9.47	0.79	
								2020/7	2023/12	−0.91	<0.01	**
>80		2009/1	2022/1	−0.30	<0.01	**		2009/1	2020/4	−0.55	<0.01	**
		2022/2	2022/7	4.56	0.55			2020/4	2020/7	5.08	0.83	
		2022/8	2023/12	−1.98	0.01	*		2020/7	2023/12	−0.60	<0.01	**

MPC: estimated Monthly Percent Change by joinpoint regression analysis, * $p < 0.05$, ** $p < 0.01$, (jump): fluctuation of female SMR under 20 years was analyzed using jump model of joinpoint regression analysis (set at the COVID-19 pandemic outbreak in Japan, April 2020).

3.3. Fluctuations in Female SMRs Disaggregated by Age from 2009 to 2023

The SMR for females aged < 20 decreased from January 2009 to December 2014, but after January 2015, it increased. In particular, the SMR for females aged < 20 sharply increased with the COVID-19 pandemic outbreak (Figure 3 and Table 2).

The SMR for females aged 20–29 decreased from January 2009 to August 2016, but this changed, non-significantly increasing from September 2016 to December 2019. However, the period January 2020 to November 2020 indicated a significant and sharp increase in the SMR followed by a significantly decreasing trend from December 2020 to December 2023 (Figure 3 and Table 2). The SMR for females aged 30–49 consistently decreased from January 2009 to December 2019, but it significantly and sharply increased with the pandemic outbreak (from January 2020 to October 2020), which was followed by a significant decrease from November 2020 to December 2023 (Figure 3 and Table 2). The SMRs of females aged 50–59 consistently decreased from January 2009 to April 2020 but significantly and sharply increased with the pandemic outbreak (from May 2020 to August 2020). This was followed by a significantly decreasing trend from September 2020 to December 2023 (Figure 3 and Table 2). The SMRs of females aged > 60 also indicated consistently decreasing trends during the observation period, whereas non-significant but sharply increasing trends were observed with the pandemic outbreak (Figure 3 and Table 2).

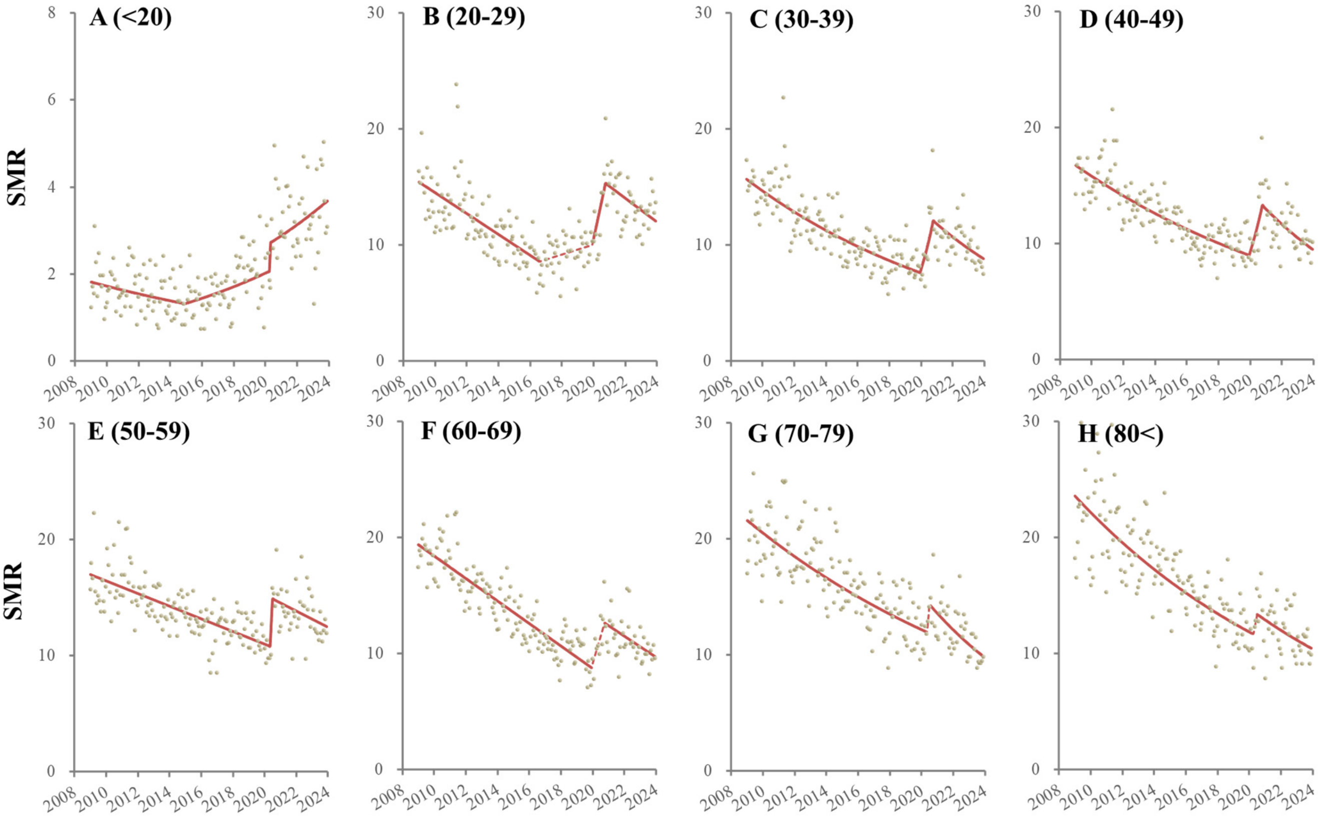

Figure 3. Temporal fluctuation of male SMRs disaggregated by age, such as younger than 20 (<20: (**A**)), 20–29 (**B**), 30–39 (**C**), 40–49 (**D**), 50–59 (**E**), 60–69 (**F**), 70–79 (**G**) and over 80 years (80<: (**H**)) from January 2009 to December 2023 in Japan analyzed using joinpoint regression analysis. Ordinate and abscissa indicate the annualized monthly SMRs (per 100,000 population) and years, respectively. Grey circles indicate the observed monthly SMR values. Red lines indicate the results calculated by joinpoint regression analysis. Solid and dotted red lines indicate the significant and non-significant trends of SMRs, respectively.

4. Discussion

Using joinpoint regression analysis, this study revealed the age- and sex-dependent temporal fluctuation patterns of suicide mortalities from January 2009 to December 2023 in Japan. In general, the SMRs of males aged 20–29 and females aged 30–59 consistently decreased before the COVID-19 pandemic outbreak, but they sharply increased with the outbreak and decreased between the period during and after the COVID-19 pandemic. Notably, we did not observe a change in the SMRs of these high-risk groups that coincided with the end of the COVID-19 pandemic. The SMRs of females over 60 years of age also consistently decreased before the COVID-19 pandemic outbreak but non-significantly and sharply increased with the pandemic outbreak; this was followed by a decrease between the period during and after the COVID-19 pandemic. On the contrary, the decreasing trends of SMRs of working-age (30–69) males attenuated from the mid-2010s. The SMRs of males aged 40–69 did not indicate changes with the COVID-19 pandemic outbreak, but they non-significantly and sharply increased in early 2022 and decreased between the period during and after the pandemic. The trends of SMRs of males and females < 20 began to increase before the pandemic outbreak (in mid 2010s); however, the SMR of females < 20 sharply increased with the COVID-19 pandemic outbreak, whereas the SMR of males < 20 did not respond to the pandemic outbreak. Contrary to our expectations, we did not detect any decreasing SMRs with the end of the pandemic. Therefore, the temporal fluctuation patterns of the SMRs of males younger than 30 and all females were similar to the results of previous reports that analyzed fluctuations from 2009 to 2022 using joinpoint regression analysis [14,15,39]; however, the non-significantly but sharply (transiently) increasing SMRs of working-age males in early 2022 possibly contributed to the tendency of previous reports to underestimate the decrease in SMRs in late 2022 [14,15,39].

4.1. Suicides among Adolescents and the Elderly

Between 2009 and 2021, suicide was the leading cause of death among adolescents in Japan [59,60]. Although suicide rates among adolescents have globally been increasing over time, most studies from other OECD countries have reported that adolescent SMRs decreased or remained unchanged during the pandemic [61–65], whereas in Japan, it has been reported that the SMRs of both males and females under 20 years old increased during the pandemic [39–41,66,67]. These reports attributed the increase in adolescent SMRs to major lifestyle changes during the pandemic, particularly pertaining to the impaired ability to engage in recreational and educational opportunities and being forced to spend much of their time at home due to social restriction measures [39–41,66,67]. In contrast, several reports have suggested that the adolescent SMRs of both males and females in Japan had already begun to increase before the pandemic outbreak [16,17,23,40,41]. This study not only substantiated that the SMRs of the generation aged < 20 had begun to increase before the pandemic but also identified that the COVID-19 pandemic outbreak was probably not a primary cause for increasing SMRs for those aged < 20.

Adolescence is a period of psychosocial and biological development that involves various social stages (e.g., middle school, high school, university, special vocational school and work) [68]. A recent study, focusing on evidence-based policy making, suggested that recently increasing adolescent SMRs in Japan may be the result of national suicide prevention programs for young populations in the “General Principles of Suicide Prevention Policy”, which place too much emphasis on making improvements in schools and relatively less on improving home environments, which play a key role in child rearing [39,41]. The primary causes of student SMRs were found to be worrying about the future and underachievement (in school-related problems) and mental illness (depression and anxiety disorders) [40,41]. Considering that the onset of internalizing disorders is at approximately 15 years of age, internalizing symptoms have likely played important roles in the recently increasing SMRs among adolescents [40,41,69,70]. Indeed, the prevalence of internalizing disorders among adolescents has been increasing in Japan [71]. Although it may be excessive over discussion, the decreasing birth rates may contribute to increasing internalizing symptoms [39,41]. Progressively decreasing birth rates have continuously increased for children without siblings, with rates of >20% in 1997 and >30% in 2015 [72,73].

In the past, emergence of second child/siblings had been argued to contribute to developmental crisis for firstborn children by earlier psychodynamics [74,75]; however, firstborn children with siblings display positive or regular responses, appear to quickly adapt to new tasks and express more positive emotions and fewer separation reactions and dependent behaviors in comparison to only children [76–82]. Additionally, parents tend to adopt strategies of high care and/or high control when raising an only child [40,41,74,75]. It has been established that low-care parenting attitudes negatively affect developmental models regarding the competent/worthy self-model and reliable/supportive relationships with others, with persistence to adolescence, resulting in increasing risks of internalizing disorders and suicide [83–92]. However, excessive high-control parenting also plays an important role in the depressive mood and feelings of hopelessness among students [93]. Furthermore, mothers with internalizing symptoms/disorders tend to adopt affectionless control styles (low care with high control) [93]. These psychological findings suggest the possibility that maternal internalizing symptoms/disorders and high-control parenting may induce a vicious negative cycle that increases the prevalence of internalizing disorders in later generations [41].

Aging is not only biological, but also a social/cultural phenomenon affected by ethnicity, class, gender and the political and economic climate [94]. According to the stages of psychosocial development, elderly is placed in the last stage, that of ego integrity or despair [95]. Globally, the SMRs of the elderly are higher than those of the younger generation [96]. Despair, loneliness and the death of a meaningful person or spouse may be suicide risk factors among the elderly [97]. Regarding the elderly living alone, possibilities of both economic poverty and healthcare vulnerability emerge [35]. However, it is noteworthy that SMRs among the elderly have not increased in some countries, such as Spain, South Korea and Japan, where SMRs among other age groups increased during the COVID-19 pandemic [16,17,33–35]. The findings regarding the consistently decreasing SMR trends of the elderly in Japan before, during and after the COVID-19 pandemic suggest that the impacts of changes in community/society environments for the elderly might be smaller than expected.

4.2. Suicide in Working-Age Females

Various studies have revealed that working-age females were a high-risk group for suicide during the pandemic [13,15–19,21–23,25,40–45]. This study also demonstrated that female SMRs for those under 60 sharply increased with the COVID-19 pandemic outbreak, whereas the ending of the pandemic did not affect them. On the contrary, the fluctuation in female SMRs for those over 60 years old related to neither the outbreak nor the ending of the pandemic. Furthermore, other than one sharp increase synchronized with the pandemic outbreak, the trends of female SMRs for those over 30 years old consistently decreased overall in the observation period. These common temporal fluctuations in female SMRs for those over 30 suggest that some kind of turmoil in the initial stage of the COVID-19 pandemic, rather than the pandemic itself, may have contributed to the increase in the SMRs of females over 30.

It is well known that the overall unemployment rates in Japan drastically increased with the COVID-19 pandemic outbreak, which was followed by a recovery [15–17]. Based on the similarity between the SMRs of working-age females and the overall unemployment rates in Japan during the pandemic, several studies have found links between them [15–17]. Before the pandemic outbreak, the positive fixed effects of unemployment rates on female SMRs could be detected, whereas this relation was abolished during the pandemic [16,17]. Unexpectedly, the increasing rates of short-term unemployment (shorter than three months of unemployment) contributed to increasing female SMRs, but relatively longer-term unemployment did not [15–17]. Traditionally, unemployment due to recessions has been established as a major risk for suicide; however, the impact of unemployment on male suicide has received more attention [98–102]. It is well known that SMRs showed a drastic increase during the Asian financial crisis, and female SMRs also increased by approximately 20%, from 12.4 (1997) to 15.3 (1998) [11,100–103]. In this study, it was shown that female SMRs in 2020 (10.74) increased by approximately 10% compared to 2019 (9.27). Therefore, the impacts of increasing shorter-term unemployment among females was at least partially involved in the sharp increase in the SMRs of working-age females.

4.3. Suicide in Working-Age Males

The temporal fluctuations in the SMRs of working-age males indicated quite different patterns to those of females, since a sharp increase in the SMRs of working-age males coinciding with the COVID-19 pandemic outbreak was not observed. However, in early 2022, the SMRs of males aged 40–69 non-statistically but sharply increased. Despite the statistical characterization of joinpoint regression analysis, which detects the transformation of trends through fitting the simplest joinpoint model, it could not detect the transiently increasing trends in early 2022 as a significant change. Therefore, considering the causes for transient increases in the SMRs of working-age males may provide important insights into exploring the mechanisms of suicide among working-age males.

The transiently increasing trend in early 2022, while not statistically significant, was a common phenomenon among the SMRs of working-age males. Previous context can provide two potential causes underlying this sharp increase. The first is an increase in unemployment rates with specific features that selectively affected the SMRs of working-age males. The fluctuations in the total overall unemployment rate indicated consistently and linearly decreasing trends before the COVID-19 pandemic, such as from 5.5% to 2.5% in 2010–2019, whereas unemployment rates sharply increased concurrently with the pandemic outbreak to >3.0% and gradually decreased during the pandemic [15,104]. However, the peak of increasing unemployment rates for over 12 months lagged to 2021 [104]. Unemployment rates for over 12 months specifically contributed to increasing SMRs of working-age males, and their positive impacts continue over 1 year, whereas unemployment rates shorter than 6 months did not significantly relate to male SMRs [15]. Therefore, the temporal positive impacts of unemployment rates lasting over 12 months on the SMRs of working-age males can provide a plausible explanation for the causes of the transient increases in the SMRs of working-age males in early 2022.

Moreover, the revision of various government supportive countermeasures against the economic deterioration caused by COVID-19 in December 2021 [105] may have been a possible factor for the transiently increasing SMRs of working-age males, which was followed by an immediate recovery in early 2022. The government's supportive countermeasures against economic deterioration caused by COVID-19 were composed of two financial support systems categorized for enterprises and individuals. In December 2021, the government's supportive countermeasures for enterprises, such as the "Sustainability Benefit", were revised to the "Business Revitalization Support Fund", whereas the government implementation of support for individuals related to COVID-19 was continued until May 2023 in the form of "COVID-19 leave support payments and subsidies" [105]. During the COVID-19 pandemic, the governmental welfare and economic support measures had to be revised due to the various changing situations caused by COVID-19. The government's supportive countermeasures for enterprises were evaluated to be consistently effective during the COVID-19 pandemic, since the number of bankruptcies during the pandemic did not increase compared to before the COVID-19 pandemic [106]. Therefore, it is possible to deny that the revision of government supportive countermeasures for enterprises in December 2021 led to subsequent socioeconomic deterioration. Indeed, transiently and sharply increasing SMRs of working-age males in the early 2022 were immediately recovered.

Recently, it has been suggested that some vulnerable individual groups might have perceived the rapidly changing socioeconomic and political changes during the pandemic as anomic shock [107–110], contributing to a sharp and transient increase in suicides, which deviated from previous trends [39]. Durkheim conceptualized the anomic suicide theory; namely, that in both economic recessions and booms, social systems are unable to sufficiently adapt to individual needs, leading to increasing suicides via weakened social integration [108–110]. In reality, the outbreak and end of the COVID-19 pandemic and/or social restriction measures had heterogeneous psychological effects [111]. Early in the pandemic, individuals suffered from stress due to the forced drastic changes in lifestyle and social systems. Indeed, the increasing SMRs of males aged 20–29 and females < 60 years of age sharply increased after the pandemic outbreak [14–16]. The revision of government economic supportive measures from providing compensation for social restriction measures to supporting economic resumption, implemented in late 2022, might be interpreted/perceived to have forced individuals to adapt to the "new normal" in the post-COVID-19 pandemic era, manifesting as anomic shock.

Providing an update regarding the fluctuation in suicide mortality in Japan, this study analyzed temporal fluctuations in SMRs disaggregated by sex and age, but it could not analyze any causalities regarding the detected fluctuations due to the delayed publication of several independent variables necessary to carry this out.

5. Conclusions

This study demonstrated that the responses of SMRs in Japan to the onset and end of the COVID-19 pandemic, disaggregated by age and sex, were completely inconsistent. The SMRs of females under 60 years old sharply increased with the pandemic outbreak, whereas any changes in the SMRs of high-risk groups at the end of the pandemic could not be detected. Contrary to females, none of the male SMRs (other than the SMRs of males aged 20–29) indicated any changes in fluctuations that correlated with the COVID-19 pandemic outbreak. Additionally, no changes in male SMRs related to the end of the COVID-19 pandemic could be observed. However, the SMRs of working-age (40–69) males non-significantly but sharply increased with the revision of the government's supportive countermeasures that were implemented to mitigate the economic deterioration caused by COVID-19 (in early 2022). Therefore, the impact of the COVID-19 pandemic on the increase in suicides in Japan since 2020 has been limited. When planning suicide prevention programs after the post-COVID-19 era, in response to the recent increase in suicides in Japan, it should be noted that focusing on pandemic-associated factors alone is not sufficient.

Author Contributions: M.O. conceptualized the study, contributed to the study design and methodology, drafted and re-viewed the manuscript. R.M. contributed to the study design and methodology, verified the underlying data, performed the statistical analysis and generated figures, drafted and reviewed the manuscript. E.M. contributed to the study design and methodology, coordinated extraction of the data. All authors have read and agreed to the published version of the manuscript.

Funding: This study is supported by Japan Society for the Promotion of Science (23K06987) and Regional Suicide Countermeasures Emergency Enhancement Fund of Mie Prefecture (2023-40). The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

Institutional Review Board Statement: The Medical Ethics Review Committee of Mie University waived the need for ethical approval due to the use of publicly available governmental data.

Informed Consent Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Data Availability Statement: All raw data are publicly available to any persons via Japanese national databases from the "Basic Data on Suicide in the Region" (BDSR) in MHLW (https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000140901.html) (accessed on 31 January 2024) and "Surveys of Population, Population Change and the Number of Households based on the Basic Resident Registration" in e-Stat (MIAC) (https://www.e-stat.go.jp/en/statistics/00200241) (accessed on 31 January 2024).

Conflicts of Interest: The authors declare no conflicts of interest.

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European Journal of
*Investigation in Health,
Psychology and Education*

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Article

A Step Forward in Long COVID Research: Validating the Post-COVID Cognitive Impairment Scale

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Abstract: Long COVID, or post-acute sequelae of SARS-CoV-2 infection, includes a variety of enduring symptoms that endure beyond the acute phase of the illness, impacting multiple facets of patients' psychological and physical health. The persistent symptoms encompass fatigue, breathing difficulties, musculoskeletal pain, and cognitive impairments, which can significantly affect daily functioning and overall quality of life. The objective of this study was to create and validate the accuracy of the Post-COVID Cognitive Impairment Scale, which is used to evaluate cognitive impairments resulting from a COVID-19 infection. This study was conducted in Iran between January and September 2023. It consisted of three phases: developing the scale, evaluating its content validity with experts, and validating its structure with 454 participants using exploratory and confirmatory factor analysis. The exploratory factor analysis revealed two variables, namely memory and attention, which accounted for 40.38% of the variation. Confirmatory factor analysis verified the model's fit, with indices indicating satisfactory alignment: CMIN/DF = 2.80, RMSEA = 0.06, SRMR = 0.05, CFI = 0.93, and TLI = 0.92. The factor loadings were statistically significant ($p < 0.001$), and Cronbach's Alpha values indicated strong internal consistency (working memory = 0.81, attention = 0.80). These results affirm the Post-COVID Cognitive Impairment Scale is a valid and reliable instrument for evaluating cognitive deficiencies in individuals with long COVID. Its application in clinical and research environments aids in the prompt detection and tracking of the treatment of such impairments.

Keywords: long COVID; cognitive impairment; post-COVID syndrome; memory; attention; neuro-long COVID

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Citation: Pour Mohammadi, S.; Etesamipour, R.; Mercado Romero, F.; Peláez, I. A Step Forward in Long COVID Research: Validating the Post-COVID Cognitive Impairment Scale. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 3001–3018. https://doi.org/10.3390/ejihpe14120197

Academic Editors: Africa Martos Martínez and Keren Dopelt

Received: 21 August 2024
Revised: 18 November 2024
Accepted: 27 November 2024
Published: 1 December 2024

1. Introduction

After the pandemic had been going on for more than three years, the Emergency Committee on COVID-19 of the World Health Organization (WHO) submitted a recommendation in May 2023 stating that the pandemic was no longer considered a public health emergency of international concern [1]. Although the acute phase of COVID-19 has decreased, the persistent consequences of the virus are still ongoing. A study found that 68.7% of non-hospitalized COVID-19 patients experienced post-acute sequelae within 30 days of infection, with some symptoms persisting for 12 weeks or more [2–4].

The enduring ramifications of SARS-CoV-2 infection are becoming increasingly concerning.

A considerable proportion of patients who have recuperated from the virus encounter enduring symptoms, a condition now often referred to as "long COVID." The persistent symptoms, known as "post-acute COVID-19", "post-COVID-19 syndrome", or "post-COVID-19 condition", have been clinically termed "post-acute sequelae of COVID-19", (PASC) [5] by the National Institutes of Health. This condition provides a new public health challenge that requires immediate attention and comprehensive understanding [6–8].

The most debilitating symptoms associated with long COVID include fatigue [9,10], cognitive impairments—commonly known as "brain fog" [11,12], which typically manifest as difficulties with memory, attention, concentration, and multitasking [13]—headache, and insomnia, all of which significantly impair daily activities [14,15]. The symptoms, termed neuro-long COVID [16,17], affect millions globally and frequently manifest in people with moderate initial COVID-19 cases who did not necessitate hospitalization with pneumonia or hypoxemia [18,19].

This pervasive problem has had a substantial impact on people's lives and poses a challenge to the conventional view of recuperation after an illness. As the medical community strives to comprehend the full extent of chronic COVID-19, the urgent inquiry persists: How can we efficiently monitor and control these persistent symptoms?

1.1. Manifestations of Long COVID and Neuro-Long COVID

Long COVID includes a variety of enduring symptoms that can impact several organ systems, with neurological manifestations being especially significant [20,21]. These symptoms endure following the clearance of the acute infection and may vary from moderate to severe, persisting for months and perhaps leading to the emergence of additional symptoms post-infection [22].

In order to accurately monitor changes in symptoms among patients with COVID-19, several nations have implemented specialized tools. Participants in the UK survey conducted by the Office for National Statistics reported experiencing any of the following 12 symptoms in the past seven days: fever, headache, muscle ache, weakness/tiredness, nausea/vomiting, abdominal pain, diarrhea, sore throat, cough, shortness of breath, loss of taste, and loss of smell [23,24]. Similar questions were asked of participants in the Understanding America Study—COVID-19 Survey regarding symptoms like fever or chills, runny or stuffy nose, chest congestion, cough, sore throat, sneezing, headaches, muscle or body aches, fatigue, shortness of breath, abdominal pain, body temperature above 100.4 °F or 38.0 °C, vomiting, hair loss, dry skin, diarrhea, loss of smell, and skin rash [25].

In March 2023, the Office for National Statistics in the UK revealed that 1.5 million individuals (79% of those with self-reported long COVID) experienced negative effects on their daily activities due to symptoms. Among them, 381,000 individuals (20%) reported significant limitations in their ability to carry out their day-to-day tasks. The predominant symptom described by persons experiencing long COVID was fatigue, with 72% of those self-reporting long COVID experiencing this symptom. This was followed by difficulty concentrating (51%), muscle aches (49%), and shortness of breath (48%) [26].

In 2021, the National Institutes of Health (NIH), alongside multicenter studies in the United States and international research, established that these symptoms are more prevalent in patients with a history of severe illness [7,27,28]. However, findings also suggest that long COVID can manifest in young individuals, children, and patients with mild COVID-19 symptoms who did not necessitate hospitalization or respiratory support [29–31].

Beyond physiological symptoms, various research has examined the neurological and cognitive manifestations of long COVID, commonly termed neuro-long COVID [5]. The results of this research have resulted in the identification of the subsequent symptoms:

- Mood and psychological symptoms: Patients with long COVID frequently have feelings of sadness, anxiety [32], depression [33], and post-traumatic stress disorder [34]. These symptoms correlate with diminished quality of life and cognitive performance, highlighting the necessity for emotional support and focused intervention [35];
- Neurological examination findings: Neurological consequences are progressively acknowledged in individuals recovering from COVID-19, involving a wide array of symptoms and syndromes [36–38]. Abnormal neurological findings, such as numbness or tingling sensations, are more prevalent in post-hospitalized patients compared to non-hospitalized persons [37]. Frequent neurological symptoms encompass headache, fatigue, dizziness, anosmia, ageusia, anorexia, and myalgias [36,38]. Severe instances of COVID-19 have been linked to more grave neurological disorders, including menin-

goencephalitis, intracerebral hemorrhage, altered consciousness, syncope, seizures, and stroke [36];

- Chronic fatigue syndrome [39], pain in the muscles, and headaches are prevalent symptoms that intersect with neurological signs, hence complicating the clinical presentation of long COVID [40]. Chronic headaches are commonly documented, adding to the total symptomatology [35];
- Sleep disorders: Individuals with long COVID usually experience sleep disorders, such as insomnia, which contribute to overall fatigue and cognitive deficits [41];
- Cognitive impairments: Cognitive deficiencies have emerged as a primary symptom linked to neuro-long COVID, impacting all facets of cognitive function in a varied and frequently overlapping manner [11,17]. While research in this domain is ongoing, data indicates that cognitive difficulties, including memory impairment, concentration problems, and "brain fog", are among the most commonly reported symptoms, affecting around 70% of persons [12,42,43]. In a 7-month research cohort, 85.1% of participants (3203 individuals) reported having brain fog and cognitive impairment, encompassing deficits in attention, executive function, problem-solving, and decision-making [12]. In another study, 86% of participants indicated that post-COVID-19 cognitive impairment substantially impacted their every day work capabilities [11,12]. Similarly, another study identified prevalent impairments such as trouble concentrating (77.8%), brain fog (69%), forgetfulness (67.5%), tip-of-the-tongue word retrieval difficulties (59.5%), and semantic disfluency (43.7%) [12]. Research demonstrates that a considerable percentage of persons with long COVID exhibit cognitive impairments in at least one area, predominantly affecting executive functions [35,41].

Cognitive symptoms differ among individuals and frequently impact various domains, including memory (working memory, retrospective, and prospective), attention, language, and executive skills, all of which may have interrelated implications on everyday functioning [11]. Memory deficits can limit the capacity to create new memories, retrieve prior information, and retain information temporarily for processing tasks, hence influencing working memory as well as retrospective and prospective memory [44]. Likewise, attention-related deficiencies may present as difficulties in maintaining focus, selective or divided attention [44], and shifting attention between tasks. Language and executive functions [11,35,41] may be impaired, manifesting as word-finding difficulties, diminished planning and problem-solving abilities, and reduced cognitive flexibility, thereby affecting the capacity to adjust to new information or evolving situations.

1.2. Assessment Tools for Long COVID Symptoms

The evaluation instruments for symptoms of long COVID have attracted interest for their capacity to encapsulate the intricate interaction of psychological, cognitive, and physical symptoms. Hughes and co-workers [45] developed a questionnaire to evaluate the intensity of symptoms in persons suffering with long COVID. The researchers utilized Rasch analysis and incorporated 131 items that were categorized into 17 scales, including a wide range of symptoms. Bahmer and co-workers [46] devised a metric in Germany to evaluate the post-COVID condition, with a special focus on the physical repercussions in various organs and systems. The researchers utilized k-means clustering and ordinal logistic regression analysis to assess the intensity of symptoms. Yuan Kuo and co-workers [47] assessed the severity of long COVID symptoms using a 24-item scale, emphasizing the continued presence of both physical and psychological symptoms for a minimum of three months following a COVID-19 infection. Several studies have recorded the presence of sadness, cognitive impairments, and sleep disturbances in persons experiencing long COVID [2,47–49].

The Neurobehavioral Symptom Inventory (NSI) is also a commonly employed tool that proficiently assesses neurobehavioral symptoms in affected persons [50]. The Neurobehavioral Symptom Inventory (NSI) is a 22-item self-report instrument designed to assess somatosensory, cognitive, and affective symptoms [50]. Nonetheless, although the NSI offers significant insights, it may not entirely capture the range of cognitive impairments experienced by patients, including focus and memory difficulties, which are common in this demographic [51,52]. The Symptom Burden Questionnaire for Long COVID (SBQ-LC) is a validated patient-reported outcome measure developed using psychometric approaches. This questionnaire seeks to thoroughly evaluate the symptom burden encountered by patients, encompassing neurocognitive symptoms such as memory impairment and attentional challenges [45]. The development of these tools is based on patients' life experiences, hence increasing their relevance and application in clinical environments. Notwithstanding these advantages, the reliability of these assessment instruments remains a significant issue. The long COVID symptom and impact tools have been evaluated for test-retest reliability, demonstrating a level of stability over time [53]. However, the subjective aspect of patient-reported outcomes can add variability, especially in neurocognitive symptoms that may fluctuate due to several causes, including exhaustion and emotional condition. Furthermore, the notion of a "patient-acceptable symptomatic state" (PASS) has been created to delineate thresholds for tolerable symptom levels. This is particularly significant for neurocognitive symptoms, as numerous patients indicate an intolerable symptomatic condition, complicating the interpretation of evaluation outcomes [54]. The PASS score for the long COVID impact tool suggests that a considerable percentage of patients endure incapacitating symptoms, which may not be entirely reflected by current assessment instruments. Construct validity represents an additional area of concern. The correlation between the scores of these instruments and health-related quality of life has been evaluated, although the particular subtleties of neurocognitive symptoms may not be sufficiently captured [11,55,56].

Patient-reported outcome measures (PROMs) are crucial for documenting the experiences of patients with long COVID, offering insights into the effects of symptoms on everyday activities [57,58]. Nonetheless, dependence on self-reported data can create biases, as patients may either underreport or overreport symptoms influenced by their emotional state or comprehension of their situation.

Furthermore, functional MRI (fMRI) investigations have elucidated changes in brain connectivity and activity during cognitive tasks in patients with long COVID, emphasizing the neurological basis of their symptoms [59,60]. Despite its efficacy, the prohibitive cost and restricted accessibility of fMRI may impede its extensive utilization in clinical environments.

Another method for evaluating cognitive domains in long COVID involves the utilization of a thorough Neuropsychological Test Battery [42]. This battery includes various cognitive domains and utilizes a variety of neuropsychological assessments administered directly by qualified neuropsychologists in face-to-face sessions rather than through self-report questionnaires. The assessments, including the Wechsler Memory Scale (WMS-IV), Stroop Test, Trail Making Test [61], Number Span, and Hopkins Verbal Learning Test–Revised [62], offer a more precise and sophisticated evaluation of cognitive capabilities. All of them highlighted the significant influence of COVID-19 on cognitive abilities [48,49,61–63].

The findings demonstrated that individuals experiencing neurological symptoms such as headache, loss of smell, and altered taste, as well as those who were hospitalized or needed oxygen therapy, showed reduced cognitive performance in these specific areas. This establishes a definitive connection between COVID-19 infection and cognitive impairments [61,62]. ICU patients demonstrated more severe and extensive cognitive deficits [64]. Nonetheless, the resource-demanding characteristics of these evaluations, frequently extending over several hours, may restrict their practicality in standard clinical environments.

1.3. The Importance of Questionnaires in Assessing Cognitive Impairments in Long COVID

Despite prior research providing significant insights into the neurocognitive difficulties associated with long COVID, a substantial gap persists in the literature concerning specialized instruments explicitly developed to evaluate cognitive impairments in this demographic. The majority of cognitive assessments performed during the pandemic predominantly utilized neuropsychological tests conducted in controlled environments rather than questionnaires designed for real-world circumstances [12,44,61,62,65,66]. Conventional tests, although comprehensive, frequently do not reflect the dynamic and situational intricacies of cognitive impairment encountered in the daily lives of patients with long COVID [17,44].

Technological advancements have facilitated the development of advanced technologies that can identify structural and functional elements of neurological abnormalities [67]. Nonetheless, these instruments are not consistently available or feasible for extensive screening and may fail to accurately represent the cognitive experiences of individuals with long COVID. Moreover, current questionnaire-based assessments typically amalgamate somatic and psychological symptoms [45–47,49], placing little attention on cognitive deficits as a distinct area of concern. The absence of specificity hinders their ability to comprehend and address the distinct cognitive challenges faced by patients with long COVID.

Questionnaires provide a distinctive and vital function as accessible, ecological, and pragmatic instruments in cognitive evaluation [68]. Their simplicity, versatility, cost-effectiveness, and efficiency render them indispensable for extensive applications, particularly for Long COVID. Screening questionnaires tailored for cognitive evaluation can enhance accessibility, enabling the identification and referral of individuals who might otherwise go undetected [69]. This is especially pertinent for individuals in diverse environments, as questionnaires can provide a more comprehensive representation of cognitive deficits that may be overlooked in laboratory tests.

Moreover, cognitive assessment questionnaires are based on patients' daily experiences, highlighting the manifestation of cognitive problems in real-world contexts. This method is particularly beneficial for patients with long COVID, who frequently experience challenges with memory, attention, and problem-solving in their daily tasks. By emphasizing daily functionality, these assessments offer a significant assessment of how cognitive impairments influence patients' quality of life and their capacity to engage with their environment [70]. In settings characterized by elevated cognitive demands or intricate stimuli, individuals with cognitive impairments may experience exacerbated difficulties, impacting their overall productivity and social interaction [71].

At present, there is no questionnaire particularly validated for post-COVID cognitive impairment that possesses both known reliability and validity. This gap highlights the urgent necessity for a technique that can precisely measure cognitive alterations in patients with long COVID, as cognitive function is essential to practically all facets of daily life, ranging from basic chores to intricate problem-solving.

1.4. Objective of the Study

Given this background, our objective was to formulate and validate a set of patient-reported instruments for monitoring cognitive impairment following the acute phase of COVID-19. The Post-COVID-19 Cognitive Impairment Scale refers to cognitive deficits that arise in persons with Long COVID. These cognitive deficits often continue for 6 months after the initial onset of COVID-19 and cannot be attributed to any other medical conditions.

2. Materials and Methods

2.1. Study Design

The study employed a cross-sectional, descriptive, exploratory research approach to create the novel Post-COVID-19 Cognitive Impairment Scale. This scale was specifically designed to assess the severity of cognitive impairment symptoms among people with a previous diagnosis of COVID-19.

The scale underwent development and validation in Iran in a three-phase procedure spanning from January 2023 to September 2023.

2.2. Instrument and Procedure

- Phase I: Formulation of the Scale (5 January 2023 to 14 March 2023).

Through a literature review, we identified two cognitive components (attention and memory) affected by COVID-19 [45,63,64,66].

To develop the questionnaire, we gathered lists of daily tasks that need the cognitive ability specified.

Subsequently, test questions were created to measure everyday activities in each cognitive domain. For this situation, the questionnaire comprised a set of questions for each design component, with seven to ten questions for each. Ultimately, 16 questions were chosen from the available items. The questionnaire had 16 items that evaluated cognitive ability in everyday situations.

Participants evaluated each topic using a five-point Likert scale, with "very little" (score 1) indicating minimal impairment and "very much" (score 5) indicating significant impairment. A higher scale score indicates a more pronounced level of symptom intensity.

- Phase II: Evaluation of Content Validity (15 March 2023 to 25 April 2023).

Five psychologists received the fully filled pilot form. Initially, they had been told to assess the questionnaire by assigning a rating on a 5-point scale based on the relevance, importance, and applicability of each item. A higher score signifies a heightened degree of relevance, significance, or suitability ascribed to the item.

Afterwards, the content validity ratio (CVR) and content validity index (CVI) were calculated.

In order to determine the content validity ratio, specialists were approached to gain their assessment regarding the requirement or lack thereof of each item. According to Lawshe's table [72], the values of 0.99 were considered acceptable. Subsequently, the content validity index was computed by assessing the items according to their pertinence, lucidity, and straightforwardness, and only those with scores over 0.79 were deemed satisfactory.

Two questions were removed from the content validity index section based on expert evaluations, adhering to a predetermined threshold of 0.79. As a result, the 14 questions demonstrated appropriate content validity and progressed to the step of assessing construct validity.

In the third phase, the questionnaire was given to a cohort of 20 persons who will not be included in the study. Their objective was to peruse the questionnaire, respond to the prompts, and bring up any problems or inquiries regarding the clarity or ambiguity of the questions.

Upon obtaining comments and ideas from the specified persons, we implemented the necessary revisions to improve the clarity of the items.

The minimum and maximum scores attainable in this 14-item evaluation were 14 and 70, correspondingly (see Table 1).

- Phase III: Structural Validation (1 May 2023–20 September 2023)

The study included a group of 454 individuals (156 men and 298 females) between the ages of 18 and 65. The primary criteria for inclusion were (i) a PCR-confirmed SARS-CoV-2 infection, (ii) a minimum interval of 6 months between the infection and participation in the research study, and (iii) obtaining written consent from individuals who are between the ages of 18 and 65 and ensuring they are fully informed about the study (Ethics Committee of University of Payame Noor Iran, Tehran, approved and permission for the study). The primary exclusion criterion was the presence of any pre-existing cognitive impairments or psychiatric disorders.

The recruitment process involved utilizing many avenues such as referrals, student groups, and online/social media platforms, notably the Telegram Long COVID Support Group, which boasts a membership of over 10,000 individuals.

The participants were administered the questionnaire using the online assessment tool "Porsline" [73].

After collecting data, the **Post-Covid Cognitive Impairment Scale** was validated using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) methodologies.

Table 1. Post-Covid Cognitive Impairment Scale.

Items	Questions
V1	The extent of your difficulty in remembering tasks or activities you intend to perform.
V2	The extent of your difficulty in recalling events that occurred to you in the past week.
V3	The extent of your difficulty in remembering the names of individuals you interact with daily.
V4	The extent of your difficulty in recognizing individuals you have previously met.
V5	The extent of your difficulty in remembering the reason for leaving your house.
V6	The extent of your difficulty during conversations: forgetting the topic of discussion and going off track.
V7	The extent of your difficulty in finding items because you placed them in the wrong location and cannot remember where.
V8	The extent of your difficulty in effectively learning new skills.
V9	The extent of your difficulty in maintaining focus due to minor distractions and ambient noise.
V10	The extent of your difficulty in fully assessing situations when making decisions.
V11	The extent of your difficulty in distinguishing between important and unimportant aspects while performing a task.
V12	The extent of your difficulty in listening attentively and without distraction to a lecture.
V13	The extent of your difficulty in concentrating on studying a single topic for more than ten minutes.
V14	The extent of your difficulty in taking notes while simultaneously listening to a lecture.

Each item in the Post-COVID Cognitive Impairment Scale was rated by participants on a five-point Likert scale, where 1 = Very Little, 2 = Little, 3 = Moderate, 4 = Much, and 5 = Very Much, with higher scores indicating greater impairment.

2.3. Data Analysis

Descriptive statistics, such as frequency, percentage, mean, and standard deviation, were employed to depict the sociodemographic features of the collected sample. The **Post-Covid Cognitive Impairment Scale** was validated using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) methodologies. In order to assess the suitability of the data for factor analysis, two indicators were employed: the Kaiser–Mayer–Oklin measure of sample adequacy (KMO) [74] and Bartlett's test of sphericity [75]. The components were extracted using eigenvalue, scree plot, and Kaiser's Rule [76], and the explained variance percentage was calculated. The analytical approach employed was maximum likelihood with direct oblimin [77]. Covariance-based structural equation modeling (CB-SEM) [78] and the robust maximum likelihood estimator technique (MLR) [79] were employed to conduct confirmatory factor analysis (CFA). The CFA analysis was performed using IBM SPSS Amos Graphic 26 [80]. The model fit assessment [81] indices used in this study included Chi-square (X2), normed chi-square (CMIN/DF), the Tucker and Lewis Index (TLI; with values ≥ 0.90), comparative fit index (CFI; with values ≥ 0.90), the standardized root mean square residual (SRMR; with values < 0.08), and the root mean square of approximation (RMSEA; with values ranging from 0.0 to 0.08). The reliability of the **Post-Covid Cognitive Impairment Scale** was evaluated by assessing its internal consistency through the use of Cronbach's Alpha.

3. Results

3.1. Sample Characteristics

The study sample consisted of 454 patients. The age of participants spanned a wide range, from 18 to 65 years. Regarding sex, women comprised 65.6% of the participants, while men comprised the remaining 34.4%. According to educational attainment, 7.5% were under diploma, 12.6% were graduates, 33.5% had a bachelor's degree, 34.1% had a master's degree, and 12.3% had a doctoral degree. Regarding marital status, 28.2% of the participants were single, 66.1% were married, 1.5% were widowed, 3.3% were divorced females, and 0.9% were divorced males (see Table 2).

Table 2. Characteristics of study sample (n = 454).

Characteristic	N	%
	Sex	
Female	298	65.6
Male	156	34.4
	Education	
Under diploma	34	7.5
High School Diploma	57	12.6
Bachelor's Degree	152	33.5
Master's Degree	155	34.1
Doctoral Degree	56	12.3
	Marital status	
Single	128	28.2
Married	300	66.1
Widow	7	1.5
Divorce-Female	15	3.3
Divorce-Male	4	0.9

3.2. Validity

The results of EFA have been reported in Tables 3–6. Table 3 shows the mean scores and standard deviations of the individual items.

Table 3 presents skewness and kurtosis data to provide a comprehensive analysis of the distribution shape for each item. Skewness denotes the asymmetry of responses relative to the mean, with values near zero indicating a more symmetric distribution. Positive skewness values suggest a distribution biased towards lower answer categories, whilst negative values show a bias towards higher categories. Kurtosis values denote the "tailedness" or peak of each item's distribution, with values approaching zero signifying a shape akin to a normal distribution. Elevated positive kurtosis indicates a more pronounced peak, whereas negative values reflect a more subdued distribution. These tests assess each item's conformity to normal distribution assumptions, thereby elucidating the scale's psychometric characteristics.

Table 3. Items analysis of Post-Covid Cognitive Impairment Scale.

Items	Mean	SD	Skewness	Kurtosis
V1	2.36	1.04	0.43	−0.32
V2	2.17	1.09	0.63	−0.41
V3	1.75	1.02	1.24	0.75
V4	1.91	0.99	0.97	0.40
V5	1.35	0.65	1.62	1.42
V6	1.80	0.92	1.13	1.06
V7	2.44	1.11	0.60	−0.22
V8	2.28	1.11	0.50	−0.59
V9	2.51	1.16	0.40	−0.67
V10	2.03	1.07	0.86	−0.03
V11	1.86	0.94	1.08	0.94
V12	3.31	1.29	−0.23	−1.06
V13	2.46	1.17	0.48	−0.55
V14	2.23	1.21	0.75	−0.46

The KMO index (0.89) and Bartlett's test of sphericity ($p < 0.001$) indicate the suitability of the **Post-COVID Cognitive Impairment Scale** items for factor analysis (the data can be consulted in Table 4).

Table 4. Values estimation of KMO and Bartlett's Test.

KMO and Bartlett's Test		
Kaiser–Meyer–Olkin Measure of Sampling Adequacy.		0.895
Bartlett's Test of Sphericity	Approx. Chi-Square	2059.983
	df	91
	Sig.	0.000

Two factors were extracted based on the eigenvalue, scree plot, and Kaiser′s Rule results. Also, the direct oblimin data showed a two-factor solution and a clear pattern. The results identified two factors that explained 40.38 of the total variances, with eigenvalues > 1 (Table 5). No items were removed from the scale. Seven items comprised one factor called "Memory." Seven items comprised a second factor called "Attention".

Table 5. Rotation sums of squared loadings.

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
Memory	4.71	33.63	33.63
Attention	0.95	6.75	40.38

In order to gain a deeper understanding of the fundamental framework of the Post-COVID Cognitive Impairment Scale, a Pattern Matrix was created as a component of the exploratory factor analysis. This matrix offers a clear understanding of the distribution of each item among the specified components, indicating the level of correlation between each item and a particular component. The factor loadings of the 14 items over two unique components, namely memory and attention, are presented in Table 6. Items that have higher loadings on a specific component suggest a more pronounced association with that cognitive domain, showcasing the scale's capacity to accurately assess these diverse elements of cognitive function.

Table 6. Pattern Matrix.

Items	**Component**	
	1	**2**
V1	0.625	
V2	0.752	
V3	0.630	
V4	0.563	
V5	0.461	0.134
V6	0.515	0.256
V7	0.448	0.273
V8	0.214	0.486
V9	0.161	0.530
V10		0.803
V11		0.716
V12	0.183	0.412
V13	0.193	0.573
V14	0.173	0.415

In Table 6. factor loadings exceeding 0.4 are deemed significant, as they signify a considerable link between the item and the respective factor. Loadings beneath this threshold (0.4) are deemed negligible and so are not emphasized as principal markers of factor structure. Furthermore, cells that are unfilled in the table signify factor loadings below 0.1, which were omitted for clarity and to emphasize the most pertinent item-factor associations.

Furthermore, CFA was conducted to verify the cognitive functions scale. The results of CFA indicate that the values of all indices are desirable. In other words, the fit indices of the model indicate the desirability of the **Post-Covid Cognitive Impairment Scale** measurement model (the data can be consulted in Table 7).

Table 7. Values estimation of confirmatory factor analysis indexes (CB-SEM).

Indices	**CFA Index Standard**	**Model**
Chi-square	-	210.20
DF	-	75
Normed chi-square (CMIN/DF)	<5	2.80
RMSEA	<0.08	0.06
SRMR	<0.08	0.05
CFI	≥0.90	0.93
TLI	≥0.90	0.92

The values of factor loadings (Table 8) illustrate that the cognitive functions scale is valid at the items level.

Table 8. Factor loading of Post-Covid Cognitive Impairment Scale.

Component	Items	Factor Loading *	Critical Ratio *	*p*. Value *
Memory	V1	0.67	13.21	0.001
	V2	0.74	13.21	0.001
	V3	0.56	10.48	0.001
	V4	0.47	8.92	0.001
	V5	0.56	10.39	0.001
	V6	0.70	12.67	0.001
	V7	0.64	11.88	0.001
Attention	V8	0.65	11.22	0.001
	V9	0.64	11.22	0.001
	V10	0.54	9.72	0.001
	V11	0.55	9.91	0.001
	V12	0.57	10.23	0.001
	V13	0.73	12.35	0.001
	V14	0.55	9.27	0.001

* "Factor Loading" refers to the strength of the relationship between each item and the underlying factor. "CR" (Critical Ratio) indicates the standardized test statistic for each item loading, which tests the significance of the loading. "*p*-value" represents the statistical significance level for each loading, with values below 0.05 indicating that the factor loading is statistically significant.

3.3. Reliability

The reliability assessment included an evaluation of internal consistency. Cronbach's alpha coefficient for the memory factor was 0.81; the attention factor was 0.80. As a result, the **Post-Covid Cognitive Impairment Scale** is reliable; it has internal consistency and measurement precision.

4. Discussion

4.1. Main Findings

The objective of this study was to create and validate the Post-COVID Cognitive Impairment Scale, an innovative instrument intended to evaluate the seriousness of cognitive impairment symptoms in persons who have long COVID. This study's findings offer valuable insights into the scale's reliability and validity, emphasizing its potential usefulness in clinical and research environments.

The Post-COVID Cognitive Impairment Scale exhibited robust psychometric characteristics, affirming its accuracy and consistency in assessing cognitive deficits across two specific areas: memory and attention. Both the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) provided evidence in favor of the scale's two-component structure, which accounted for 40.38% of the total variance. The KMO measure of sample adequacy (0.89) and Bartlett's test of sphericity ($p < 0.001$) have verified that the data is suitable for factor analysis, suggesting a strong component structure.

The CFA findings provided additional evidence supporting the reliability of the scale, as indicated by the fit indices such as CMIN/DF (2.80), RMSEA (0.06), SRMR (0.05), CFI (0.93), and TLI (0.92), all of which suggest a strong match. Furthermore, the factor loadings for each item were statistically significant, which strengthens the evidence supporting the scale's construct validity. The scale's internal consistency was verified using Cronbach's alpha coefficients. The coefficients for memory and attention were 0.81 and 0.80, respectively, indicating reliable performance ranging from acceptable to good.

4.2. Comparative Analysis with Prior Studies

This study's findings align with an expanding corpus of literature emphasizing the cognitive deficits linked to long COVID, often known as neuro-long COVID [11,17,35,41]. Consistent with other studies, our findings highlight substantial impairments in memory and attention in individuals who have recovered from COVID-19, including those with moderate acute symptoms who did not necessitate hospitalization [29–31]. This corresponds with research indicating that cognitive impairments are widespread across multiple domains, such as memory, attention, executive function, and problem-solving skills [11,12,42,43,61,62,65,66].

Prior neuropsychological evaluations have consistently revealed cognitive impairments in survivors of COVID-19 [61,62,64]. Almeria et al. [61] and Becker et al. [62] employed extensive neuropsychological test batteries to identify abnormalities in attention, executive functioning, and memory. Although these assessments offer comprehensive insights, their applicability is constrained by the requirement for specialist staff and prolonged administration time [42]. This study contributes to the field by presenting the Post-COVID Cognitive Impairment Scale, a proven and effective tool specifically created to evaluate cognitive abnormalities in post-COVID individuals. This instrument provides a practical option that can be easily utilized in clinical and research environments.

Unlike previous evaluation instruments that frequently combine somatic, psychological, and cognitive symptoms, such as the Symptom Burden Questionnaire by Hughes et al. [45] and the scale by Bahmer et al. [46], our instrument is solely dedicated to cognitive deficits. The Symptom Burden Questionnaire, although extensive with 131 items over 17 categories, is unwieldy for regular application. Bahmer et al.'s scale predominantly focuses on physical sequelae and necessitates intricate analytical techniques, hence constraining its utility for cognitive evaluation. By focusing on memory and attention, our scale meets the essential requirement for a targeted assessment of cognitive processes that directly influence daily living and quality of life in patients with long COVID.

Furthermore, our research addresses the recognized deficiency in the availability of particular, validated questionnaires for post-COVID cognitive impairment [11,17,44]. Although instruments such as the Neurobehavioral Symptom Inventory (NSI) [50] and the Symptom Burden Questionnaire for Long COVID (SBQ-LC) [45] encompass cognitive symptoms, they fail to offer the requisite granularity for comprehensive cognitive evaluation and may lack sensitivity to nuanced deficits encountered by patients. The NSI includes somatosensory, cognitive, and affective symptoms but may not adequately reflect specific cognitive difficulties, such as memory deficiencies and attentional lapses, commonly observed in long COVID [51,52].

Our findings corroborate research indicating the prevalence of cognitive symptoms in patients with long COVID, irrespective of the original infection's severity [18,19,29–31]. This highlights the imperative for extensive cognitive assessment utilizing accessible instruments such as our scale. The significance of patient-reported outcome measures (PROMs) is clear since they offer critical insights into the impact of cognitive deficits on patients' daily functioning [57,58]. Nonetheless, dependence on self-reported data may introduce biases, a drawback acknowledged by our work, which is addressed by stringent validation procedures, including exploratory and confirmatory factor analyses.

Moreover, our research enhances the discussion over the ecological validity of cognitive evaluations in long COVID. Conventional neuropsychological assessments, while comprehensive, may not accurately represent patients' cognitive experiences in real-world contexts [17,44,70]. Our scale provides an ecologically valid assessment by creating a questionnaire that reflects patients' daily experiences with memory and attention, so addressing the dynamic and situational aspects of cognitive impairments in long COVID.

Although our scale provides a useful instrument for the preliminary assessment of cognitive impairments in patients with long COVID, it is crucial to recognize its limits. This questionnaire is intended as a first step in identifying persons who may be experiencing cognitive impairments. Additional extensive neuropsychological assessments that specifically evaluate cognitive functioning are advised to confirm diagnoses and formulate thorough intervention strategies. This approach corresponds with previous research highlighting the necessity for comprehensive evaluations after initial screenings to thoroughly comprehend the severity of cognitive impairments in persons with long COVID-19 [61,62,64].

4.3. Clinical Practice Consequences

The validated Post-COVID Cognitive Impairment Scale has important implications for clinical practice. It offers healthcare providers a dependable and accurate instrument for evaluating cognitive deficits in persons who have long COVID, making it easier to detect and address these issues at an early stage. The scale may be utilized to observe the advancement of symptoms and the effectiveness of treatment, consequently enhancing patient results.

Utilizing this scale to identify cognitive deficits can also provide valuable insights for the creation of focused rehabilitation programs. Comprehensive treatment, which encompasses cognitive rehabilitation and mental health assistance, can be customized to meet the unique requirements of persons suffering from extended COVID, therefore improving their quality of life and functioning capabilities.

Moreover, the emphasis of the scale on cognitive impairments underscores the significance of addressing mental health in addition to physical health in post-COVID treatment. Adopting a holistic approach is crucial for effectively managing and facilitating the complete healing of patients.

4.4. Limitations and Prospects for Further Investigation

Although this study offers strong evidence supporting the validity and reliability of the Post-COVID Cognitive Impairment Scale, it is important to recognize several limitations. The cross-sectional approach hampers the capacity to evaluate alterations in cognitive deficits over a period of time. In order to monitor the development of cognitive symptoms and evaluate the impact of therapies, it is recommended that future studies utilize longitudinal designs.

Furthermore, the study sample was specifically selected from the geographic region of Iran, which might potentially restrict the applicability of the results to a broader population. It is necessary to conduct replication studies in various communities and situations to validate the scale's suitability for different cultural and demographic groupings.

Further investigation is required to examine the correlation between cognitive deficits and additional long-term symptoms of COVID-19, including tiredness and respiratory problems. Gaining insight into these interconnections can offer a more thorough understanding of the post-COVID state and guide complete treatment strategies.

Additionally, the utilization of an online platform (e.g., Porsline) for data gathering in the validation of the cognitive assessment tool entails some limitations. Online platforms provide considerable benefits regarding accessibility and ease, allowing efficient engagement with a wide and varied participant base; nevertheless, they also present certain restrictions that may affect data dependability and validity. Online evaluations do not provide the controlled atmosphere of in-person settings, perhaps leading to distractions or inconsistencies in participant engagement with the questionnaire. The absence of control may impact the uniformity of responses, particularly in self-reported cognitive evaluations when external variables can impair focus and comprehension. Moreover, participants' proficiency with digital devices may differ; those with restricted digital literacy can encounter challenges in navigating the online platform, perhaps leading to biases or compromising the accuracy of their responses. Moreover, online data collecting may unintentionally exclude persons with significant cognitive impairments or those lacking dependable internet connection, thereby compromising the generalizability of the results. To improve reliability, future validations may utilize a hybrid approach that integrates online and in-person data collection methods, thus enhancing data quality and inclusivity.

In addition, although the Post-COVID Cognitive Impairment Scale serves as a useful instrument for the preliminary assessment of cognitive deficits, it is crucial to acknowledge its limitations when used alone. The questionnaire is intended as a first step in identifying individuals who may be experiencing cognitive impairments. Consequently, more thorough neuropsychological assessments that specifically evaluate cognitive functioning are advised to validate diagnoses and formulate complete remediation strategies. Integrating objective cognitive evaluations with the scale can improve diagnostic precision, offer a deeper insight into the severity and characteristics of cognitive deficits, and guide more targeted and effective treatment approaches.

5. Conclusions

The Post-COVID Cognitive Impairment Scale is an accurate and dependable tool for evaluating cognitive deficits in persons who are recuperating from COVID-19. This instrument fulfills an important requirement by providing a realistic and targeted method to assess cognitive impairments in this specific group. The scale's strong psychometric qualities validate its use in clinical and research environments, enabling the early detection, tracking, and treatment of cognitive deficits linked to long COVID.

The Post-COVID Cognitive Impairment Scale offers a consistent approach to evaluating cognitive impairments. Its use can enhance patient treatment and results, aiding in the continuous endeavors to tackle the lasting effects of COVID-19. Subsequent investigations should further improve and authenticate this instrument, guaranteeing its pertinence and efficiency in various demographics and environments.

Author Contributions: Conceptualization, S.P.M., F.M.R. and I.P.; methodology, S.P.M.; software, S.P.M.; validation, S.P.M. and R.E.; formal analysis, S.P.M., R.E., F.M.R. and I.P.; investigation, S.P.M. and R.E.; resources, S.P.M.; data curation, S.P.M. and R.E; writing—original draft preparation, S.P.M. and R.E; writing—review and editing, S.P.M., F.M.R. and I.P.; visualization, S.P.M.; supervision, F.M.R. and I.P.; project administration, S.P.M.; funding acquisition, S.P.M. and R.E.; All authors have read and agreed to the published version of the manuscript.

Funding: No funding was provided for this investigation.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki. The University of Payame Noor Iran, Tehran, Ethics Committee approved and permission for the study (protocol code IR.PNU.REC.1400.149 and date of approval 11 September 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has also been obtained from the patients to publish this paper.

Data Availability Statement: Data that substantiate the conclusions of this investigation are accessible from the corresponding author upon reasonable request.

Acknowledgments: We extend our heartfelt gratitude to all the participants who contributed to the investigation.

Conflicts of Interest: The authors declare no conflicts of interest.

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European Journal of
Investigation in Health, Psychology and Education

Article

Higher Education in Public Health as a Tool to Reduce Disparities: Findings from an Exploratory Study among the Bedouin Community in Israel

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Abstract: The Bedouin community is a minority disadvantaged population in Israel that suffers from a variety of health and socioeconomic disparities and limited access to higher education. The current study aimed to examine perceptions, successes, and challenges experienced by Bedouin students during their studies and to assess an internship program developed on the principles of a community-based participatory research approach to public health. In-depth interviews were conducted with 34 Bedouin students studying in the public health academic track between January and April 2023. Grounded Theory was used to analyze the data. Three main themes emerged from the analysis: (1) facilitators for the decision to pursue higher education in public health, (2) challenges and coping strategies, and (3) experiences of success. The internship program included eleven Bedouin students who conducted six community intervention projects covering a range of topics with different target Bedouin populations. Higher education is crucial for empowering minorities, producing leadership, and reducing socioeconomic and health gaps. The field internship enabled the necessary alignment between academia and public health practice. It is important to further reflect on the integration of minority groups in public health studies and its role in decreasing health inequity.

Keywords: education; public health; academia; community; minority; bedouin population; disparities; internship

Citation: Bashkin, O.; Suisa, A.; Levi, S. Higher Education in Public Health as a Tool to Reduce Disparities: Findings from an Exploratory Study among the Bedouin Community in Israel. *Eur. J. Investig. Health Psychol. Educ.* **2023**, *13*, 2082–2094. https://doi.org/10.3390/ejihpe13100147

Academic Editor: María del Mar Simón Márquez

Received: 11 August 2023
Revised: 27 September 2023
Accepted: 28 September 2023
Published: 30 September 2023

1. Introduction

The Bedouin population in southern Israel is one of the largest minority groups in Israeli society, constituting about 3% of the total population and 14% of the Arab population in Israel [1,2]. Residing in traditional and tribal villages, located in the periphery and characterized by a unique patriarchal social structure, the Bedouin community suffers from a variety of disparities as compared to other minority groups in Israel. The low socioeconomic and educational levels, limited availability of medical services, limitations of geographic mobility due to limited public transportation in the Bedouin villages, and language and socio-cultural barriers lead to difficulties in obtaining appropriate health services and thus contribute to significant health inequities [3–6].

There is an integral relationship between education and health within the structural and contextual frameworks of society, and it plays a fundamental role in the general well-being of individuals and societies [7]. Education affects health in various mediated links including improving employment and economic status [8], enhancing health behaviors [9], developing better social–psychological supportive circles in life [10], and improving access to healthcare [7].

1.1. Health Disparities among the Bedouin Population in Israel

It is widely acknowledged that health disparities are highly prevalent in Bedouin villages due to poor living conditions as well as cultural and socioeconomic factors. About half of the Bedouin population lives in unrecognized villages with poor sanitation and limited basic infrastructures such as electricity, water supply, and access to healthcare services [11]. As a result, poor health outcomes are common among the Bedouin population, including a high rate of congenital disorders due to consanguineous marriages [12,13], a high rate of infant mortality [14], an increasing rate of type 2 diabetes mellitus causing low life expectancy compared to Israeli Jews [15], a higher level of psychological distress [16], a predominance of injuries among Bedouin males [17], and more.

There are various efforts to decrease health disparities and increase health equity for the Bedouin population in Israel, primarily employed by the Ministry of Health, health maintenance organizations, and non-governmental organizations in Israel. Among these efforts are the expansion of mother and child clinics in the Bedouin villages, health promotion workshops for Bedouin women, and training nurses and other health professionals in the Bedouin population, such as nurse case managers for diabetes Bedouin patients [18]. Despite these efforts, additional steps are necessary to significantly improve health outcomes, including using culturally sensitive, health-focused continuous interventions.

1.2. Higher Education among the Bedouin Population in Israel

Higher education is important for empowering minority development, expanding the leadership required for socioeconomic development, and reducing health gaps [19]. However, evidence shows that the Bedouin population's access to higher education is limited and challenging. There are several barriers to higher education among the Bedouin population; of significance is poor education services and a lack of resources at the pre-university stage. This includes, among other things, insufficient guidance for choosing an academic track. Due to this, many young Bedouins tend to choose the same study tracks, primarily academic programs in teaching and social sciences, although many of them prefer health sciences and medical programs. Therefore, they are less likely to complete their university degrees [19,20]. Additional barriers to higher education among the Bedouin population include the admissions procedures in Israeli universities, which are challenging for young Bedouins [21], language barriers, the lack of sufficient financial resources for Bedouins for university studies, cultural and traditional gender roles, inadequate financial resources, and physical access barriers [22].

One of the latest intervention programs to decrease inequity in higher education among the Bedouin population is called "Gateway to Academia" developed and implemented by the Council of Higher Education in Israel as of 2016. The program assists Bedouins to integrate into higher education studies, even if they do not meet admissions requirements, by providing a one-year program (pre-undergraduate studies) provided in small group classes focusing on extra English and Hebrew language training and academic literacy, alongside financial and social support [23,24]. Recent assessments of the program outcomes reveal high cognitive, economic, emotional, and social satisfaction among Bedouin students participating in the program [25].

1.3. Integrating Bedouins in Public Health

As part of the "Gateway to Academia" program, as of 2019, young Bedouins were integrated into an undergraduate degree in public health at the Ashkelon Academic College (AAC). The undergraduate public health track was established in 2014 at AAC, located in southern Israel. The process, challenges, and achievements of this unique public health track are described in a previous article [26].

The Bedouin students enrolled in the "Gateway to Academia" program at AAC are provided with academic skills, social and financial support, and a few basic introductory courses in health sciences. At the end of the pre-undergraduate one-year program, the students choose one of the three academic tracks included in the AAC School of Health Sciences: Nutrition, Nursing, and Public Health. To date, 34 Bedouin students study in the Public Health undergraduate track. To assist the Bedouin students in successfully integrating into the undergraduate public health track, we implemented several tools including periodic personal follow-up meetings of academic staff with Bedouin students, strengthening the social relationships between Jewish and Bedouin students through various activities, mentoring programs, personal tutoring by graduate students, and providing additional practice hours for Bedouins students. Moreover, in 2022–23, an internship program was developed and implemented with the participation of Bedouin students to integrate public health students in the field and reduce health disparities in their communities.

At the end of four years of participation in the public health track, an understanding of the integration of Bedouin students is important for future planning and expansion. Therefore, the current study aimed to examine perceptions, needs, successes, and challenges experienced by Bedouin students during their studies. In addition, we describe the implementation of an internship program developed on the principles of a community-based participatory research approach to public health to mitigate health and education disparities among the Bedouin community. Both the interviews and the internship program lay the groundwork for the future development of interventions to alleviate gaps in education and health among minority groups.

2. Materials and Methods

This exploratory study was conducted to gain in-depth insights into how Bedouin students perceive their experiences in the public health academic track. The research includes qualitative in-depth interviews and a review of intervention projects implemented by Bedouin students in their communities. The Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist was used to report the study [27]. The study was approved by the Ashkelon Academic College Ethics Committee (Approval # 57-2023).

2.1. Interview Participants

Interview participants were recruited using purposive sampling. In purposive sampling methods, researchers select individuals who meet specific prescribed criteria [28]. The criteria was being a Bedouin student in the Public Health undergraduate track. All 34 Bedouin students studying in the public health academic track at the AAC were recruited for the study and were interviewed between January and April 2023. Interviewees included 10 men and 24 women; 9 of them were first-year students, 10 were second-year students, and 15 were third-year students. The Bedouin students completed matriculation in local high schools. While the high schools in the Bedouin communities often have poorer education services, the students all had the opportunity to participate in the “Gateway to Academia” program at AAC in order to reduce gaps and allow them to qualify according to the same admission standards as students from other backgrounds. In the public health track, all of the Bedouin students are at the 35th percentile of scores. The students’ age ranged between 19 and 23. Participants gave informed consent for inclusion in the study and were informed about the methods to protect the data for anonymity and privacy.

2.2. Qualitative Data Collection

Data were collected using a semi-structured interview format. The topics considered in the development of the interview guide included the decision to pursue higher education and to study public health, challenges, and unmet needs during their studies, sources for support, and successful experiences.

The interview guide was comprised of non-directive and open-ended questions about perceptions and experiences during academic studies (Appendix A). The wording and order of the questions were adapted according to the interview dynamics to maintain continuity and flow and encourage openness of interviewees. The content validation method was used to ensure that the questions in the guide were relevant to the study goals. The guide was pilot tested with two students to ensure a smooth interview flow and verify comprehension of the questions.

The interviewer was a third-year student in public health, trained in qualitative research methods, and supervised by the corresponding authors. All interviews were conducted face to face, individually, at the college and lasted 30–60 min. Interviews were audiotaped and transcribed verbatim in Hebrew in a standardized format. It was emphasized to all interviewees that their details would remain confidential, that they did not have to answer all the questions, and that they could stop the interview at any time. In addition, all interviewees approved the recording and transcript of their interview.

2.3. Qualitative Data Analysis

Interview transcripts were analyzed by the authors using a thematic analysis method based on Grounded Theory [29]. Interpretive analysis was performed soon after the interviews were conducted. The analysis included incorporating deductive and inductive themes that arose from the research topics based on the literature and from the research data [30]. The analysis stages included: (1) a literal reading of all the interviews to gain a comprehensive picture of the data; (2) identifying categories and themes related to the research objectives; (3) redefining central themes to include encoded quotes and examples based on re-reading the transcripts; (4) the themes and quotes were translated and documented in English. An ongoing internal quality audit was conducted to determine whether the data were collected, analyzed, and reported consistently following the study protocol [30].

2.4. Community Intervention Projects

In parallel to the qualitative interviews, a special internship program was piloted for third-year students. The purpose of the internship was to utilize academic skills acquired during public health track studies to reduce health disparities in the community. The internship was coordinated and guided by the authors and lasted eight months. The internship program was developed on the principles of the community-based participatory research (CBPR) approach to public health, a collaborative research approach that involves active participation of community members, researchers, and other stakeholders [31]. The CBPR method has long been recognized as a method to cope with health disparities [32]. In CBPR, the partnership between researchers and community members is emphasized with the goal of addressing issues and concerns that are relevant and meaningful to the community being studied, as intended when involving Bedouin students in actions that facilitate a change in the lifestyle and behaviors within their communities. As action researchers and public health representatives within their community, the Bedouin students are better able to question and grapple with issues that other researchers or professionals may be able to access as well as translate knowledge for the target population [33].

The internship program included three phases:

1. The first stage included identifying a public health issue in the Bedouin community that needs to be addressed and conducting a literature review.
2. The second stage included the development of small-scale health-promotion interventions aimed at addressing the defined problem in their community using models, tools, and competencies taught and acquired during their studies. The students developed materials, mentored by the course instructors. The students were required to work with partners in the community and seek and gain collaboration from different organizations to finalize and conduct the intervention project that they developed.
3. The third stage included the implementation of their intervention. The students were responsible for presenting the sessions and leading the discussions in the community. The student conducted a process and outcomes assessment, which was presented at the end of the year in the college, as well as community and personal reflection.

The internship program included 11 students who conducted 6 community intervention projects. The program was assessed for its contribution to the integration of Bedouin students in the public health field, feedback on the effects of the projects in the community, and the influence of the projects on the students' perceptions and experiences.

3. Results

The interviews revealed common perceptions and experiences across the Bedouin student population. Analysis of the data from the interviews revealed three main themes: (1) facilitators for the decision to pursue higher education in public health, (2) challenges and coping strategies, and (3) experiences of success.

3.1. Theme 1: Facilitators for the Decision to Pursue Higher Education in Public Health

Most of the interviewees described the decision to pursue higher education as one that was made with significant encouragement from family members or high school teachers. Many students described the poor employment of their parents as a major factor affecting their decision to participate in higher education and the "Gateway to Academia" program. Most of the interviewees see the program as a significant tool helping them integrate into academic studies and appreciate the opportunity they have received to be better prepared for academia. They mentioned the challenge of meeting the requirements needed for enrolling in universities in Israel, in particular the psychometric test, which is mandatory for most of the academic tracks.

Many indicated their desire to study a field that could improve the health of their community as a main factor in the decision to study public health. Some students have relatives or other important role models who work in the health field or inspired them to enroll in the public health track.

Female student, 20 years old, second year:

> *The decision to study public health was not my decision but my teacher's. He told me that there is a field that he thought would suit me, I wasn't familiar with this profession and the teacher just pushed me into it. I discovered that I really like this field, the studies and the field are very interesting, and I was really attracted to it. I decided that I wanted to do a master's degree in public health because it is more interesting to me and important in my community.*

It is important to note that many of the interviewees described their former plan to study nursing but since they did not meet the admissions requirements, they decided to study in the public health track and attend an accelerated track for academics to transition to nursing in the future.

Male student, 19 years old, first year:

> *I came here at first because you can do an accelerated transition to nursing at the college after graduating in public health. My matriculation grades were high, and I wanted to study nursing because that's what I relate to the most. I took psychometrics several times, but I could not get a satisfactory score. But now things have changed, I want to do a master's degree in public health, I like the field.*

Female student, 23 years old, second year:

> *From a young age, I wanted and aspired to get into a higher education institution to study something related to medicine. I chose to study public health because it was the only way to get into nursing without the psychometric exam. I focus on moving on, telling myself that I will succeed because it won't help me to complain and stand still. I need to move forward. Everyone helps me, especially my parents.*

3.2. Theme 2: Challenges and Coping Strategies

The geographical distance and mobility barriers were mentioned by most of the students. As mentioned above, the Bedouin community suffers from insufficient internal and external public transportation networks, which affect students' mobility and access to the campus located about 60 km from the main Bedouin town and 80 km from most of the Bedouin villages. The support they receive from parents was mentioned as an important factor in coping with this barrier.

Male student, 19 years old, first year:

> *Coming here from my home is the most challenging aspect for me. Despite the distance, I wake up at five in the morning and make my way here. My father is one of the people who helps me out; every day he expresses his pride in me and wishes to see me succeed.*

Female student, 22 years old, third year:

> *My most significant difficulty all these years is that I come from far away to study here, and I must take so many bus trips that are hard for me. I leave the house really early in the morning and ask Allah to help me stay strong and finish this degree.*

Many of the participants stated that the language barrier significantly affects their ability to succeed. The language barrier often forced the Bedouin students to translate the learning material and lecturers into Arabic-Bedouin, causing them excessive workload and stress during their studies. Some have referred to the willingness of relatives and family members to assist in translation as a significant factor in their academic success. Others mentioned the assistance of their classmates and stated that forming close relationships with Hebrew-speaking classmates helped them better understand the language and the learning material.

Female student, 23 years old, third year:

> *The first year was very difficult for me, I did not know how to speak Hebrew well, and the language was very difficult for me. The hardest thing for me was the difficulty in expressing myself in class and also doing presentations in front of the class, it really challenged me. During the years I tried to explain myself to the Jewish students, the lecturers tried to understand me, and I tried to understand them and that's how it works out. I got used to it and learned to accept it.*

The students mentioned limited cultural competency in the academic system and among some of the academic staff as a factor that poses a challenge for them, especially in situations of asking for help from the academic staff. Female Bedouin students emphasized the continuous need to explain gender-based cultural challenges they face during their studies. For example, due to the socio-cultural structure of the Bedouin society and gender-based norms, Bedouin women feel embarrassment that prevents them from speaking in class during presentations or catching a ride from the village to the campus with a male student. In addition, several of the female Bedouin students are married and pregnant as expected from a woman their age in Bedouin society, which adds difficulties to maintaining a study routine and academic continuity. Nevertheless, the feelings of being a role model for women in the community and a sense of mission to promote the health of the Bedouin population were common among female Bedouin interviewees.

Female student, 22 years old, second year:

> *Socially it's not easy for me. Academically, in the beginning, it was hard, but the lecturers provided us with extra classes, and I see how I'm improving little by little. Without a degree, I am worth nothing, so it is important for me to succeed. The hardest part is presenting in front of the class, it scares me the most. I practice at home in front of my family, they correct me when necessary and advise me how to speak. They give me a lot of confidence and tell me not to be afraid and that I will succeed in the end. I want to study for an advanced degree in physical activity because it is lacking in the Bedouin community.*

Female student, 23 years old, second year:

> *I decided to go to higher education because I think that the Bedouin society needs to progress, Bedouin women are not sufficiently educated, and I decided to be one of those who are. Public health is a field of knowledge that I really like. I am less connected to the practice of medicine on an individual level, but more on a community level, and I think that this thing is lacking in our community, that's why I chose public health.*

Female student, 23 years old, third year:

> *According to my perception, every woman should have a bachelor's degree because I see that when a woman studies, her thinking changes. But it was difficult for me that people here at the academy did not understand our culture and our difficulties. Many times, I wanted to quit my studies and then I saw how far I had come, how much I had achieved. I continued my study, and it makes me the happiest. This is my greatest success.*

3.3. Theme 3: Experiences of Success

Overall, the students voiced experiences of success alongside the different challenges they face, in particular as they progress through their academic studies. All the interviewees mentioned good grades and the ability to continue to advance academic studies as the main success. Some of the first- and second-year students stated the ability to form good relationships with their Jewish peers and speak Hebrew fluently as an important accomplishment.

Female student, 20 years old, second year:

> *Some Jewish students like to talk to us, they mainly want to know about our culture, about our religion, so they ask, and we answer. It connects us and helps us to feel comfortable in class. In addition, it is very helpful to get assistance from Bedouin students in advanced years who give smart tips and advice. My most successful and significant experience in this degree is that I manage to connect with people and cope successfully with challenges in my studies.*

Third-year students specifically felt that they succeeded in the challenging journey of academic studies and described feelings of satisfaction, pride, and empowerment. Most of them stated that they feel self-confident in their academic and social abilities and their capability to cope with the academic challenges they faced during their studies. All of the Third-year students stated that they feel confident in their ability to contribute to and promote Bedouin community health.

Male student, 24 years old, third year:

> *I started academic studies on a different track at first. After a while, I decided to switch to the public health track. I realized that the issues of public health really interest me. I have an attention disorder, so it was very difficult for me. I searched and found methods to cope with the difficulty. I recorded the lectures and used other Jewish students' summaries in class. At home, I invested time in understanding the learning material and I succeeded. My academic achievements are high, and I am proud of myself for that. This is my biggest success, and it encourages me to pursue a master's degree in public health.*

3.4. Community Intervention Experiences in the Bedouin Community

During the internship, students experienced challenges and successes, implementing academic competencies, public health knowledge, and leadership as well as accountability skills in practice. The internship community projects covered a range of topics with different target populations (see Table 1). These topics were all selected based on the identification of an issue demanding action research and intervention within the Bedouin community.

All of the projects were coordinated with organizations in the community including schools, health organizations, municipal agencies, and NGOs. The projects were conducted in accordance with cultural norms as regards language, dress, and settings for example male public health students conducted meetings with men at community mosques; female public health students conducted physical activity promotion with adolescent girls in school.

Table 1. Overview of internship community projects in the Bedouin community.

Topic	Target Population	Intervention Design	Quotes from Participants/Key Findings
Prevention of congenital disorders	Women in childbirth years	Two sessions were conducted with the welfare department (N = 30); information sharing and discussions regarding the causes of congenital disorders and the importance of early screening.	I always thought that disorders/diseases were my fault, but I learned in this meeting that the responsibility is shared between my husband and myself.
Prevention of early childbirth	Women with a high-risk pregnancy	Qualitative focus group sessions (N = 7) which included discussions and provision of information.	There is a lack of workshops on childbirth. . . This is the first time the clinic invited us to participate in this type of program.
Promotion of healthy nutrition	Adolescent girls (15–16 years old)	Four sessions in a high school setting (N = 36) provision of information on healthy nutrition and body image; short pre-post survey.	During the program due to the success, there was a request for additional meetings. Adolescents reported higher rates of healthy nutrition.
Promotion of physical activity (PA)	Adolescent girls (15 years old)	Three sessions in two schools including the provision of information, PA sessions with an instructor, and a short pre-post survey; a school with a designated PA room for girls (N = 15) and a school without a designated PA (N = 15)	In schools with a PA room, there were higher PA rates in school; following sessions, both groups reported higher PA rates outside of school hours and a higher rate of in-school PA rates also in the school without a designated PA room. A joint WhatsApp group was developed to share positive feedback and promote social norms.
Smoking prevention	Adolescent boys and girls (13–14 years)	Three sessions in a middle school setting (N = 30), including provision of information, demonstration of effects of smoking, and short pre-post survey	Adolescents spoke about problematic norms, in the family, among peers, and in the community. My father prepares at least 10 nargila (hookah water pipe) heads for guests that visit over the weekend. We always buy cigarettes at the neighborhood shop and the owner doesn't even ask us who they are for (despite regulations).
Prevention of child unintentional injuries (backover crashes)	Men with children aged 0–4	Two sessions a month apart in the mosque (in multiple groups, total N = 50), provision of information, demonstration of the field of vision while backing up, and short pre-post survey	Significant increases in reported knowledge regarding distance in the field of view, behavior checking behind the vehicle prior to backup, and environment setting up a separation between the vehicle and play areas.

In a review of the internship program and the community projects, several key findings emerge at the community level:

- There is a lack of programs engaged in knowledge transfer in the field of health for members of the Bedouin community;
- Serious knowledge gaps exist in all of the health topics that were covered in the various community programs;
- Cultural norms are often a barrier to health-promoting behaviors;
- Bedouin children, adolescents, and adults voiced a desire for tailored information and programming by members of the community;
- Intervention programs that align with cultural norms have the potential to reach a larger audience.

In several cases, partners in the community project requested additional programming and recommended that the projects continue in some format. Program participants provided positive feedback and evaluation results were promising.

A review of the internship program also sheds light on the influence of the projects on the students' perceptions and experiences, including:

- Feelings of success, empowerment, and recognition of their vocation in increasing awareness and promotion of healthy behaviors within the community;
- Identification of knowledge gaps and cultural norms that may prevent the adoption of healthy behaviors within their community, particularly regarding gender disparities in the Bedouin community; for example, during recruitment for workshops with women, public health students met resistance from Bedouin husbands who would not permit their wives to attend;
- A desire to work within their community to continue to promote public health.

The internship program provided the Bedouin public health students with deeper insights into health determinants within their community and practical exposure to health promotion.

4. Discussion

The current study examined perceptions, needs, successes, and challenges experienced by Bedouin students during their studies and assessed an academic framework for implementing a field internship, including community intervention experiences, in the Bedouin community, as a tool to decrease academic and health disparities. Our findings help lay the groundwork for the future development of community-based interventions to alleviate education and health gaps among minority groups.

The interviews revealed common perceptions and experiences across the Bedouin student population. The main findings indicate that young Bedouins experience a major challenge in meeting the requirements needed for enrolling in universities in Israel and see the "Gateway to Academia" program as a valuable opportunity to help them integrate into higher education. This finding is in line with previous studies describing the admission procedures to higher education institutions as a significant obstacle to minority and disadvantaged populations acquiring higher education [21]. Admission procedures including psychometric exams are not good predictors of academic abilities among minority students, causing a culturally based disadvantage for students who wish to enroll in higher education institutions [34]. In this context, a structured population-tailored solution such as that offered by the "Gateway to Academia" program is valuable in assisting minority students to cross this deep socio-cultural barrier and improving the access and integration of the Bedouin community to higher education.

Several major challenges were mentioned by the Bedouin students: geographical distance and mobility barriers, language barriers, and cultural and gender-based barriers. These challenges mentioned in previous studies conducted among minorities and the Bedouin population need to be carefully addressed [19,22]. Since educational attainment is one of the key factors affecting the Bedouin community's socioeconomic status, it is important to develop innovative plans to promote education and professional development while addressing these social and structural barriers through necessary changes in government policy. Further consideration of appropriate additional support for Bedouin students, in particular during the first and most challenging year of academia, is recommended. Moreover, additional training on cultural competency for academic staff is recommended to improve their understanding and recognition of these aforementioned gaps. Cultural competency training of faculty and trainers in the health field is recognized as imperative to support a culturally diverse patient population [35]. Moreover, in public health, cultural competency training is recognized as essential to target population-based health and reduce health disparities, including culturally sensitive research, programming, and evaluation [36].

Along with the barriers mentioned, our students noted experiences of success in the challenging journey of academic studies and described feelings of satisfaction, pride, and empowerment. Considering most of them indicated their initial desire to study a field that could improve the health of their community as a main factor in the decision to study public health, it was encouraging to see that all of the third-year students stated that they feel confident in their ability to contribute to and promote Bedouin community health. These findings were further supported by their positive experiences conducting small-scale intervention projects in the community during the internship program. The beliefs and attitudes regarding increased self-efficacy that the Bedouin students developed over the course of their studies have the potential to contribute significantly to their future performance in the fields of public health practice and research [37,38].

Based on our experience implementing field internships in the Bedouin communities, higher education is crucial for empowering minorities, producing the leadership necessary for social and economic progress, and reducing socioeconomic and health gaps among minority groups. Moreover, the field internship enabled the necessary alignment between academia and public health practice, which is known to improve public health actions, by conducting population-adjusted and collaborative interventions for complex public health issues [39]. Involving Bedouin public health students in community-based participatory research and programming within their community adds the element of culture-centeredness, which is an important strategy in confronting social determinants of health and reducing health disparities [40]. Accordingly, the Bedouin students who participated in the internship had the opportunity to explore and gain an in-depth understanding of the ways to deal with the variety of health determinants in their community, initiating collaborations and obtaining leadership competencies that impact the lived experiences and realities of their community [41,42]. Finally, the community-tailored field internship offered undergraduate students exposure to potential employment opportunities after graduation, which may fulfill the need for highly qualified and skilled public health professionals with the appropriate foundation, practical experience, and knowledge of specific community structures [43,44].

This study has several limitations. First, the study was conducted in Israel, among a single minority group, the Bedouin community; therefore, it may be difficult to generalize the findings to other countries. In addition, we did not compare the experiences reported by the Bedouin students to those of other cultural groups of students. It is possible that such a comparison would have revealed additional organizational and social factors that may influence the students' experiences, difficulties, and successes. Nevertheless, we believe that our methodology, which included both qualitative interviews and the internship development and assessment, enables replication in other academic programs enrolling minorities aiming to decrease disparities among minority groups.

5. Conclusions

The integration of Bedouin students in academic studies is complex and challenging. It is important to reflect on the complete picture regarding the integration of Bedouin students in public health studies to adapt and meet the unique needs that were identified in this study. The findings of the research reveal the specific challenges and barriers students face in public health studies, as well as their achievements and successes, and enable a deeper understanding of the Bedouin student's perceptions and experiences. We believe that our experience with the integration strategies and the community internship model may be replicated in other academic programs aimed at decreasing disparities among minority groups.

Author Contributions: Conceptualization: O.B., A.S. and S.L.; methods design: O.B. and S.L.; data curation: O.B., A.S. and S.L.; analysis and interpretation O.B. and S.L.; writing-original draft: O.B. and S.L.; review and editing final draft: O.B., A.S. and S.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was approved by the Ashkelon Academic College Ethics Committee (Approval # 57-2023). Participants gave informed consent for inclusion in the study and were informed about the procedures planned for anonymity, data protection, and privacy.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data supporting this study's findings are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Acknowledgments: We deeply thank the students who participated in the research.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Semi-Structured Interview Guide:

The following interview is designed to learn from you about your experiences as a public health student here at Ashkelon Academic College. The interview is anonymous, your participation is completely voluntary, and you can request to stop the interview at any time.

1. Tell me a bit about yourself, how old are you and what year of academic study are you in?
2. Please share with me how you came to the decision to study in academia (institute for higher learning)?
3. Why did you decide to study your undergraduate degree in Public Health?
4. How would you describe your acclimation to academic studies? (Probe: Would you describe it as successful?)
5. Tell me a bit about any challenges you faced in your studies? (Probe: What would you say is the main difficulty or challenge)
6. (If there were challenges) How did you cope with the challenges? (Probe: What or who helped you?)
7. Do you feel you have support from your family?
8. Do you have any needs or requests that have not been resolved with the staff at the college?
9. Are you considering continuing for further academic or graduate studies at the end of this program?
10. Please share with me any successful experiences you had during your studies. (Probe: What would you say was the main successful experience? What helped you to be successful?)

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European Journal of
*Investigation in Health,
Psychology and Education*

Systematic Review

Interculturality in the Development of Technology-Mediated Courses for Massive Health Education: A Systematic Review

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Citation: Cunha, P.S.d.; Barbalho, I.M.P.; Fernandes, F.R.d.S.; Romão, M.H.; Rodrigues da Silva Valentim, J.L.; Dantas Coutinho, K.M.; Sampaio de Araújo, K.; de Medeiros Valentim, R.A.; de Pinho Dias, A.; Araújo do Nascimento Batista, N.; et al. Interculturality in the Development of Technology-Mediated Courses for Massive Health Education: A Systematic Review. *Eur. J. Investig. Health Psychol. Educ.* **2024**, *14*, 2754–2771. https://doi.org/10.3390/ejihpe14100181

Academic Editors: Ana Belén Barragán Martín and María del Mar Simón Márquez

Received: 1 July 2024
Revised: 17 September 2024
Accepted: 30 September 2024
Published: 8 October 2024

Abstract: Virtual Learning Environments have become innovative tools in health professionals education. Through Massive Open Online Courses, they enable different ways of connecting with knowledge, facilitating study autonomy, interaction, and closer alignment with professional practices and the context of course participants. MOOCs comprise an educational strategy for many fields, including health. As they educate health professionals about a variety of practices, MOOCs play a crucial role in interculturality by enabling professionals to approach cultural diversity in work settings. This study provides a review of the literature investigating the element of interculturality in the production of healthcare-related MOOCs intended for a variety of audiences, including practicing healthcare professionals, healthcare professional trainees, and the general public. Based on a systematic review protocol, we searched for peer-reviewed studies published between 2016 and 2023 in Science Direct, PubMed, ERIC, and Scopus. Fifteen studies were selected for final analysis, which highlighted MOOC development, its underlying processes, and its importance in promoting health and social well-being. MOOCs have (1) provided new approaches to technology-mediated learning in distance health education, (2) aided training, (3) disseminated knowledge, and (4) promoted interculturality. Continuous collaboration and innovation in MOOC development are essential to ensure their effectiveness and relevance in the contemporary educational scenario.

Keywords: virtual learning environment; MOOC development; interculturality; health training; distance education; technology-mediated education

1. Introduction

Health practices and care are significantly influenced by the cultural (including customs, beliefs, and religions), historical, social, political, and economic aspects of the territory in which the health professional works. In this process, interculturality appears as a fundamental element to be considered in health professional education. The implementation of cultural safety and anti-racist practices, as well as the promotion of equity in medical care, are actions that can reduce health disparities. In addition, they can improve communication between healthcare professionals and patients from different cultural backgrounds to create a more inclusive and equitable healthcare environment [1].

The concept of interculturality was coined to represent a set of ideas aimed at democratic coexistence between diverse cultures. Martín et al. [2] describe it as the process of interaction and exchange between different cultures aimed at mutual understanding, valuing diversity, and building peaceful and harmonious coexistence. From this perspective, interculturality involves recognizing and respecting cultural differences and promoting intercultural dialog and cooperation between diverse groups.

In Raymundo's view [3], promoting interculturality means pursuing contextualized dialog based on the experiences of each interlocutor to achieve effective and not just superficial communication. Some factors contribute to interculturality in its broadest sense, e.g., knowing the other person's culture, recognizing one's own culture, eliminating or neutralizing prejudices, establishing empathetic relationships, and recognizing metacommunication, which is not an obvious element. Put succinctly, metacommunication involves the investigation and analysis of implicit and non-verbal messages, which are often subtle and not obvious [4].

Interculturality encourages the construction of an inclusive and plural society in which diverse cultural identities are recognized and valued. However, the realization of such a society is confronted with significant challenges. They relate to the existence of stereotypes, prejudices, inequalities, contradictions, and conflicts. There are also those factors that hinder metacommunication, such as ignorance, universalization based on one's concepts, and the overvaluation of differences.

In line with the perspectives of cultural diversity and interculturality, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has been working towards recognizing equality and the definition of intercultural diversity to adopt new social and humane policies [5]. Interculturality aims not to separate the universal from the particular but to bring together and organize an integrative social and relational context. Therefore, it is necessary to consider this pluralism to promote dialog between different types of knowledge since the common objective between them is to seek balance or health through care [3].

The intercultural approach to health, or interculturality in health, means the set of actions and policies that seek to recognize and incorporate the user's culture into the healthcare process. The cultural relevance of such a process surpasses the exclusively ethnic dimension, as it implies valuing biological, cultural, and social diversity as essential elements in all health and disease processes [2]. This is attributable to the strong influence of cultural, historical, social, political, religious, and economic aspects on health care [3,6]. Therefore, the intercultural approach comprises an innovative way of considering the aspects that impact individual well-being.

When it comes to health professional education, interculturality elements are relevant for the promotion of learning environments with enriching interactions between professionals from different cultural backgrounds [7]. This could help train health professionals that provide more empathetic and effective care, respecting the uniqueness of each individual's cultural context.

Owing to the importance of interculturality in promoting equity in health and in training professionals capable of recognizing and valuing cultural diversity, there is a need to investigate the presence and effectiveness of intercultural elements in courses offered by Virtual Learning Environments (VLEs), looking at the production process of MOOCs in health. In turn, intercultural dialog is relevant not only among distinct cultures and identities but also across different knowledge fields. Thus, interculturality in health can be seen as the complementarity between various perspectives on the same health problem, established through dialog and exchange. It is about the coexistence of different worldviews in a complementary way, without prejudice or the imposition of one over the other [3].

Health training is increasingly recognized as a fundamental element in improving the clinical practices of health professionals to promote individual and collective health in Indigenous and, above all, intercultural contexts for the definition of health policies [8]. Over the last two decades, technology-mediated training has been adopted as an essential strategy for promoting health education [9]. VLEs are a case in point, as they have been used to promote innovative educational practices in the training of health professionals and the general population. This allows new ways of connecting with knowledge, autonomy in study and interaction, as well as greater proximity to professional practices and specific contexts.

VLEs provide the environment for the dissemination of Open Educational Resources (OERs). OERs are "learning, teaching and research materials in any format and medium that reside in the public domain or are under the copyright that has been released under an open license, that permits no-cost access, re-use, re-purpose, adaptation and redistribution by others" [10]. OERs on health topics can be developed to meet the specific needs of different population groups, offering culturally sensitive information adapted to different socioeconomic contexts. Some examples include OERs that cover the prevention, diagnosis, and treatment of syphilis and other Sexually Transmitted Infections (STIs) or learning pathways aimed at the prison system [11]—with OERs adapted for very specific audiences such as people deprived of liberty, prison officers, and health workers operating in prisons.

Courses known as Massive Open Online Courses (MOOCs) are hosted in VLEs with the intent to broadly disseminate information, including OERs. They are scalable, offer learners the flexibility of time and space, and can disseminate information rapidly to address public health crises and facilitate intercultural dialog. MOOCs are designed to involve many participants in remote learning, which can include health care related topics. MOOCs are also a means for social inclusion, as they are efficient for massively disseminating educational content across diverse groups globally [12].

The adoption of educational practices supported by MOOCs has openly boosted the dissemination of knowledge free of charge in certain VLEs, contributing to the promotion of a culture of sharing and collaboration. In the field of health, this dissemination of knowledge is especially relevant, as it allows important information on prevention, treatment, and health care to reach a wider and more diverse audience [8]. In this sense, access to OERs has significantly contributed to tackling health crises and emergencies worldwide, reaching different regions and cultures in a broad, accessible, and equal way [13].

In this context, it is essential to develop expertise in the production of educational resources that meet the demands of training in the health area. Education mediated by technology has peculiarities that require greater care regarding communication and the use of Information and Communication Technologies (ICTs) in the teaching-learning process, in pedagogical strategies, and in the educational methodologies necessary for the construction of knowledge [11]. Thus, creating a MOOC requires a careful construction of teaching material.

MOOC production in the health field entails several stages, including planning, content development, technical review, instructional design, and platform integration. In the context of continuing health education, the process aims to improve distance learning for health professionals, ultimately enhancing their ongoing training and professional practices [14].

In view of the above, this study aims to conduct a systematic literature review to investigate the element of interculturality in the production of MOOCs in the health field, exploring the role of these courses as fundamental tools for promoting the education process of health professionals.

2. Materials and Methods

This review followed the systematic review guidelines proposed by Kitchenham [15] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist [16]. Systematic Literature Reviews (SLRs) provide a structured analysis of the available evidence and assist in detecting patterns, gaps, and trends within the existing body of literature. In addition, they permit comparisons of practices, methodologies, and results across different studies, providing valuable insights into the research practices undertaken and indicating new directions for future research [17].

Our primary focus was to investigate the element of interculturality in the production of MOOCs in the health field, emphasizing the role of these courses as fundamental tools for promoting the education process of health professionals. We also sought to identify features of the development process, such as production planning, content definition, target audience, platform for provision, platform for access, and definition of the professionals involved in MOOC development [11,18]. Four research questions (RQs) were defined to obtain relevant information and achieve the research objective (see Table 1).

Table 1. Research questions.

No.	Description
RQ01	How are MOOCs being developed in the health field, and what are the stages involved in the production process?
RQ02	What are the main elements/characteristics of interculturality applied in MOOC development?
RQ03	Do MOOCs contribute to improving distance education in health?
RQ04	What methodologies are employed in MOOC production, and how is interculturality incorporated into such methodologies?

Articles included in this review were retrieved from the ScienceDirect, PubMed, ERIC, and Scopus databases in March 2023. The following search string was applied: ("distance education" or "virtual learning environment" or "VLE") AND ("massive open online courses" or "MOOC") AND ("human training in health" or "health education"). The selection process was performed in three stages: (i) identifying and organizing the articles; (ii) screening the articles according to inclusion and exclusion criteria; and (iii) analyzing the articles according to their quality.

In stage (i), the first set of articles returned from the database search was identified. In stage (ii), inclusion and exclusion criteria were defined (see Table 2). The set of articles obtained in stage (i) was screened according to the inclusion criteria (IC) applied in the databases. Subsequently, exclusion criteria (EC) were applied with the aid of the Rayyan web platform [19], generating the set of articles for quality criteria assessment.

Table 2. Inclusion and exclusion criteria for articles retrieved.

Inclusion Criteria	Exclusion Criteria
IC01—Studies published from 2016 to 2023	EC01—Duplicate articles
IC02—Original articles published in academic journals	EC02—Review articles
IC03—Articles on the area of distance education in health	EC03—Studies not related to distance education in the field of health

We included peer-reviewed articles published between 2016 and 2023. The decision to include studies published from 2016 onwards follows the Qingdao Declaration from UNESCO [20]. The declaration calls for the development of comprehensive strategies and training programs to harness the potential of OERs and promote the integration of ICT into education. The IC01 was also based on the need to capture and analyze the current state of practice and research in the field under investigation. The timeframe analyzed enabled a comprehensive view of emerging trends, technological innovations, and changes in educational approaches considering cultural diversity [21]. By concentrating on recent studies, the review sought to update knowledge of how different cultures are integrated into VLEs, identifying successes, challenges, and shortcomings. In addition, such temporal delimitation facilitated comparison across studies, providing consistency to the criteria and valuable insights for future educational practices and research.

During stage (iii), the articles retrieved from the previous stages were fully screened and assessed according to the quality assessment (QA) criteria (see Table 3). At this stage, the articles were assessed using the arithmetic mean of the weights (w) assigned to each quality assessment criterion, according to Equation (1) [13].

$$score = \frac{1}{n_{QA}} \sum_{i=1}^{n_{QA}} w_{QA_i} \tag{1}$$

where:

- n_{QA}: total number of criteria for QA;
- w_{QA}: value corresponding to the weight assigned to the QA criteria under analysis.

Table 3. Quality Assessment Criteria.

No.	Description
QA01	Does the study address the production process and stages of MOOCs in the field of health?
QA02	Does the study address the main elements/characteristics applied to interculturality in MOOC development?
QA03	Does the study address the contribution of MOOCs to improving Distance Education actions in the field of health?
QA04	Does the study address the methodologies adopted in MOOC production? Was interculturality incorporated into such methodologies?

The weight value measures the extent to which a study meets a given QA criterion, with 1.0 being the most relevant weight and 0 the least relevant, according to Equation (2). Primary articles scoring 0.5 or higher were considered eligible (i.e., $0.5 \leq score \leq 1.0$).

$$\begin{gathered} wQA = 1.0\text{, yes, it fully describes,} \\ 0.5\text{, yes, it partially describes,} \\ 0\text{, it does not describe.} \end{gathered} \tag{2}$$

Studies from other sources were included via another method, where a further search included studies on health education. To accomplish this, search methods were applied in academic research platforms, including SciELO, Educapes, and EDUFRN. These searches were actively conducted, employing the keywords "health education" and "MOOC". This process made it possible to widen the research scope, as well as to incorporate relevant studies, therefore contributing to a more comprehensive approach to the subject. Figure 1 describes how the study search and selection process was conducted.

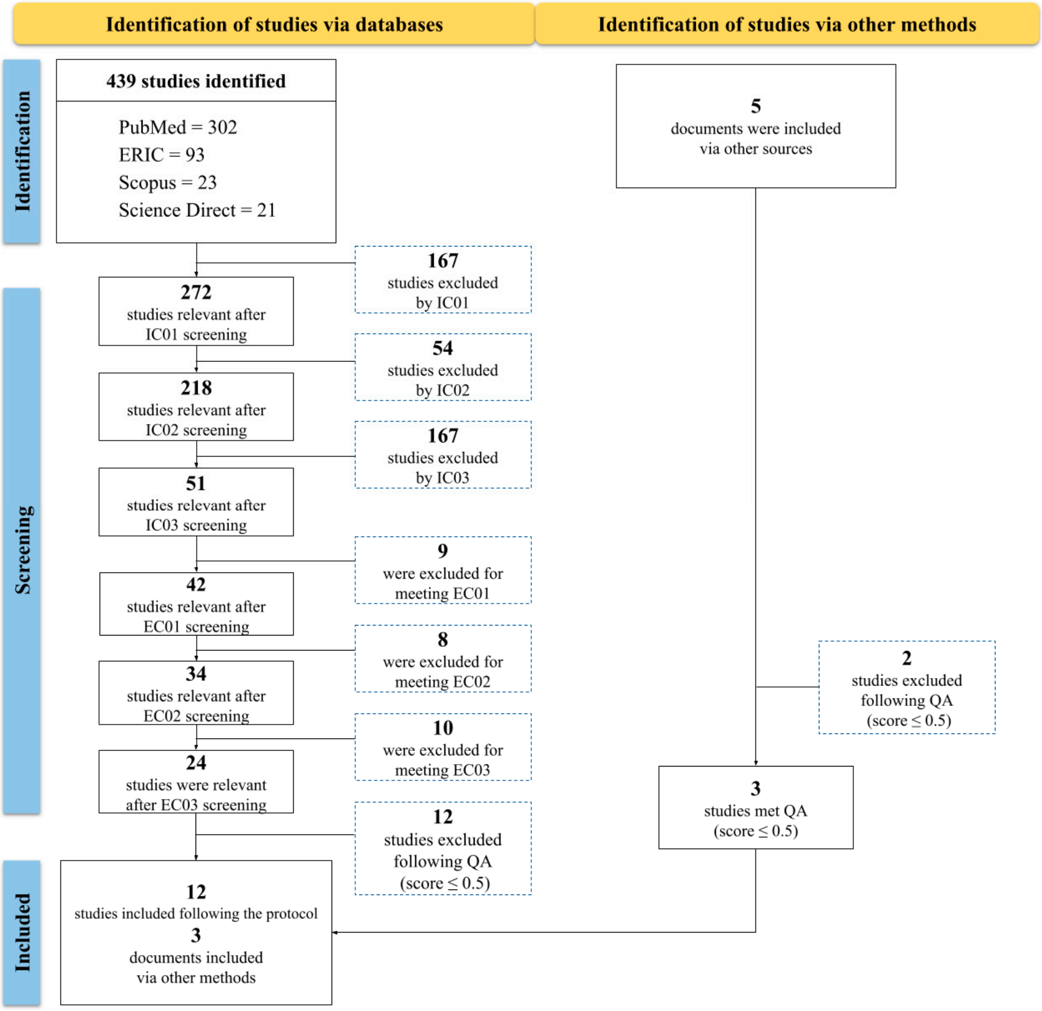

Figure 1. Protocol for identifying, screening, and including studies in the review.

3. Results

In the identification phase, the search conducted in the established databases resulted in 439 selected articles (Figure 1). Subsequently, IC and EC were applied, as well as the QA criteria used for study selection. This resulted in a sample of 24 articles for analysis. From this sample, 12 were excluded during evaluation for not reaching the minimum score stipulated (score $\leq$ 0.5). Finally, 12 articles remained for inclusion in the review.

Moreover, five additional articles were identified through an independent search strategy to broaden the research scope and include other relevant studies in health education. These articles underwent the QA process, resulting in the exclusion of two studies due to insufficient scores. This resulted in three being selected for the review. At the end of the process, 15 articles were selected for a detailed analysis with the aim of answering the research questions.

Figure 2 shows an analysis of the references included in the systematic review in terms of the RQ. As mentioned, a total of 15 articles were selected that addressed the issue of how MOOCs are being produced; 11 of them discussed elements and characteristics of interculturality applied in the MOOC production process; 15 were found to have contributed to a process of technology-mediated education in the health field; and 15 indicated the methodologies used in the MOOC production process and how the theme of interculturality is reflected in these methodologies.

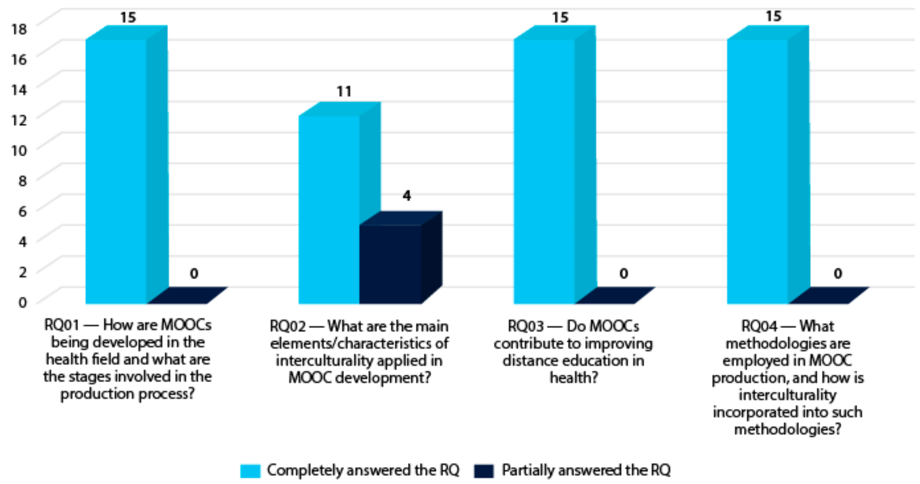

Figure 2. Analysis of the studies in the systematic review according to the RQ.

Table 4 shows the 15 studies selected for this review, describing the title, authors, and year of publication. The journals were peer-reviewed and published in English and/or Portuguese. The studies covered the production process of MOOCs, aspects of interculturality, and the benefits of distance health education, presenting information relevant to achieving this research goal. In this context, the research questions are answered below.

Table 4. Studies selected for systematic review based on the protocol to search for articles published between 2016 and 2023.

n	Citation	Year	Title	Country
1	Álvarez-Pérez et al. [22]	2022	Co-Creation of Massive Open Online Courses to Improve Digital Health Literacy in Pregnant and Lactating Women	Spain
2	Burlamaqui et al. [23]	2016	Design instrucional para cursos a distância: Um guia para construção de material didático do AVASUS	Brazil
3	Caitano et al. [11]	2022	Massive health education through technological mediation: Analyses and impacts on the syphilis epidemic in Brazil	Brazil
4	Eglseer [24]	2023	Development and evaluation of a Massive Open Online Course (MOOC) for healthcare professionals on malnutrition in older adults	Austria
5	Gilligan et al. [25]	2018	Using MOOCs to Promote Digital Accessibility and Universal Design, the MOOCAP Experience	Ireland, Norway, and Greece
6	Gomes Oliveira et al. [13]	2019	A estruturação de um MOOC para capacitação em pesquisa bibliográfica em bases de dados de enfermagem	Brazil
7	Kusnoor et al. [26]	2021	Design and implementation of a massive open online course on enhancing the recruitment of minorities in clinical trials—Faster Together	United States
8	Longhini et al. [27]	2021	What knowledge is available on massive open online courses in nursing and academic healthcare sciences education? A rapid review	Peru
9	Maxwell et al. [12]	2018	Massive open online courses in U.S. healthcare education: Practical considerations and lessons learned from implementation	United States

Table 4. *Cont.*

n	Citation	Year	Title	Country
10	Oliveira & Gerhardt [28]	2022	O primeiro Curso Aberto, On-line e Massivo (Mooc) sobre COVID-19 e iniquidades no Brasil: potências da saúde coletiva no enfrentamento da infodemia e das fake news	Brazil
11	Patiño-Toro et al. [29]	2023	Proposed methodology for designing and developing MOOCs for the deaf community	Colombia
12	Pessoa et al. [30]	2021	Massive Online Open Course como estratégia para o ensino de segurança no processo de medicação	Brazil
13	Ponnaiah et al. [31]	2022	Design and implementation challenges of massive open online course on research methods for Indian medical postgraduates and teachers -descriptive analysis of inaugural cycle	India
14	Rodrigues & Rossi [32]	2020	Guia de Referência para criar MOOCs: Storytelling integrado ao modelo ADDIE	Brazil
15	Sneddon et al. [33]	2018	Development and impact of a massive open online course (MOOC) for antimicrobial stewardship	Scotland

3.1. RQ01—How Are MOOCs Being Developed in the Health Field, and What Are the Stages Involved in the Production Process?

According to the 15 studies included in this systematic review, the production of MOOCs in the health field has been undertaken by teams, professors, and professionals within the field in a series of stages. These stages range from planning to launching the course on an online platform.

On the platform of the Virtual Learning Environment of the Brazilian Health System (AVASUS), developed by the Laboratory for Technological Innovation in Health (LAIS) of the Federal University of Rio Grande do Norte (UFRN), the production of MOOCs follows certain criteria for the development of courses.

MOOC development includes a series of important stages, such as course planning, training of content creators, content development, technical and scientific review, pedagogical review, instructional design—i.e., how the content will be presented to course participants—, language style standardization, educational resources formatting, integration into the VLE, validation of the content to ensure its quality, and the final launch. All these stages involve teams from different fields, such as education, communication, design, health, information technology, engineering, accessibility, and linguistics [23].

For instance, this process includes the ADDIE model, a methodology that follows five stages: Analysis, Design, Development, Implementation, and Evaluation, which has been applied to the Moodle platform. Notably, renowned institutions such as the Open University of Portugal, the University of London, the University of Puerto Rico, New York University, the University of Edinburgh, and the University of Queensland have adopted this model.

According to Rodrigues & Rossi [32], the ADDIE production model is characterized by the analysis of course objectives, verification of the target audience, and definition of skills and knowledge. The aim is for participants to be guided and to set realistic expectations of the course, contributing to a more efficient and satisfying learning experience, and for the course design to ensure that the content is well-structured, engaging, and effective in sharing the intended knowledge [32].

From the perspective of MOOC production in the health area, i.e., the focus of this study, Valentim et al. [34,35] highlighted the need to increase scalability. It pertains to the reach of these courses when offered on the platforms, as they must reach many health professionals across the different geographical regions of the country. In addition, the authors pointed out the need to develop strategies in the production process, such as more dialogical and enjoyable content to fit in with the study routine of these professionals and reflect the dynamic reality of the Brazilian Health System (SUS). It is worth noting that the dialogical approach involves the creation of content that promotes interaction and exchange of ideas among MOOC students, facilitating active and participatory learning.

Longhini et al. [27] mapped data through a sample, making it possible to identify trends, patterns, and common characteristics of MOOCs. This study used methods and tools to measure learning outcomes and factors that increased the effectiveness of the courses, ensuring continuity of education in undergraduate and postgraduate programs in the Health Sciences. The students' motivation and involvement led to a high level of knowledge, skills, and health literacy.

Some authors show that the courses produced went through stages of translation before being published on the VLE platforms [11,25,26,28,30,31]. In other words, there was a need for another stage in the production process to make the content more accessible when it comes to issues related to language and local culture.

According to the articles analyzed in this review, MOOCs have been developed following sequential production stages by means of prior planning according to local and cultural needs, whether these are those of the region or the country. After the planning stage, the content was developed in its raw format. The educational resources were then developed using elements such as videos, texts, clinical trials, design, accessibility, and other formats. It is important to note that the accessibility features included audio volume control for people who are hard of hearing, the use of voice commands on the computer, and biometric alternatives, which are technological combinations that facilitate communication, the learning process, and social inclusion. The final stage of this process consists of evaluation, followed by making the course available to the public on the VLE.

3.2. RQ02—What Are the Main Elements/Characteristics of Interculturality Applied in MOOC Development?

By analyzing the selected articles, it was possible to identify some characteristics and elements applied in the production process of MOOCs involving the theme of interculturality. In the studies, interculturality was taken into account and used during the content proposal according to the need to produce and offer courses. The purpose was to reach a specific audience to promote policies and good practices, interaction, and understanding on the subject, as well as respect between different cultures and groups.

In these studies, accessibility, global reach, diversity of participants, flexibility, autonomy, technology, and interactivity were all strengths of MOOCS. In terms of limitations, we observed superficiality in interactions, inequalities in access to technology, challenges in moderation and mediation, and cultural context limitations. These were related to ineffective communication, which could not encompass cultural differences, thus hindering mutual understanding and homogeneity of teaching materials.

The MOOCs reported by Caitano et al. [11] included people in situations of vulnerability, including LGBT people (Lesbian, Gay, Bisexual, Transgender), men who have sex with men (MSM), and people deprived of liberty. In addition, the MOOCs also contain topics related to syphilis in pregnancy and prenatal care, vertical transmission of syphilis, congenital syphilis, testing and diagnosis, public health surveillance, primary health care, general information on syphilis, and other STIs. In this way, the MOOCs present interculturality in the sense of addressing relations to health processes, prevention, and care, respect for differences, diversities, as well as mutual enrichment.

Álvarez-Pérez et al. [22] discussed the development of a pilot project to improve health through digital literacy from electronic sources. The pilot project provided a study with adult and adolescent patients with type 1 and 2 diabetes, in which it was possible to interpret information about the patients' health online. The approach allowed these people to interact with health professionals, which promoted greater self-management of health conditions, healthier lifestyles, diabetes control, and quality of life. In the context of interculturality, the MOOC included patients from three countries: Spain, Italy, and

Sweden, allowing for cultural exchange, using medical systems, improving accessibility, equity, integration of health care, humanization, and continuity of care. It also fostered good practice, interaction, and understanding of the course theme.

Kusnoor et al. [26] described a MOOC carried out by a transdisciplinary working group of clinical researchers, specialists in developing work with groups or communities in situations of vulnerability, educators, and knowledge management scientists. The aim was to improve minority recruitment through effective strategies. Interculturality was contemplated in the MOOC with racial and ethnic minorities who were threatened by the generalization of results in clinical trial recruitment processes.

Patiño-Toro et al. [29] developed a project for deaf and hard-of-hearing individuals. At the time, the MOOCS combined different methodologies and educational resources to cater to this group, using tools and content that facilitated the learning process and social inclusion. In addition, elements of interculturality were used, building values such as respect, citizenship, equality, democracy in education, and human rights.

As for Eglseer [24], the development of the MOOC covered the subject of malnutrition in the elderly, an innovative form of nutritional education to train health professionals to care for this specific group and correct malnutrition immediately and effectively. The course contributed to improving knowledge related to oral food intake, medical nutrition, and multidisciplinary cooperation between health professionals. The contributions were evaluated using pre-tests and post-tests, feedback questionnaires to measure the degree of satisfaction of the participants, performance evaluation, analysis of participation in forums and cooperation activities, interviews and focus groups, and descriptive results. By adopting these multi-faceted evaluation approaches, the researchers had a comprehensive view of the course's impact and future improvements. As a result of the research, according to the paper, the MOOC improved the malnutrition rate and increased the knowledge of the professionals who deal with that group. In terms of interculturality, it has elements linked to social and cultural factors, as well as good practices, interaction, and understanding of the subject.

Ponnaiah et al. [31] show the development of an introductory MOOC on biomedical research to serve a medical education body in India by presenting knowledge in epidemiology and biostatistics. The intercultural elements and characteristics of the course addressed sustainability issues. In addition, they have enabled inclusive medical education in India capable of catering to racial/ethnic diversity, including low-income participants. According to the authors, with MOOCs already available online for users, it was also possible to share cultural knowledge involving other countries facing epidemiological crises and conditions of social inequality. This has enabled people around the world to access quality education and learning experiences inclusively, without significant geographical or financial barriers.

Sneddon et al. [33], in partnership with the University of Dundee and the British Society for Antimicrobial Chemotherapy (BSAC), developed a MOOC capable of meeting the global need for education to support antimicrobial stewardship in low- and middle-income countries. The course engaged participants with traditional health education methods, supporting clinical practices in an intercultural approach. In this way, the course was accessible to a global multi-professional audience, covering a variety of clinical backgrounds and social interactions, enabling the acquisition of new knowledge and skills for clinical practice. The elements of interculturality related to the study concern social inclusion, cultural diversity, and access to education.

In the study by Gilligan et al. [25], a MOOC was developed for the medical community. The development of the curriculum was influenced by research and experience in line with the European Committee for Standardization (CEN) Workshop Agreement and the main accessibility resources for people with disabilities. The intercultural elements identified involved accessibility for people with disabilities. Issues related to blindness and low vision, deafness and hearing loss, learning difficulties, cognitive limitations, limited movement, speech difficulties, photosensitivity, and combinations of these elements were addressed with the medical community.

Oliveira & Gerhardt [28] developed a MOOC on the worsening of social inequalities in the context of the COVID-19 pandemic, covering the area of public health and the fight against inequalities. The elements of interculturality related to the study, namely social inclusion, cultural diversity, and access to education, allowed for the exchange of information, communication, and knowledge shared with society. They also motivated feelings of collectivity in favor of a more just, equitable, and supportive society, responding to the urgency of dialoguing with society about science and health. Table 5 summarizes the findings based on the literature analyzed in response to RQ02.

Table 5. Summary of the results to RQ02 based on the literature reviewed.

Author	Course Content	Specific Target Audience	Key Elements of Interculturality				
			SI	**CD**	**CE**	**AE**	**AD**
Álvarez-Pérez et al. [22]	Development of a pilot project to improve health through digital literacy from electronic sources.	Health professionals	x	x	x	x	
Caitano et al. [11]	Studies on the inclusion of people in vulnerable situations.	LGBT (Lesbian, Gay, Bisexual, Transgender) groups, men who have sex with men (MSM) and people deprived of liberty	x	x		x	
Eglseer [24]	Development of a course on Malnutrition in the elderly.	Nurses, nutritionists, physicians, and other health professionals	x	x		x	
Gilligan et al. [25]	Development of work on digital accessibility and online courses with more in-depth and focused learning topics.	Information and Communication Technology (ICT) professionals	x			x	x
Kusnoor et al. [26]	Development of work to improve the recruitment of minorities (groups or communities in vulnerable situations) through effective strategies.	Health professionals	x	x		x	
Oliveira & Gerhardt [28]	Development of the first MOOC in the field of public health on COVID-19 and health inequities.	Health professionals	x	x		x	
Patiño-Toro et al. [29]	Development of work aimed at adequately assisting people with special needs in educational processes. (Hearing Impairment)	Health professionals	x			x	x
Ponnaiah et al. [31]	Development of a basic course on research methods for postgraduate doctors (PGs) and members of the teaching staff of medical institutions.	Professionals with a medical degree	x	x		x	
Sneddon et al. [33]	Development of a course to meet the global need for education and support antimicrobial stewardship in low- and middle-income countries.	Health education professionals	x		x	x	

Key: SI = Social Inclusion; CD = Cultural Diversity; CE = Cultural Exchange; AE = Access to Education; AD = Accessibility for People with Disabilities; x = indicates the presence of a key element of interculturality in the study.

In general, the articles in Table 5 presented elements and characteristics of interculturality. As for the characteristics of MOOCs, two points stood out. MOOCs (1) promoted knowledge about the culture of other individuals, emphasizing values such as respect, citizenship, equality, democracy in health education, and human rights, and (2) fulfilled their purpose of being offered to a large audience.

3.3. RQ03—Do MOOCs Contribute to Improving Distance Education in Health?

The studies analyzed indicated that MOOCs positively contributed to technology-mediated health education, bringing attractive and up-to-date content to the population and improving the training of health workers. The articles analyzed demonstrated the potential of using MOOCs in the teaching and learning process. In addition, MOOCs integrate digital technologies and innovative content, enhancing this process and enabling interaction between students and teachers in VLEs. The content covered in MOOCs tends to make a positive contribution to the community, providing more knowledge on the proposed topics and with great potential for scalability.

According to the studies analyzed, MOOCs are opportunities of great social value, with the potential to impact distance education in health to improve teaching and encourage institutions to develop MOOCs for different groups through innovative pedagogical practices and learning flexibility [31].

Based on the studies and from an interculturality standpoint, MOOCs have contributed to improving technology-mediated education in the health field, as they have provided dialogs and interrelationships between peoples and cultures, shared knowledge, expertise, and experiences, generating sociocultural recognition.

In the view of Ponnaiah et al. [31], MOOCs contribute to improvements in technology-mediated health education due to the dissemination and multiplication of knowledge, the flexibility of time and space, the supply of variable content, and the stimulation of interaction among participants.

Álvarez-Pérez et al. [22] note that MOOCs advance the dissemination of health information by increasing opportunities to (1) access information when it offers opportunities to access digital health in any geographical location; (2) increase engagement as MOOCs offer interaction between participants, ensuring relevant, understandable, and useful content for the target audience—in this case, healthcare professionals and people with diabetes; (3) offer data analytics and assessment, because this MOOC offers valuable results and information as an educational tool, and (4) provide scalability, due to the scope of the training, reaching a large number of people.

Caitano et al. [11] analyzed MOOCs released during the syphilis epidemic in Brazil, offering insights into the role of distance education in health. The authors observed that extending MOOC reach by leveraging technology could encompass wider audiences compared to traditional educational methods. Their study also demonstrated two aspects related to MOOCs. First, MOOCs promoted access to information on syphilis, prevention, diagnosis, and treatment for individuals across the country, including those in remote areas with limited access to health services. Second, they enhanced community engagement by promoting awareness campaigns and preventive measures on syphilis, social media interaction, and active user participation. Lastly, the authors demonstrated the effectiveness of impact assessments, describing the potential of this approach in reducing disease incidence and improving health outcomes.

In the view of Oliveira & Gerhardt [28], the MOOC contributed to technology-mediated education in health by providing broad access to knowledge about COVID-19 and its implications in terms of public health and inequalities; a focus on health inequities, promoting a deeper understanding of health disparities and encouraging actions to mitigate inequalities; combating infodemic and fake news, promoting public health and preventing the spread of false information; as well as interdisciplinary collaboration, providing an integrated and holistic approach to dealing with public health challenges, enriching the educational experience of course participants.

Kusnoor et al. [26] dealt with the inclusion of minority groups in clinical trials and the promotion of equity in health. The improvements contemplated in this study include broad access, training health professionals, and promoting health equity. The MOOC reported by Patiño-Toro et al. [29] promotes distance education in health for the deaf community, helping to overcome barriers and promoting inclusion and training. In this sense, this MOOC addressed health education components such as accessibility, social inclusion, empowerment, and professional development.

3.4. RQ04—What Methodologies Are Employed in MOOC Production, and How Is Interculturality Incorporated into Such Methodologies?

Based on this review, the methodology generally used in the development of MOOCs is action research, which is empirically based social research that is designed and conducted in close association with an intervention or a collective problem resolution. In this process, researchers and participants, representatives of the issue or problem, engage in a cooperative and participatory way [36]. In such a methodology, several strategies have been applied to accomplish the proposed objective, which depends on the MOOC scope and proposal. It was observed that the MOOC production process allows for a dynamic integration between research and practice, enabling course creators to adapt their strategies based on the results obtained along the way. Given this context, Table 6 summarizes the findings based on the literature analyzed in response to RQ04.

Table 6. Summary of the results to RQ04 based on the literature reviewed.

Authors	Methodological Approach	Methodological Description
Kusnoor et al. [26]	Action Research	Critical analysis of available literature to support the development of courses and underpin their theoretical basis.
Caitano et al. [11], Eglseer [24]	Data and Impact Analysis	Evaluation of the impact of courses on participants' learning and clinical practice as evidence of their effectiveness.
Maxwell et al. [12], Álvarez-Pérez et al. [22]	Discussions and Research	Collection of feedback and opinions from participants, contributing to the continuous improvement of the courses.
Gilligan et al. [25], Ponnaiah et al. [31], Sneddon et al. [33]	Educational studies	Evaluation of the effectiveness of specific interventions in the courses, ensuring an evidence-based approach.
Gomes Oliveira et al. [13], Pessoa et al. [30]	Evaluation of Quantitative and Qualitative Data	Comprehensive analysis of course results, combining quantitative and qualitative data to achieve deeper insights into the participants' experience.
Maxwell et al. [12], Gomes Oliveira et al. [13], Sneddon et al. [33]	Incorporation of elements of interculturality	Integration of professionals from different cultural backgrounds and specialties, with adaptation of course content to reflect diverse cultural values and practices.
Maxwell et al. [12]	Interviews	In-depth comprehension of students' needs and expectations, providing valuable insights for course development.

The methodologies used in MOOC development have been found to incorporate elements of interculturality in several forms, bringing together professionals from different cultural backgrounds and areas of specialization in a collaborative and interdisciplinary process [13]. This process can include language adaptation, e.g., content translation into several languages, consideration of specific cultural values and practices, and incorporation of examples, feedback, and cases relevant to diverse communities [12].

Such methodologies aimed to promote inclusiveness and accessibility in courses, enabling a wide range of people, irrespective of their cultural background, to benefit from the knowledge shared through MOOCs [33]. Finally, the variety of methodological approaches reflects the wide range of strategies for achieving course objectives based on specific needs. This aspect may also enhance the production of MOOCs and the careful construction of the OERs.

4. Discussion

MOOCs are known for their global accessibility, flexible scheduling, variety of content, and innovative teaching approaches, making them a promising tool for educating the public, healthcare providers in training, and practicing healthcare professionals [37]. The production of MOOCs in health is an important strategy for improving medical training in primary health care (PHC), i.e., the first level of health care in Brazil related to low-complexity services. In the context of the Brazilian National Health System (SUS, for its acronym in Portuguese), this strategy can provide interventions related to the reality of the territory [38]. Some examples of this are the interventions implemented by the "More

Doctors Program"—a Brazilian government program that seeks to place physicians in regions where there is a shortage or absence of these professionals—and primary health care programmatic actions. Our findings suggest that the use of MOOCs for technology-mediated health training could shape the work of these professionals [39].

From the perspective of Valentim et al. [40], producing MOOCs in the health area involves a series of essential steps to ensure the quality and effectiveness of these courses. In the process, it is essential to carry out pilot tests and continuous evaluations to identify and correct any problems and guarantee the quality of the course. In addition, it is important to consider accessibility, making the course accessible to people with visual, hearing, or motor disabilities.

To summarize the findings of the first of our four RQs, the process of producing MOOCs in the health sector requires careful planning, an appropriate pedagogical approach, and the use of innovative educational technologies to offer quality teaching that is accessible to many people.

In addition, the courses found in the articles analyzed are available on various platforms. The platform of the Virtual Learning Environment of the Brazilian Health System (AVASUS) is an example. As an official platform of the Brazilian Ministry of Health, AVASUS was developed for health professionals and students and aims to improve training, management, and care in the Brazilian National Health System (SUS) [18]. It currently has more than 1,200,000 total registered users, 3,300,000 enrolled users, and more than 420 Active Courses; see https://avasus.ufrn.br/ (accessed on 1 June 2024).

The platform of the Virtual Campus for Public Health (VCPH, available at https://campus.paho.org/) and the Pan-American Health Organization (PAHO/WHO) is also an example of a virtual environment whose digital tools provide access to knowledge and resources essential to public health. The VCPH offers courses in South America, Central America, and the Caribbean in many languages, e.g., Spanish, Portuguese, and English.

Additionally, collaboration among institutions with expertise in technology-mediated education, both national and international, has been a common practice in the production and distribution of MOOCs [22]. This partnership broadens the scope of the courses, enriches their content, and promotes interculturality in a diversity of perspectives, which ensures a more complete and fulfilling educational experience for the participants [41].

Regarding RQ02, MOOCs have applied various elements and characteristics of interculturality to foster dialog and interrelationships between different cultures and groups. This entails the inclusion of content that addresses issues relevant to different communities, respecting their cultural particularities, and promoting the recognition of sociocultural diversity. Alongside this, strategies such as translating into different languages, adapting content, and using culturally relevant examples have been employed to ensure the accessibility and relevance of courses for diverse audiences [28].

Interculturality also plays a key role in the production of MOOCs and the structuring of learning pathways in the healthcare area, as it promotes inclusion and mutual understanding between students from different cultural backgrounds. When developing online courses, it is essential to consider the cultural diversity of the participants, integrating content and pedagogical approaches that are culturally sensitive and relevant. This perspective allows courses to address different health practices and cultural contexts, providing a richer and more inclusive educational experience.

Furthermore, interculturality encourages the exchange of knowledge and experiences between students from different regions, enriching collective learning and fostering a global understanding of health practices. In this way, incorporating interculturality not only improves the quality and effectiveness of MOOCs and learning pathways but also promotes equity and inclusion in the area of health education [27].

Concerning RQ03 and the contribution of MOOCs to continuing health education, the studies analyzed point to a series of benefits. These courses offer attractive, up-to-date, and accessible content that contributes to the ongoing training of health professionals and the dissemination of relevant information to the community [24].

According to Ceccim [42], continuing health education, which includes the use of MOOCs, constantly aims to update practices in line with the latest theoretical, methodological, scientific, and technological knowledge available. Moreover, it entails the construction of relationships and processes that go from within health teams to organizational and inter-institutional/intersectoral practices. This involves not only health professionals but also health institutions and the policies that surround health actions. In the context of public health, continuing health education can have several positive impacts, such as improving the quality of services, preventing and controlling diseases, strengthening the health system, and patient safety, among others. For health students, the impacts are also notable, as their theoretical and practical knowledge is broadened, resulting in a learning process that is more contextualized with the actual demands of health services. This leads to improved technical and behavioral skills, promoting the ability to manage complex situations and make more informed decisions [43].

Over the years, continuing health education has undergone a transformation process of continuous learning regarding professional careers, intending to promote the updating, improvement, and integration of knowledge, skills, and attitudes among health professionals. Approaches to health professional practice require constant adaptation to changes in the fields of medicine, technology, and clinical practice. In short, continuing health education endeavors not only to provide technical knowledge, but also to promote a holistic and collaborative approach to patient care, as well as strengthening commitment to evidence-based practice and professional ethics [44].

Finally, MOOCs can be a powerful tool for public health in various contexts, providing accessible education for health professionals, managers, decision-makers, and the community in general. The reason behind this is due to ongoing education in health by offering relevant content that is varied, flexible, accessible, interactive, adaptable, and applicable, meeting the learning needs of a wide variety of participants in different contexts.

Regarding RQ04 and the methodologies used in the production process of the MOOCs surveyed, a variety of approaches can be observed, but with a general trend towards action research. This methodology allows for a dynamic integration between research and practice, enabling course designers to adjust their strategies based on the results obtained during the process [22]. Various strategies have been employed, such as action research, data and impact analysis, discussions and research, educational studies, evaluation of quantitative and qualitative data, incorporation of elements of interculturality, and interviews [22,24,29].

The production of high-quality MOOCs requires meticulous planning, the integration of innovative educational technologies, an appropriate pedagogical approach, and a pedagogical approach that is adequate for its application. This process is essential to optimize learning in a dynamic online environment, involving text dialogicity, the proposal of reflection activities, and educational resources that capture the student's attention, such as videos, podcasts, interactives, games, and others.

By providing an inclusive platform for the continuing education of health professionals, MOOCs democratize access to learning and promote the exchange of knowledge and experiences on a global scale. In this way, they contribute to improving the quality of healthcare and training professionals who are better prepared to face the contemporary challenges of the field [24].

5. Conclusions

This review found that the production of MOOCs has been conducted comprehensively and collaboratively, thus involving interdisciplinary teams and institutional partnerships to ensure course quality and relevance. In this sense, interculturality is a key element in MOOC development, including content and strategies that respect and promote sociocultural diversity, fostering a more inclusive and enriching educational environment.

Based on this study, MOOCs exert a positive impact on continuing health education. They offer attractive, up-to-date, and accessible content that contributes to the continuing training of health professionals and the dissemination of relevant information to the community. Such courses rely on digital technologies and innovative methodologies to promote social interaction between participants and facilitate access to knowledge in different contexts and locations.

Concerning the limitations reported in the literature, when it comes to the use of MOOCS in the field of health, some strategies should be considered. An example is the inclusion of synchronous activities to increase the depth of interactions between course participants, the adaptation of teaching materials to reflect cultural diversity, and the use of complementary data collection methods, e.g., interviews and focus groups, to obtain a richer and more detailed understanding of intercultural dynamics [1].

In terms of the methodology for content production, MOOCs have adopted a diversified approach, with a general trend towards action research. This methodology allows for a dynamic integration between research and practice, enabling refinements and adjustments throughout course development. Several other strategies were adopted, such as questionnaires, evidence-based research, discussions and surveys, interviews, data and impact analysis, clinical trials, and quantitative and qualitative data evaluation. This was to make the content more compelling and dynamic.

Some limitations should be considered regarding this review's findings. In particular, the sample of articles analyzed does not represent the full diversity of MOOCs, which restricts the generalization of the conclusions. A further limitation is the reliance on evaluation methods that may not be completely objective. Thus, the focus on interculturality to the detriment of other equally important aspects in MOOC development, combined with uncontrolled variables, may hinder the effectiveness of the analysis. Such limitations are accentuated by the difficulty in generalizing the findings to other contexts or populations. This underscores the need for more comprehensive and methodologically robust future studies that delve deeper into the development and impact of MOOCs in health education.

MOOCs constitute a robust tool for promoting technology-mediated health education. They can potentially train health professionals, disseminate knowledge, and promote inclusion and interculturality. Therefore, continuous collaboration and innovation in MOOC development are essential to ensure their effectiveness and relevance in the contemporary educational scenario. This study could serve as a basis for future trajectories and findings based on further investigations, highlighting the importance of ongoing efforts to improve the quality and impact of MOOCs in health education.

Author Contributions: Conceptualization, P.S.d.C., R.A.d.M.V., M.d.F.P.A. and K.D.C.; methodology, software, validation, data curation, P.S.d.C., I.M.P.B. and F.R.d.S.F.; formal analysis, J.L.R.d.S.V., K.M.D.C. and R.A.d.M.V., investigation, P.S.d.C., M.H.R. and A.d.P.D., writing—original draft preparation, P.S.d.C., M.H.R., A.d.P.D. and K.D.C.; writing—review and editing, J.L.R.d.S.V., K.M.D.C., K.S.d.A., R.A.d.M.V., A.d.P.D., N.A.d.N.B., J.A.d.S., H.A.C., M.d.F.P.A. and K.D.C.; supervision, M.d.F.P.A. and K.D.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Brazilian Ministry of Health through the project titled "Action Research in Humane Training in Health with Technology and Over the Life Course: A Look at the Sustainable Development Goals in SUS" (TED 85/2021), executed by the Laboratory for Technological Innovation in Health (LAIS) at the Federal University of Rio Grande do Norte (UFRN).

Acknowledgments: We kindly thank the Ministry of Health of Brazil for supporting this research. In addition, we would like to acknowledge the meticulous contributions of Natalia Araújo do N. Batista, Bruna Fernandes de Araújo, and Ruana E. Galvão in translating this paper into English.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study, in the collection, analyses, or interpretation of data, in the writing of the manuscript; or in the decision to publish the results.

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European Journal of Investigation in Health, Psychology and Education Editorial Office
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ISBN 978-3-7258-3147-0