



Review

Housing, Transportation and Quality of Life among People with Mobility Limitations: A Critical Review of Relationships and Issues Related to Access to Home- and Community-Based Services

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Abstract: Anecdotal reports suggest that adequate housing and transportation could be fundamental elements required to ensure quality of life (QOL) for people with mobility limitations. Certain home- and community-based services (HCBS) are also necessary to ensure that housing and transportation needs are met. Understanding QOL as it relates to housing and transportation is critical for people with mobility limitations but requires appropriate assessment of these constructs. The aims of this research were to explore the relationships between housing and transportation on QOL for people with mobility limitations, to describe the current conceptual measurement issues and to propose dimensions of access that could facilitate assessment of QOL as it relates to housing, transportation and HCBS. A critical review of the literature was conducted by experts in disability, QOL and access theory. While evidence indicated a potential influence of housing and transportation on QOL for people with mobility limitations, the relationships between these concepts were weak and inconclusive. Moreover, the measurement tools used lacked appropriateness to specifically measure these constructs. Approaching these measurement issues within an access theory may better position future research to address the housing, transportation and HSBS needs of people with mobility limitations. Future research may consider elements of availability, accessibility, accommodation, affordability, acceptability and awareness to ensure access for people with mobility limitations. A better understanding of QOL as it relates to housing, transportation and HCBS will improve the quality of research, which may in turn improve access of adequate services for people with mobility limitations.

Keywords: quality of life; housing; transportation; service needs; disability; access

1. Introduction

Based on his own experience, Stephen Hawking conveyed that ‘Disability need not be an obstacle to success’ [1]. This notion of ‘success’ for people with disabilities can be interpreted as an effective participation in valued life activities, achievement of appropriate

social roles, and contribution to various aspects of community life, which are elements that ultimately influence quality of life (QOL) [2]. Such a vision of a social accomplishment is consistent with the Convention on the Rights of Persons with Disabilities (CRPD), adopted in 2006 by the General Assembly of the United Nations, that enshrines the right to full and effective participation, to live independently and to be included in the community [3].

While CRPD acknowledged the rights of people with disabilities to have access to a range of in-home and community support services (Articles 9, 19, 28), many people do not have equal access to disability-related services that they require to fully participate in their community [4]. Conceptualizations of community access are commonly focused on physical access, as defined by architectural and physical factors in the environment (e.g., ramps and curb cuts), but this is only one aspect of a comprehensive vision of the environmental dimensions influencing participation [5]. Other environmental dimensions include health and socio-economic factors, such as access to primary health care, social and family support, education and job training. Accessible housing and transportation are of particular importance for people with mobility limitations who commonly face environmental and societal barriers. It is critical that housing extends beyond ‘four walls and a roof’ to include interpretation from many perspectives that consider various forms of freedoms and entitlements [6]. This was highlighted by a person with a disability who expressed, ‘Home is the place where I have choice, control, dignity, privacy, where I can socialize, entertain, people can come in’ [7]. To ensure adequate housing, one must also have access to the community and community services. Transportation, defined as a means of travel from one place to another [5], provides this critical link to the community to facilitate attainment of community services and participation in social activities (e.g., education, health, employment and social activities) [8]. Transportation can be achieved in various ways, such as independent automobiles, car shares, public transportation, ride sharing, taxis, bicycles and wheelchairs [9], but accessibility often poses challenges for people with mobility limitations.

Among a series of personal and environmental factors, housing and transportation represent critical elements needed to carry out meaningful life activities with a potential to enhance QOL. QOL emerged in the nineties as an important concept defined by the World Health Organization as ‘individuals’ perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns’ [10]. However, in practice, a clear operational definition of QOL has been lacking [11]. Therefore, QOL has become analogous to sub-concepts such as happiness, well-being, health status or functioning, which can be interpreted in many ways.

While various conceptualizations and models of QOL have been presented in the literature [12–15], there has been a general agreement on two main conceptualizations. The first, the objective approach, is based on one’s characteristics that can be objectively measured by an external appraiser. The second, the subjective approach, focused on the person’s emotional or cognitive assessment of the congruence between their life expectations and achievements [11,14]. Within the objective approach, there is the concept of health-related QOL (HRQOL), which represents a dimension of QOL focused on health status, including functioning in specific domains.

Since the development of the International Classification of Functioning, Disability and Health (ICF) and its previous version (The International Classification Impairment, Disability and Handicap) [4], several authors have tried to conceptualize superordinate models that would incorporate QOL concepts with the ICF domains, including personal and environmental factors [16–20] that interact to influence a person’s functioning and disability [12]. Essentially, a visual model of functioning and disability that depicts the interactions among the concepts, including subjective well-being, can be viewed from the ICF model as depicted by Post and Noreau (2005) [12].

Few studies have tried to determine the relationship between the ICF concepts and QOL, reporting a large range of explained variance (from 27 to 70%) [21–23]. Beyond the evidence that supports associations with personal factors, it is relevant to also consider how

social factors influence QOL. For example, in a seminal article on QOL in spinal cord injury, lower psychological and social functioning were more highly associated with QOL than with injury-related variables (e.g., level of spinal cord injury (SCI)), suggesting that these factors may be more predictive of QOL than disability alone [20]. Comparable findings have been reported for other disability groups, such as limb loss, multiple sclerosis and stroke [24–27].

Growing evidence suggests that QOL may also be associated with vital needs such as housing, attendant care, transportation and personal development needs (e.g., emotional support, peer support) [28]. In this way, the elements of housing and transportation for people with mobility limitations and their access to home- and community-based services (HCBS) that help meet fundamental needs are characteristics of the physical and social environment as described in the ICF model. Therefore, it is plausible that when these needs of housing and transportation are met, the likelihood of community integration or full societal participation and valuable QOL will be increased.

To support such a hypothesis, a comprehensive approach that considers the context of measurement of QOL concepts and the selection of appropriate tools is required. However, to date, major gaps remain in the conceptualization of QOL as it relates to specific domains and in the development of appropriate measurement tools. Dijkers's model provides a comprehensive and potentially useful QOL model that integrates various approaches to objective and subjective QOL measurement. Intended as a roadmap for understanding QOL, Dijkers [14] conceptualized 'QOL as utility', 'QOL as achievement' and 'QOL as subjective well-being' (including positive affect and life satisfaction). The resulting framework (Figure 1) has been useful for understanding what aspects of QOL are assessed by different outcome measures in various domains that are important for people with mobility impairment (i.e., spinal cord injury) [29].

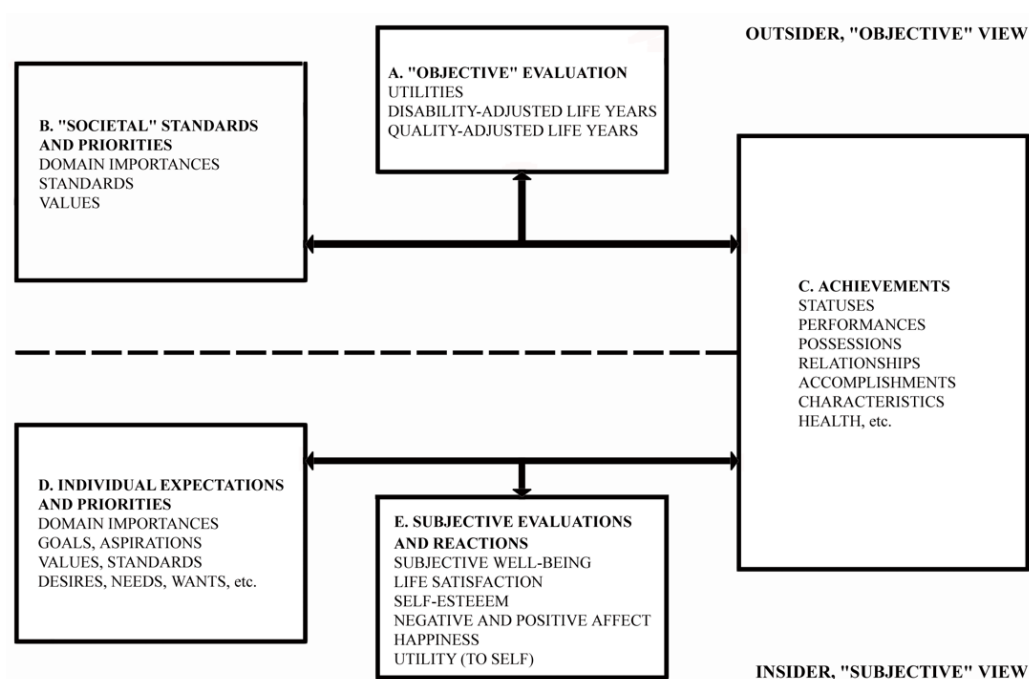


Figure 1. Dijkers' theoretical framework for the classification of quality-of-life outcome tools [14] (Reprinted from the Archives of Physical Medicine and Rehabilitation, 84, Dijkers, M.P., Individualization in quality of life measurement: Instruments and approaches, S3–S14, Copyright 2003, with permission from Elsevier).

When assessments of QOL are reflective of societal standards, such as economic factors (i.e., QOL as utility) or having features or accomplished things considered reflective of good QOL (i.e., QOL as achievements), then these are considered objective measures. Conversely,

when a person judges their personal satisfaction with their own life (i.e., QOL as subjective well-being), these measures offer a subjective understanding of QOL. In this way, perceived life satisfaction has been considered a valuation of QOL [15]. In addition, some relevant outcomes of rehabilitation for people with mobility limitations [30,31], such as functioning, and participation, are commonly used concepts to assess QOL in people with mobility limitations (i.e., 'QOL as achievement') [29].

Dijker's model has been successfully applied to identify the most likely measures that demonstrate the association between personal factors (i.e., various secondary health conditions) and QOL in people with SCI, which provided evidence of the value for both objective and subjective outcomes [29,32–35]. Moreover, this model of QOL is highly suitable to examine QOL across a variety of other groups of people with or without disability [36].

Despite some previous evidence of associations between some environmental factors and QOL, the relationships between housing, transportation and QOL among people with mobility limitations remain unclear, thus rendering intervention and policy development difficult. Beyond basic infrastructure, access to HCBS is essential to ensure adequate housing and transportation for people with mobility limitations. Acknowledging that access to appropriate HCBS among people with mobility limitations is variable, one can hypothesize that this level of access would be an important concept to be appropriately assessed.

Consequently, it would be critical to determine, in domains such as housing and transportation, their relationship with QOL and how to adequately assess the level of HCBS access and its potential link with QOL. Therefore, the aims of this study were to explore the relationships between housing and transportation and their influence on QOL for people with mobility limitations, to describe the current measurement issues in the conceptualization and evaluation QOL and to propose dimensions of access to HCBS (objective and subjective) that would facilitate its assessment related to housing and transportation.

2. Research Process

A critical review was undertaken to explore relationships between the fundamental elements of housing and transportation and QOL for people with mobility limitations. Specifically, the conceptualization and measurement of QOL as it relates to housing and transportation were considered. This critical review provided an opportunity to summarize and appraise what is of value in the current literature, while conceptualizing development and subsequent testing of new hypotheses or models [37]. Four researchers and two trainees with expertise in disability, QOL and access theory critically reviewed the relevant literature related to housing, transportation and QOL (all dimensions). Given the limited development of constructs related to housing and transportation in relation to QOL needed to improve the understanding of existing relationships, the literature on the access theory was then reviewed through an interpretive lens inspired by Pechansky and Thomas [38].

Electronic online databases (MEDLINE/PubMed, CINAHL, PsycINFO, Embase, Web of Science, International Bibliography of Social Sciences, Sociological Abstracts, Social Services Abstracts) were used. Initial searches were focused on SCI as a model for explaining barriers to housing and transportation, as this population commonly experiences high and varying levels of mobility impairment (e.g., tetraplegia, paraplegia), for which two separate systematic reviews examining the influence of housing and transportation on QOL were presented at international conferences. The search was then widened to include mobility limitations more broadly to explore the QOL constructs more deeply, as a focus on an understudied population of SCI would be limiting.

Boolean logic was applied to combine key words (and their variants) related to: (1) disability (e.g., disability, impairment, SCI, wheelchairs); (2) housing (e.g., housing, public housing, independent living program, disabled housing, social housing, public assistance, housing assistance, housing support); (3) transportation (mobility, driving,

public transportation, paratransit, accessible transportation); and (4) quality of life (quality of life, participation, activities of daily living, personal satisfaction, well-being).

Both quantitative and qualitative studies were considered to maximize the identification of potential domains or constructs for review (e.g., those related to housing, transportation, QOL). Articles written in English that included people with mobility limitations (≥ 18 years of age) with physical disabilities (e.g., SCI, multiple sclerosis, stroke) living in the community and that investigated relationships between QOL and housing or transportation were considered. Articles that evaluated constructs related to QOL (e.g., well-being, satisfaction, participation) and global constructs related to QOL (e.g., autonomy, functional independence) were also considered.

The measurement tools used to evaluate QOL (and related constructs, such as participation) as it relates to housing and transportation were categorized using Dijkers's model according to the QOL construct assessed (e.g., global QOL, life satisfaction, participation, utility or achievements), and critiqued based on their contribution to understanding QOL for people with mobility limitations. For the purposes of this review, our focus was on the theoretical conceptual underpinnings of the included outcome measures rather than the individual psychometric properties of each tool. Findings from relevant articles were narratively summarized to describe existing relationships between QOL as it specifically relates to housing and transportation.

3. Findings

The types of articles represented in this critical review were mainly cross-sectional and qualitative in design, took place in North America and included SCI populations. There were no high-level randomized controlled trials that fit the criteria for this review.

3.1. Measurement Tools Used to Assess QOL as It Relates to Housing and Transportation

Conceptual measurement issues of QOL were explored using Dijkers's QOL model [14]. The majority of tools used to establish relationships between QOL as it relates to housing and transportation provided subjective evaluations and reactions of global QOL assessments or used related constructs as indicators of QOL, while three tools provided objective evaluations of QOL. These included the following:

Global assessments of QOL: The World Health Organization Quality of Life abbreviated version (WHOQOL-BREF) [39], available in multiple languages [40], includes one question related to satisfaction with transportation. Other global assessments of QOL related to housing and transportation were carried out using various Visual Analog Scales (VAS) [41–43].

Life satisfaction: The Life Satisfaction Questionnaire (LISAT) was used to provide a global rating of QOL as subjective well-being without items specific to housing or transportation [44]. The Satisfaction with Life Scale (SWLS) [45], in conjunction with the Craig Hospital Inventory of Environmental Factors (CHIEF) [46] (quantifying environmental barriers to participation), was used as a dependent variable to assess the impact of the environment (including transportation) on QOL as subjective well-being [47].

Participation/functioning: Constructs related to participation and functioning were used to evaluate 'QOL as achievement'. For example, considered measures of participation, the Personal Independence Profile (PIP) [48], the Participation Scale (P-Scale) [49] and the Canadian Occupation Performance Measure (COPM) [50] were used to assess the influence of housing on QOL. While the P-Scale was developed to assess perceived participation restrictions in people with mobility limitations, the PIP and COPM were developed for use in the general population.

Three tools used to evaluate the relationships of housing or transportation with QOL were classified as 'Objective measures of Utility or Achievements'. The Functional Independence Measure (FIM) [51], the Modified Barthel Index (MBI) [52] and the Craig Handicap Assessment and Reporting Technique (CHART) [53] measure the level of disability, degree of independent functioning and degree of handicap in community integration and social participation, respectively. Only the physical independence and social integration

sub-scales of the CHART included some items relevant to housing (e.g., ability to enter and exit homes independently, independent access to spaces inside the home and living arrangements). However, neither tool was specific to QOL, housing or transportation. More recently developed, the Spinal Cord Independence Measure III (SCIM III) measures various types of function in SCI specifically (i.e., self-care, respiration and sphincter management and mobility) [54,55]. The mobility section of the SCIM III, composed of nine items, was used to assess the influence of transportation on QOL [56].

3.2. Measurement of QOL as It Relates to Housing

According to Berg et al., home environments that facilitate independence and moving around should be considered a basic need for people with mobility limitations [57]. In fact, a poor fit between a person and their home was demonstrated to negatively impact QOL and well-being in a previous review [58]. Among people who use wheelchairs, the presence of adequate accommodations (e.g., ramps and accessible doors) reduced the likelihood of requiring caregiver assistance [59]. Specifically, in comparison to having no home accommodations, the presence of each additional home accommodation decreased the odds of having help from unpaid caregivers by 14% ($p < 0.05$). While not a direct evaluation of QOL, an inverse relationship between the number of accommodations in the home and hours of unpaid help ($p = 0.01$) was reported, suggesting that adequate home accommodations facilitate greater autonomy and independence for people who use wheelchairs. Moreover, compared to people who did not receive home accommodations, wheelchair users with home modifications perceived statistically significant increases in safety when completing tasks related to activities of daily living (self-care, preparing food, grocery shopping), getting in and out of the home and participating in leisure activities [60].

In a cross-sectional study on 56 people with mobility limitations, there were statistically significant relationships between housing (i.e., perception of homemaking) and global QOL as measured by VAS ($r = 0.41$; $p < 0.01$) and Sickness Impact Profile ($r = 0.33$; $p < 0.01$). Qualitative findings from people with mobility limitations living in accessible shared housing confirmed the need for a ‘value added approach’ to housing that incorporates essential symbolic and relational concepts of value, such as being of value to others and having value. People with mobility limitations expressed that having an accessible residence designed for disability supported social engagement with others, helping them to achieve a sense of value [61].

Findings of QOL as it related to housing were to some extent associated with participation outcomes. For example, in a pre–post study with 59 people with mobility limitations evaluating an intervention designed to optimize housing through provision of appropriate assistive technology, home modifications and user control (Smart Home IRIS), performance of meaningful activities improved by 36% ($p < 0.001$) and satisfaction with performance improved by 43% ($p < 0.001$) [62]. In addition, regression modeling suggested that living independently was predictive of employment opportunities ($R^2 = 0.21$; $p = 0.03$) and participation in leisure and physical activities ($R^2 = 0.04$; $p = 0.03$) among people with mobility limitations [63]. Conversely, a greater presence of mobility barriers in the home was associated with less social participation (adjusted $\beta = 0.44$, $p < 0.01$) one month after discharge from rehabilitation [64]. In a sample of 24 people with SCI in Nepal, 80% of whom could not enter their homes independently, 80% indicated they experienced ‘severe’ or ‘extreme’ restrictions to community participation [65].

Finally, outcomes related to satisfaction with housing suggested a weak link with QOL. For example, in a sample of over 2000 people with mild to severe disabilities, housing satisfaction was predictive of life satisfaction ($\alpha = 0.05$, $p < 0.01$) [66]. Similarly, access to home-based services was shown to be associated with higher perceived life satisfaction among people with mobility limitations. Specifically, higher satisfaction with available services was related to better functional health status ($r = -0.25$; $p < 0.001$) and life satisfaction ($r = -0.32$, $p < 0.001$) [67]. In a regression model, functional health status explained 29% of the variance in life satisfaction variance ($p < 0.001$), and satisfaction with services

explained an additional 5% ($p < 0.001$) [67]. Additional indirect qualitative links have been established, such as the perceived impact of poor accessibility on independent living, social participation and overall health by people with mobility limitations [68]. Housing services were also perceived by people with mobility limitations to be focused on basic physical needs, with far less consideration for other aspects of health and well-being [7].

3.3. Measurement of QOL as It Relates to Transportation

While a causal effect of driving on QOL has not yet been documented, the differences in life satisfaction between drivers and non-drivers suggest that independent driving may play a strong role in QOL [56]. People with a spinal cord injury who drove independently reported statistically significant ($p < 0.05$) higher scores on the mobility, occupation and social integrations scales of the CHART short form, and higher life satisfaction (WHOQOL-BREF median IQR score of 75 (69–81)) compared to those who cannot drive independently (WHOQOL-BREF median IQR score of 32 (25–47)) [56]. Although public transportation may afford similar access to the community and community-based services as driving, people with mobility limitations who drove their own cars reported statistically significant higher life satisfaction (SWLS mean score of 25 versus 22 for those who did not drive; $p = 0.02$) [69]. In addition, strong statistically significant moderate to high correlations ($r = 0.56$ to 0.79 ; $p < 0.05$) were reported between driving and QOL according to the WHOQOL-BREF [70]. Likewise, access to private transportation was moderately associated with general QOL and perceived physical and psychosocial health status ($r = 0.50$ to 0.53 , $p < 0.001$) [43].

The influence of transportation on QOL was also implied among people with mobility limitations who reported that not having transportation to and from healthcare providers was a major barrier to accessing healthcare services, a particular concern for those living in inaccessible homes [68]. In this way, a lack of accessible transportation restricted access to necessary healthcare services, which may have negative impacts on physical and mental health. Among people who recently experienced a traumatic SCI, the most frequently used means of transportation was the Independent Living Services, which are medical and social services for people with mobility limitations designed to promote community living through minimized barriers [71].

Transportation was also described by people with mobility limitations as essential to community participation and maintenance of social interactions, which was expressed to be an important factor predicting happiness [72]. Without accessible transportation, people with mobility limitations may become dependent on family members, friends, or peers for transportation, and thus may lose autonomy and independence when making decisions about participation and social roles [42,47]. In fact, transportation issues were ranked as the second highest barrier to participation among 2726 people with SCI [45]. Correspondingly, Block et al. [73] reported a lack of transportation as the major barrier to achieving participation goals among people with mobility limitations who took part in a community-based health promotion and capacity-building program. To better understanding the impact of transportation (and other barriers) on participation, the authors evaluated how needs were (or not) being met. The findings from this assessment were that driving was a common goal among people with mobility limitations [73].

While public transportation may provide affordable and reliable transportation, many people with mobility limitations did not perceive improved satisfaction as a result of using these services [74]. Given that public transport routes are not determined by the user, people with mobility limitations reported sometimes feeling limited in the selection of adequate routes. Moreover, many public transportation and related public spaces were not wheelchair-accessible (e.g., floors of buses cannot be lowered), and people with mobility limitations expressed inconsistencies with locating reliable information about schedules and accessible routes [75]. In fact, the design of public transportation infrastructure determined whether and where people with mobility limitations could travel [74], with one people with mobility limitations expressing that ‘I would say that QOL is being able to go wherever I

want [76]. In a recent investigation of public transportation use for people with mobility limitations, the most significant barriers were physical and attitudinal in nature. As a result, modifications to the physical environment and educational opportunities to reduce negative attitudes toward people with mobility limitations were recommended [77].

4. Discussion

A critical review of the measurement of QOL as it relates to housing and transportation for people with mobility limitations revealed that both factors are important determinants of QOL, but these specific QOL concepts are not well-conceptualized and are under-researched when considering disability. With regard to housing, it is clear that having a home environment that is accessible provided more opportunities for autonomy and independence, which translated into better outcomes for people with mobility limitations. Similarly, access to transportation was critical for community participation for people with mobility limitations, but that private means (e.g., private vehicle) appeared to be associated (albeit implicitly) with greater autonomy and therefore preferred by people with mobility limitations. These findings align with more recent arguments for including concepts of autonomy and social engagement in rehabilitation goals, which acknowledges that independence may not always be achievable due to the functional limitations associated with disability, but that that ‘even when persons require assistance from others, they may achieve key life goals, take charge of their lives and maintain key relationships and respect’ [78]. Relatedly, challenges with housing and transportation limit opportunities for social engagement, which is critical for achieving a good level of QOL.

Although the literature reviewed seemed to suggest that housing and transportation may influence certain dimensions of QOL for people with mobility limitations, the documented relationships were usually weak, unclear and inconclusive. One of the key elements that may explain such weak relationships is the appropriateness of the tools used to measure QOL, specifically as it relates to housing and transportation. Most tools were developed to assess various dimensions of QOL (e.g., well-being, HRQOL, functioning/participation), but they were not developed to evaluate specific constructs related to housing and transportation. While the tools have been developed to measure various dimensions of QOL, with some tools including items related to housing and transportation, the conceptualization and content validity for assessing relationships specific to QOL related to housing and transportation may explain the current findings. Accurate descriptions and tools to measure the impact of housing, transportation and HCBS on QOL are critical to ensure equitable access for people with mobility limitations.

While it has been long recognized that living in a minimally restrictive environment is likely to contribute to improved QOL [58], it is generally known that people with mobility limitations are not satisfied with current service delivery. Many people with mobility limitations still experience inaccessible housing and transportation, which remain key barriers to community participation and QOL. It is plausible that an underlying issue exists related to access, such that people with mobility limitations lack access to the appropriate HCBS services to ensure adequate housing and transportation.

Moreover, although not explicitly evaluated in the current literature, adequate housing and transportation may impact delivery of health-related services (e.g., medical appointments, pharmaceutical needs and rehabilitation), and thus relationships between housing and transportation and HRQOL should be explicitly investigated. However, before exploring these hypotheses, appropriate conceptualization and proper measurement tools are needed, which must be then situated within a framework or model that considers access to HCBS. It is only then can hypotheses related to housing, transportation and QOL (including HRQOL) be properly assessed, and the quality of research improved. The result in the long term may be improved access and QOL for people with mobility limitations.

4.1. Access Theory and Measurement

‘Accessible means that a people with mobility limitations is afforded the opportunity to acquire the same information, engage in the same interactions, and enjoy the same services as a person without a disability in an equally effective and equally integrated manner, with substantially equivalent ease of use’ [79]. Therefore, people with mobility limitations must have access to the information and the HCBS as fully, equally and independently as a person without a disability. It is only then can people with mobility limitations achieve optimal QOL according to societal standards and personal judgement. A focus on theories and definitions of access could reinforce equity for people with mobility limitations.

From a large perspective, Ribot and Peluso [80] defined access as the ‘ability to benefit of something (at the opposite of the term ‘property or ownership’) that can be tangible or intangible’. As reported by Fougeyrollas et al. [81], several authors considered that access is contextually defined (i.e., transport, infrastructures, health care, property, information) and usually seen as domain-specific (geography, architecture, economy, communication, health and law). In the field of healthcare, access to services was already studied in the 1970s and 1980s to establish conceptual frameworks and to identify various dimensions of the concept [38,82,83]. Since then, the concept of access has been extensively investigated in healthcare, and its complexity (based on its multidimensionality) was acknowledged and could explain the lack of consensus for a common definition of access and its dimensions [84,85]. Three more dominant models are described in the literature [83,86]. They present access as the ‘a potential and actual entry of a given population group to the health care delivery system’ [87,88] or ‘a fit between the person’s need and the system’s ability to meet those needs’ [38] or ‘a timely use of personal health services to achieve the best possible health outcomes’ [89]. These models comprised dimensions to operationalize the concept of access, which included elements such as availability, accessibility, use and barriers of services, the person’s characteristics, needs for services, outcomes and satisfaction regarding the service delivery.

There are numerous reports on healthcare and disability [90–95], and many focuses specifically on physical access (or lack of) to care [96–99]. Moreover, an important study put an emphasis on the concept of accessibility and related concepts [100–102], which is sometimes used interchangeably with the concept of access due to a lack of conceptual precision [103]. Accessibility regularly refers to the encounter between the person’s functional capacity and the design of the physical environment [101].

To our knowledge, there are fewer reports on access to HCBS and its assessment for people with mobility limitations despite such services having a major contribution to successful participation in valued life activities. In such a context, a proposition of appropriate conceptualization and measure of access would be essential to document in relation to housing and transportation. The Penchansky and Thomas theory of access [38] may serve as a basis to develop a HCBS access measure. The five dimensions of access comprise: (1) availability (type and quantity of services in relation to the person’s needs); (2) accessibility (relationship between the person’s location and the service delivery, including transportation, travel time and cost); (3) accommodation or usability (the manner in which the service delivery is organized in relation to the ease with which the person may use it and his/her perception of appropriateness); (4) affordability (relationship between the cost of service and the person’s financial capacity to use it); and (5) acceptability (relationship between the person’s attitudes about the personal characteristics and attitudes of the service providers, and vice versa).

More recently, another dimension of access was proposed, which was inspired from the Penchansky and Thomas theory: awareness (effective communication and information strategies with relevant service users, including consideration for health literacy) [104] and adaptability, which has similarities with the accommodation dimension in the original model [81,105]. While Penchansky and Thomas focused on a subjective component of access (essentially satisfaction regarding the five dimensions), the addition of an objective component of each dimension would allow a more comprehensive description of the access

to HCBS. Table 1 describes potential components that can be used to measure the access of services related to housing and transportation.

Table 1. Description of the proposed component (objective and subjective) to support the assessment of the access to services related to housing and transportation. ‡ Dimension proposed by Saurman [104].

Dimension of Access of Service Delivery	Objective Component of Access	Subjective Component of Access
Availability		
Housing	<ul style="list-style-type: none"> - Accessible housing services and programs (Y/N) - Public transportation (Y/N) 	<ul style="list-style-type: none"> - Satisfaction with the availability of those services
Transportation	<ul style="list-style-type: none"> - Door-to-door public transit (Y/N) 	
Accessibility		
Housing	<ul style="list-style-type: none"> - Proximity of the housing services (convenience of location, time, distance from home) 	<ul style="list-style-type: none"> - Satisfaction with the convenience and the ease of those services
Transportation	<ul style="list-style-type: none"> - Proximity of the public transportation or door-to-door public transit (convenience of location, time, and distance from home) 	
Accommodation		
Housing	<ul style="list-style-type: none"> - Appropriateness and organization of the housing services (office hours, delay of services, office accessibility) 	<ul style="list-style-type: none"> - Satisfaction with appropriateness of those services
Transportation	<ul style="list-style-type: none"> - Appropriateness and organisation of the public transportation or door-to-door transit (operation hours, schedule, delay, bus access) 	
Affordability		
Housing	<ul style="list-style-type: none"> - Cost associated with the housing services in relation to the person's financial capacity 	<ul style="list-style-type: none"> - Satisfaction with the cost of those services
Transportation	<ul style="list-style-type: none"> - Cost associated the public transportation or door-to-door transit in relation to the person's financial capacity 	
Acceptability		
Housing	<ul style="list-style-type: none"> - Relationships between the housing service providers and the person (respect, cordiality, support appropriate manner of interventions) 	<ul style="list-style-type: none"> - Satisfaction with the relationships between the service providers and the person
Transportation	<ul style="list-style-type: none"> - Relationships between the public transportation or door-to-door transit services (operators, drivers), providers and the person (respect, cordiality, support appropriate manner of interventions) 	
Awareness ‡		
Housing	<ul style="list-style-type: none"> - Effective communication and information of the housing services in relation to the person's level of literacy 	<ul style="list-style-type: none"> - Satisfaction of the effective communication and information from the service providers
Transportation	<ul style="list-style-type: none"> - Effective communication and information about public transportation or door-to-door transit services in relation to the person's level of literacy 	

It is recommended that, to work towards achieving these measurement goals, qualitative research is undertaken to obtain the in-depth perspectives of people with mobility

limitations framed within an access model about these issues to inform a path forward about what factors are conceptually important to measure. The outcomes will provide an initial platform with which to design future lines of inquiry and importantly provide opportunities for critical reflection and change in practice and policies promoting access to transportation and housing in communities for people with mobility limitations.

4.2. Limitations

While there is considerable value in conducting systematic reviews to identify all the available literature on a topic under review, a critical review does not include a standardized method of the search, synthesis or analysis. Therefore, one limitation of the research was that it lacked a formal standardized process for reviewing, selecting and synthesizing evidence. However, the goal of a critical review is not to formally assess the quality of the literature, but instead to emphasize the conceptual contribution of the topic under question (i.e., QOL as it relates to housing and transportation for people with mobility limitations) [37]. In this way, this critical review aggregated literature on the topic of housing, transportation and QOL, such that the interpretative elements were purposefully subjective to provide a starting point for future research. People with mobility limitations were used as models in this review; therefore, QOLs for other types of disabilities were not considered in this review. However, the access theory may have broader application for all disability types and could be considered as a framework for future research on QOL as it relates to housing and transportation for disability more broadly. Finally, the individual psychometric properties of each measurement tool were not considered in this review, as the purpose was to explore conceptual measurement issues. Future studies may consider validating the measurement of QOL as it relates to housing, transportation and access to community-based services.

5. Conclusions

Access to transportation and housing for people with mobility limitations is critical for QOL but is an under-research topic that requires a more nuanced theoretical approach to understand. There is also a need for robust, sensitive and domain-specific outcome measures that will help identify how people with mobility limitations perceive their access to housing, transportation and HCBS and how it ultimately affects their QOL. QOL is multidimensional and challenging to assess. This review provided some clarity, suggesting there are both subjective and objective dimensions to QOL to consider. Applying this viewpoint may help to clarify key conceptual measures on how to examine QOL in relation to housing and transportation for people with mobility limitations. Considering both subjective and objective dimensions of QOL may help to elevate the quality of work moving forward.

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