

## Article

# Taiwan's Forest from Environmental Protection to Well-Being: The Relationship between Ecosystem Services and Health Promotion

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**Abstract:** In Taiwan's forest environment, the type closest to people's living area is the protection forest, which mainly has the aims of regulating, supplying, and supporting, in those of the ecosystem services (ES). In recent years, due to the people's demand for being close to nature and relieving stress, protection forests have become venues for people's sports and leisure activities. The purpose of this study was to investigate the relationship between public perceptions of the value of ES and mental health benefits, so as to adjust the Taiwan's management policy towards its protection forests. Our research site is the Zhunan Protection Forest on the western coast of Taiwan. In total, 355 questionnaires were issued, and 301 of those were deemed valid. The results showed that (1) people have a high perception of the ES, in which supporting and regulation values were higher than cultural and provisioning values. Education could enhance the perception of ES. (2) For the people who have exercise habits and live near protection forests, their "compatibility" of PRS was higher than for other people. (3) People who live around protection forest areas had a higher positive mood and lower negative mood, which could have healthier mental effects. (4) People's perceptions of ES were related to PRS dimensions. The higher ES values people were also more likely to participate in exercise in the forest, achieving good mental health. The results are discussed with relevant literature and provide suggestions for follow-up research for revising forest protection management policies.

**Keywords:** ecosystem services; attention restoration theory; POMS; Perceived Restorativeness Scale (PRS); exercise habits



**Citation:** Lee, S.-H.; Chu, Y.-C.; Kung, P.-C. Taiwan's Forest from Environmental Protection to Well-Being: The Relationship between Ecosystem Services and Health Promotion. *Forests* **2022**, *13*, 709. <https://doi.org/10.3390/f13050709>

Academic Editor: Elisabetta Salvatori

Received: 27 March 2022

Accepted: 27 April 2022

Published: 30 April 2022

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## 1. Introduction

Forest occupies more than sixty percent of Taiwan's land, hence being its largest area of land types. Within this land type, the protection forest is that which is closest to communities, tribes, reservoirs, roads, coasts, and collapsed areas. As we know, forest environments have a specific function to prevent natural hazards. When the Japanese government ruled Taiwan, the many protection forests have been established according to the natural topography of their catchment areas. Their main functions are water conservation, flying sand prevention, wind protection, natural conservation, and for health care, altogether preserving the environment and the safety of human communities and farmland [1]. These protection forests are rich in biodiversity, while being the environment closest to people's daily life that provide the value of forest ecosystem services. The Economics of Ecosystems and Biodiversity (TEEB) [2] proposed that the functions of protection forests to be mainly the in the ecosystem service (ES) of regulating (such as adjustment of climate and air quality, carbon absorption and storage, mitigation of extreme weather, prevention of soil erosion, etc.). With the global environmental changes and rapid changes in human land use patterns severely impacting the balance of ecosystems, sustainable

urban-rural development requires that these surrounding natural areas provide ecosystem services [3–5].

Recently, many studies have shown that being close to natural environments such as forests and coasts has the benefits of physical well-being, mental health, and fostering creativity [6–10]. The Taiwanese government has formulated relevant development strategies for forest therapy, and has promoted some forest therapy activities in private forests and forest recreation areas [11]. There have not been plans to implement or explore the benefits of people's mental health in the protection forests. According to statistics, there are 470,000 hectares of protection forests in Taiwan, of which about 60,000 hectares are located near major residential areas. Therefore, opening to the public for exercise and leisure activities without affecting the main ecosystem services of the protection forest has become an important issue of forest utilization and management policies. Moreover, there is no relevant research on the perception of ES and the mental health benefits of entering protection forests for sports and leisure. Understanding the public perception of ES and discussing the benefits to people's mental health is necessary for the sustainable management of Taiwan's protection forests.

### *1.1. Ecosystem Services—Its Concept and Evaluation Indicators*

United Nations' Millennium Ecosystem Assessment Organization (2005) defined ecosystem services as "the benefits that people get from ecosystems" and analyze the current status and trends of the world's ecosystem services system, summarizing the relationships between ES and humans into four categories, including: (1) Provisioning services: materials produced by the ecosystem; (2) Regulating services: aspects of climate and atmosphere composition, water conservation, disaster reduction and prevention; (3) Cultural services: non-material benefits from the ecosystem, and are obtained by people through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences; (4) Supporting services: necessary service functions of ecosystem for other service systems [2]. Supporting services are the basis of the other three types of ES. Provisioning services provide resources that humans need. Regulating services reduce the impact and disaster of human survival by natural environmental change. Cultural services allow humans to obtain spiritual satisfaction from leisure and entertainment, while providing aesthetics and educational values. Regardless of the attributes of the four types of ecosystem services, all services are necessary for maintaining human health and providing a safe life [12]. van Wensem [13] proposed that the concept of ecosystem services was put forward to clearly distinguish natural resources. Taiwanese scholars also have done research on the perception of forest ecosystem services based on the types of people's attitudes with environments and found that the "low environmental perception" attitude types have low evaluations of various service functions. So far, much decision-making and research were mainly focused on services related to the biophysical dimensions of environmental support systems. There has been little research and attention focused on the direct impact of natural experiences with ecosystem services on human mental health [14].

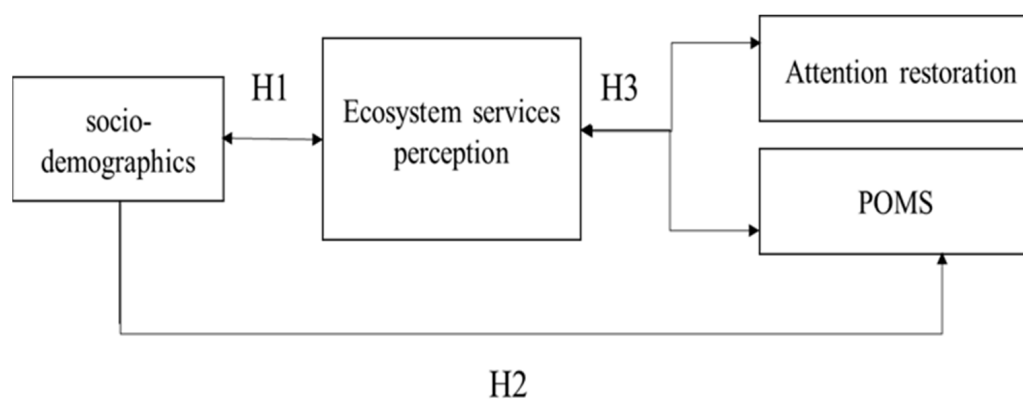
### *1.2. Forest Environment and Health*

Many scholars focus on the health benefits of being close to the natural environment; for example, the natural environment can promote better psychological well-being and/or improve mental health [6,15]. It also can improve concentration, relieve stress [16,17], and restore attention [18–21]. Literature on the relationship between the natural environment and stress reduction was reviewed and it was found that the most commonly used emotional measurement scale was the Profile of Mood States (POMS) [22]. The study compared the emotional changes of 168 people in 14 cities and 14 forest environments in Japan, with these people spending 2 days in a city or in forest environments. The study found that the positive emotions of the subjects in the forest were higher than those in the city. It showed that being in the forest can reduce "tension and anxiety", "anger and hostility", "fatigue", "chaos" and "total emotional state", and increase "vitality". Forests can therefore reduce

negative emotions and enhance positive emotions [23]. Kaplan and Kaplan [19] have also proposed Attention Restoration Theory (ART). They believe that the natural environment can help people to recover attention from fatigue. A restorative environment has four components for its subjects: (1) being away; (2) fascination; (3) extent; and (4) compatibility. The third component extent implies the settings have scope and coherence that engage the mind and promote exploration. The Perceived Restorativeness Scale (PRS) therefore divided measures perceptions into five restorative qualities: being away, fascination, coherence, scope and compatibility [24,25]. Consequently, this research measures the following five restorative constructs: being away, fascination, coherence, compatibility, and scope.

Many researches focused on the aim of ES of maintaining an environmentally safe and healthy life for humans, mostly discussing from the environmental perspective, but few are from the view of human values, attitudes, and beliefs [26]. What is the respondent perception of ES and the forest activities that benefits a protection forest? Is the respondents' socioeconomic background related to their perception of the forest ES and forest activities' benefits? Is the respondents' perception of the ES of the protection forest related to their own recovery of attention and emotional state after leisure activities? According to literature review and research questions, the purpose of this study is to examine the relationships between the perception of ES and mental health in protection forestry which are near people's living area.

The main purpose of research is to explore the relationships between ES and forest healing benefit from the perspective of local people and participants, who are entering the protection forests. The socio-demographics include age, gender, education level, place of residence, and exercise habits. The perceived mental health includes Perceived Restorativeness Scale (PRS) and Profile of Mood States (POMS). The specific purposes are to examine whether: (1) the socio-demographics are related to perception of ecosystem services; (2) the socio-demographics are related to perception of mental health; (3) there are relationships between perception of ecosystem services and perceived attention restoration and mood states (Figure 1).

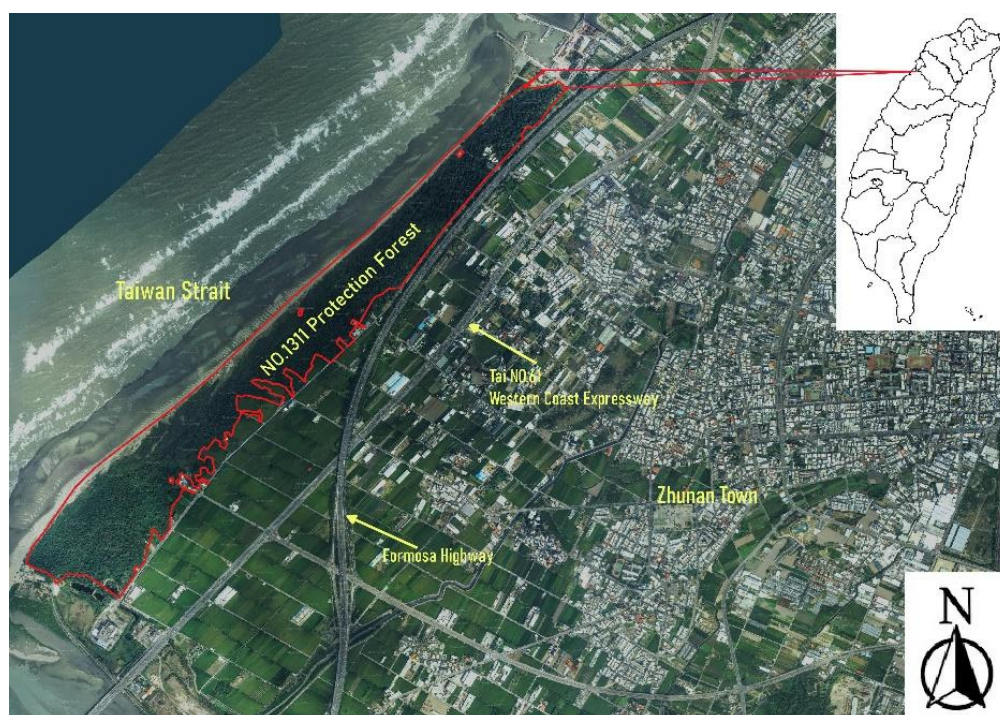


**Figure 1.** Research framework.

## 2. Materials and Methods

### 2.1. Study Site

The study site is Zhunan Protection Forest on the western coast of Miaoli County, Taiwan. (Figure 2). Due to leisure and recreation needs, the Miaoli County Government has planned the Zhunan Coastal Forest Recreation Area. The recreation area is divided into three districts: "Holiday Forest", "Family Forest" and "Evergreen Forest".



**Figure 2.** Location map of No. 1311 Protection Forest (Painter: Huang-Sheng Chiu).

## 2.2. Experimental Design

This study used convenience sampling in the Protection Forest of Zhunan Town, Miaoli County, Taiwan, where there are frequent exercise and recreational activities. The questionnaires were distributed at the intersection of the rest area of Holiday Forest on Friday, Saturday, and Sunday in October 2020. In this study, a total of 355 questionnaires were distributed. After deducting the missing or repeated responses, the number of valid questionnaires was 301, with the effective response rate being 85%.

## 2.3. Participants

The gender of the participants is 144 males (47.8%) and 156 females (51.8%). The number of people under the age of 29 is 104, accounting for 34.7%, with an average age of  $39.49 \pm 14.99$  years old. Mostly, their education level is university, accounting for 55.5%. The major occupations are technology and service industry, accounting for 36.2%. The residents in Miaoli County make up almost 40%, while from outside the county makes up 61.8% (Table 1). Most respondents have regular exercise habits, accounting for 70%. The proportion of chronic diseases is about 10% and shows that the subjects are mostly middle-aged, of a high level of education, with exercise habits, and mostly in good physical health.

**Table 1.** Socio-demographic information of the respondents.  $N = 301$ .

| Items                                     | Frequency/% | Items                            | Frequency/% | Items                              | Frequency/% |
|---|-------------|----------------------------------|-------------|------------------------------------|-------------|
| <b>Gender (Missing 1/0.3%)</b>            |             | <b>Age (Missing 1/0.3%)</b>      |             | <b>Occupation (Missing 7/2.3%)</b> |             |
| Female                                    | 144/47.8%   | ≤29                              | 104/34.4%   | Government employee                | 20/6.6%     |
| Male                                      | 156/51.8%   | 30–39                            | 68/22.7%    | Agricultural staff                 | 5/1.7%      |
| <b>Educational level (Missing 5/1.7%)</b> |             | 40–49                            | 36/12%      | Worker                             | 35/11.6%    |
| Junior high                               | 15/5.0%     | 50–59                            | 47/15.7%    | Business                           | 24/8.0%     |
| High school                               | 65/21.6%    | ≥60                              | 45/15.0%    | Technology                         | 57/18.9%    |
| Collage                                   | 167/55.5%   | <b>Disease (Missing 12/4.0%)</b> |             | Service industry                   | 52/17.3%    |
| Graduate                                  | 49/16.3%    | No                               | 260/86.4%   | Freelance                          | 25/8.3%     |

Table 1. Cont.

| Items                          | Frequency/% | Items                       | Frequency/% | Items                              | Frequency/% |
|--------------------------------|-------------|-----------------------------|-------------|------------------------------------|-------------|
| <b>Gender (Missing 1/0.3%)</b> |             | <b>Age (Missing 1/0.3%)</b> |             | <b>Occupation (Missing 7/2.3%)</b> |             |
| Place of residence             |             | diabetes                    | 4/1.3%      | Retired                            | 49/16.3%    |
| Local                          | 115/38.2%   | hypertension                | 21/7%       | Others                             | 27/9.0%     |
| Other places                   | 186/61.8%   | gout                        | 2/0.7%      | Exercise habits (Missing 3/1.0%)   |             |
|                                |             | Mental illness              | 2/0.7%      | Yes                                | 211/70.1%   |
|                                |             |                             |             | No                                 | 87/28.9%    |

## 2.4. Instrument

### 2.4.1. Ecosystem Service (ES)

According to a study of TEEB, the ES groups into four categories. The 13 items measure the perception of provisioning services (3 items), regulating services (4 items), supporting services (3 items), and cultural services (3 items). The Cronbach's alpha of perception of ES is 0.835, which shows a reliable measurement. The mean value of four dimensions has "supporting" (4.49) the highest, followed by "regulating" (4.47), "provisioning", (4.01) and "culture" (4.27) being the lowest.

### 2.4.2. Perceived Restorativeness Scale (PRS)

Based on studies of ART and PRS, the Chinese version of PRS is made up of 10 items and measures the perception of 5 restorative factors: "being away" (2 items), "fascination" (2 items), "coherence" (2 items), "compatibility" (2 items) and "scope" (2 items). The Cronbach's alpha of PRS is 0.901, considered a reliable measurement.

### 2.4.3. Profile of Mood States (POMS)

The measurement of emotional state refers to Shacham, Reinhardt, Raubertas & Clelland [27], the short version of the POMS scale, and the Chinese version by Chang & Lu [28] and Hsu, Chang & Lu [29]. It includes 30 items in 7 dimensions: self-esteem (4 items), tension/anxiety (5 items), anger/hostility (5 items), fatigue/inertia (5 items), depression/dejection (3 items), confusion/bewilderment (4 items) and vigor/activity (4 items). The Cronbach's alpha of POMS is a reliable measurement of 0.8.

## 2.5. Data Analysis

In addition, a hierarchical method was used for two-stage cluster analysis; the ES is divided into 3 clusters, called "Low ES", "Medium ES", and "High ES". We used one-way ANOVA to analyze whether each cluster has significant differences in ES dimensions. Scheffé's multiple comparisons were further used to compare the differences between each cluster (Table 2). There are 121 subjects in Low ES, and the subjects have significantly lower perceptions of ES than the other groups. Cluster 2 is called "Medium ES" and accounts for 64 subjects, significantly lower in dimensions of provisioning, regulating, and cultural than "High ES". "High ES" accounts for 116 participants and has the highest perception of all categories of ES.

Table 2. Analysis of Ecosystem Service Clusters.

| ES Dimension | ES Cluster   |                |               | Mean | F-Value     | Scheffe      |
|--------------|--------------|----------------|---------------|------|-------------|--------------|
|              | Low ES (121) | Medium ES (64) | High ES (116) |      |             |              |
| Provisioning | 3.66         | 3.59           | 4.65          | 4.02 | 169.400 *** | 1 < 3, 2 < 3 |
| Regulating   | 3.97         | 4.74           | 4.87          | 4.48 | 322.428 *** | 1 < 2 < 3    |
| Supporting   | 3.96         | 4.84           | 4.86          | 4.50 | 360.284 *** | 1 < 2, 1 < 3 |
| Cultural     | 3.92         | 4.03           | 4.81          | 4.29 | 125.212 *** | 1 < 3, 2 < 3 |

\*\*\*  $p < 0.001$ .

**Hypothesis 1.** *The socio-demographics of participants are significantly related to the perception of ES.*

The chi-square test is used to detect the difference between different groups of ES and socio-demographics. There is only one significant difference in education level.

**Hypothesis 2.** *The socio-demographics of participants are significantly related to mental health promotion (PRS, POMS) of forest activities.*

Independent sample *t*-test and ANOVA were conducted to examine the relationships of socio-demographics and perceptions of mental health promotion (Table 3).

**Table 3.** The relationships of socio-demographics and PRS.

| PRS | Exercise Habits (Mean) |           | <i>t</i> -Test | Place of Residence |                    | <i>t</i> -Test | Education   |             |            |          |
|-----|------------------------|-----------|----------------|--------------------|--------------------|----------------|-------------|-------------|------------|----------|
|     | No (87)                | Yes (211) | <i>t</i>       | Local (115)        | Other Places (186) | <i>t</i>       | Junior High | Senior High | University | Graduate |
| BEI | 4.37                   | 4.34      | 0.39           | 4.38               | 4.33               | 0.686          | N.S.        | N.S.        | N.S.       | N.S.     |
| FAC | 4.12                   | 4.16      | −0.50          | 4.13               | 4.16               | −0.333         | N.S.        | N.S.        | N.S.       | N.S.     |
| COH | 3.72                   | 3.79      | −0.69          | 3.84               | 3.73               | 1.201          | N.S.        | N.S.        | N.S.       | N.S.     |
| COM | 3.82                   | 4.07      | −3.02 **       | 4.14               | 3.90               | 3.515 ***      | 3.90        | 3.91        | 3.73       | 3.61     |
| SCO | 3.89                   | 4.11      | −2.42 *        | 4.17               | 4.00               | 2.402 *        | N.S.        | N.S.        | N.S.       | N.S.     |

\*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$ ; BEI = Being away; FAC = Fascination; COH = Coherence; COM = Compatibility; SCO = Scope.

To test the relationships between POMS and socio-demographics of participants, independent sample *t*-test and ANOVA were conducted (Table 4).

**Table 4.** The relationships of socio-demographics and POMS.

| POMS               |                    | T-A      | A-H      | F-I      | D-D    | C-B      | V-I       | S-E       |
|--------------------|--------------------|----------|----------|----------|--------|----------|-----------|-----------|
| Exercise Habits    | No (87)            | 2.12     | 2.15     | 2.24     | 2.01   | 2.15     | 3.43      | 3.35      |
|                    | Yes (211)          | 1.87     | 1.85     | 1.95     | 1.81   | 1.93     | 3.74      | 3.64      |
| <i>t</i> -test     | <i>t</i>           | 3.31 *** | 3.97 *** | 3.62 *** | 2.48 * | 2.63 *** | −3.62 *** | −3.64 *** |
| Place of Residence | Local (115)        | 1.90     | 1.90     | 1.96     | 1.84   | 1.93     | 3.80      | 3.67      |
|                    | Other places (186) | 1.97     | 1.96     | 2.08     | 1.90   | 2.05     | 3.55      | 3.48      |
| <i>t</i> -test     | <i>t</i>           | −0.95    | −0.95    | −1.73    | −0.77  | −1.58    | 3.12 ***  | 2.56 *    |
| Age                | Under 29           | N.S.     | N.S.     | N.S.     | N.S.   | N.S.     | 3.41      | 3.35      |
|                    | 30–39              | N.S.     | N.S.     | N.S.     | N.S.   | N.S.     | 3.57      | 3.45      |
|                    | 40–49              | N.S.     | N.S.     | N.S.     | N.S.   | N.S.     | 3.81      | 3.69      |
|                    | 50–59              | N.S.     | N.S.     | N.S.     | N.S.   | N.S.     | 3.92      | 3.78      |
|                    | Over 60            | N.S.     | N.S.     | N.S.     | N.S.   | N.S.     | 3.89      | 3.82      |
| ANOVA              | F                  | N.S.     | N.S.     | N.S.     | N.S.   | N.S.     | 7.82 ***  | 7.15 ***  |

\*  $p < 0.05$  \*\*\*  $p < 0.001$ .

**Hypothesis 3.** *There are relationships between respondents' perception of ES and perceived mental health promotion of forest activities.*

Participants of High ES had significantly higher PRS than Medium ES and Low ES groups in ANOVA test (Table 5).

**Table 5.** ANOVA test of ES Clusters and PRS.

| PRS Dimension | ES Clusters  |                |               | Total Mean | F-Value    | Scheffe      |
|---------------|--------------|----------------|---------------|------------|------------|--------------|
|               | Low ES (121) | Medium ES (64) | High ES (116) |            |            |              |
| BEI           | 4.10         | 4.38           | 4.60          | 4.35       | 28.959 *** | 1 < 2 < 3    |
| FAC           | 3.86         | 4.20           | 4.43          | 4.15       | 25.189 *** | 1 < 2, 1 < 3 |
| COH           | 3.65         | 3.64           | 3.97          | 3.77       | 6.709 **   | 1 < 3, 2 < 3 |
| COM           | 3.81         | 4.02           | 4.19          | 4.00       | 10.454 *** | 1 < 3        |
| SCO           | 3.86         | 3.98           | 4.28          | 4.05       | 11.402 *** | 1 < 3, 2 < 3 |

\*\*  $p < 0.01$  \*\*\*  $p < 0.001$ ; BEI = Being away; FAC = Fascination; COH = Coherence; COM = Compatibility; SCO = Scope.

The high ES perceived significantly higher value than Medium ES and Low ES in all PRS dimensions. High ES and POMS scale “tension/anxiety(T-A)”, “anger/hostility(A-H)”, “fatigue/inertia(F-I)”, “depression/dejection(D-D)”, “confusion/bewilderment (C-B)”, “vigor/activity(V-A)” and “self-esteem(S-E)” were analyzed by ANOVA (Table 6).

**Table 6.** ANOVA test of ES Cluster and POMS.

| POMS | Ecosystem Service |                |               | Mean | F-Value   | Scheffe      |
|------|-------------------|----------------|---------------|------|-----------|--------------|
|      | Low ES (121)      | Medium ES (64) | High ES (116) |      |           |              |
| T-A  | 2.08              | 1.90           | 1.83          | 1.95 | 5.621 **  | 1 > 3        |
| A-H  | 2.06              | 1.94           | 1.81          | 1.94 | 5.416 **  | 1 > 3        |
| F-I  | 2.16              | 2.06           | 1.90          | 2.04 | 4.707 **  | 1 > 3        |
| D-D  | 2.02              | 1.87           | 1.74          | 1.87 | 6.029 **  | 1 > 3        |
| C-B  | 2.12              | 2.02           | 1.87          | 2.00 | 4.385 *   | 1 > 3        |
| V-A  | 3.48              | 3.63           | 3.83          | 3.65 | 8.269 *** | 1 < 3        |
| S-E  | 3.43              | 3.47           | 3.73          | 3.55 | 7.607 *** | 1 < 3, 2 < 3 |

\*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$ .

### 3. Results

**Hypothesis 1.** *The socio-demographics of participants are significantly related to the perception of ES.*

**Proof of Hypothesis 1.** The “High ES” has the highest proportion of graduate schools. “Low ES” has the highest percentage of junior high school education level. ES is rather not significantly related to gender, age, residential area, health state, occupation and exercise habits, with the result showing that education could enhance the perception of ES. □

**Hypothesis 2.** *The socio-demographics of participants are significantly related to the mental health promotion (PRS, POMS) of forest activities.*

**Proof of Hypothesis 2.** The results showed that “exercise habits” and “place of residence” were significantly related to the “compatibility” and “scope” dimensions of PRS. People with exercise habits have significantly higher “compatibility” and “scope” values than those who have no exercise habits. Local residents have a significantly higher perception of “compatibility” than other counties and cities’ residents (Table 3). Participants’ education level in high school has a significantly higher “compatibility” value (3.91) than those in university (3.71) and at the graduate level (3.61) ( $F = 3.98$   $p = 0.000$ ). (Table 3). □

The results showed that age, education level, exercises habit, and place of residence are related to POMS. People with age above 40 group, high school education level and local residents have higher emotional state in “vigor/activity (V-A)” and “self-esteem (S-E)” components. It is worth noting that those with “exercise habits” have significantly higher values than those without exercise habits among all components of POMS, “tension-anxiety (T-A)”, “anger-hostility (A-H)”, “fatigue/inertia (F-I)”, “depression-dejection (D-D)”, “confusion-bewilderment (C-B)”, “vigor/activity (V-A)” and “self-esteem (S-E)”. Research results showed that the dimensions of emotional state “vigor/activity (V-A)” and “self-esteem (S-E)” are significantly related to place of residence and education level, and all dimensions of emotional states are significantly related to exercise habits (Table 4).

**Hypothesis 3.** *There are relationships between respondents’ perception of ES and perceived mental health promotion of forest activities.*

The High ES group has the highest sensitivity in each aspect of attention restoration. On the contrary, the “Low ES” group has the lowest susceptibility to all aspects of attention

recovery. In summary, different ecosystem service perception groups have significant differences in PRS dimensions. (Table 5).

**Proof of Hypothesis 3.** The results showed that ES cluster is significantly related to perceptions of POMS. The “High ES” group has the lowest negative sentiment value and the highest positive sentiment value. The “Low ES” group has the highest negative sentiment value, indicating that groups with different ecosystem service perception has significant differences in an emotional state. □

#### 4. Discussion

In this study, the hypotheses H1, H2, and H3 were verified. The perception of ES is found affected by education level, the negative emotion of low ES perception being high, and exercise habits and place of residence do affect the emotional state (POMS). The result shows that the average values of the supplying, regulating, supporting and cultural ES are all over 4; this means that people have high perception of the various types of ES in the protection forest. Consistent with previous studies [14,30], the regulating and supporting values are more significant than others. However, the cultural value is becoming more valuable, especially for people who maintain exercise habits. According to the social and economic background of the participants, there is no significant difference in ES when it comes to gender and age, but there is a significant difference related education level; the people graduated from a research institute have their perception of supplying ES dimension higher than people graduated from only secondary school. This research conducted a questionnaire to research the people who enter the protection forests after exercise and leisure activities to understand their ES perception. As for the social activities and educational background, it could be explained that due to the transmission of educational knowledge and the accumulation of life experience, people have a higher awareness of the functions of the protection forests in mitigating the greenhouse effect, soil and water conservation, biodiversity, regulating climate, improving air quality, and reducing noise.

##### 4.1. Correlation between ES Perception and Mental Health

The results were consistent with previous studies [31]; the participants of High ES have the highest susceptibility to each aspect of attention restoration, with the lowest negative emotion and the highest positive emotion value. The differences in education level and living area of the subjects resulted in different perceptions of the ES, and also different mental health benefits.

##### 4.2. Attention Restoration Benefits of Protection Forest

Consistent with previous studies [32], the people with exercise habits and live near protection forest have their “compatibility” dimension of PRS is higher than others. Compatibility means the environment is suitable for personal expectations and preferences, and allow individuals to engage in further participation [33]. The result corresponds to the local residents having better “compatibility” because they have better understanding of the characteristics of the environment [34].

##### 4.3. Emotional State Benefits of Protection Forest

The results found that place residence is significantly related to dimension of “vigor/activity” and “self-esteem” of POMS, and exercise habit is also highly related to each aspect of POMS. That means people who live around a protection forest area will have higher positive emotional dimension and lower negative emotion which could result in higher mental health. Participants who have regular exercise habits and participate in leisure activities will have improved mental health [35]. The exercise habits people have can promote optimism and reduced negative emotions [36–38].



## 5. Conclusions and Suggestion

This study complements a research gap on the relationship of natural experiences with ES to human mental health. For the Cultural Ecosystem (CES) in the context of ES research, initially only recreation and culture were classified, which means the non-physical benefits that people perceived from the ecosystem were aesthetics, cultural/historical value, social value, economic, environmental education and recreation [39]. Compared with other dimensions of Ecosystem services, such as supporting, provisioning and regulating, CES is more difficult to measure and study. However, the loss of CES will directly or indirectly degrade local ecosystems [40]. Therefore, researchers have been paying more attention to CES. Cheng and Van Damme & Uyttenhove [41] reviewed 293 journal studies on CES between 2005 and 2017 and found that most studies focused on recreation and ecotourism, followed by aesthetic value, educational values and spiritual values, while social relations and cultural differences have received less attention, and neither is related to health promotion. This research has complemented research gaps and confirmed that recreation and leisure activities of CES are related to health promotion, which might be an important value of protection forests for residents.

The study found that ES perception is positively correlated with mental health benefits, and local residents have higher mental health benefits of exercise and leisure activities in the protection forest than do non-local residents. Therefore, improving the facility quality and accessibility such as forest trails and exercise facilities for residents to participate in recreational activities in the protection forest and urban forests will be an important issue for the Forestry Bureau, so that people can easily enter the forest to relieve stress. In addition, from the perspective of education, when the Forestry Bureau promotes environmental education programs or conducts ecotourism activities, it is recommended to cooperate with the ES value of Taiwan's forest so that the public can understand supporting, provisioning, regulating and cultural ecosystems' service value.

This research involved field research in the protection forests along the western coast of Taiwan. However, the types and functions of protection forests are diverse in Taiwan, and they have different functions due to the characteristics of the environment. Therefore, it is suggested that follow-up research can be conducted according to different types of protection forests. This study is a quantitative one. It is suggested that there be post-experience in-depth interviews with the public to understand the meaning of the ES and health promotion for further research. We also suggest that the Forestry Bureau revises the restricting of people to access protection forests policies and to cooperate with community forests to conserve protection forestry and sustain protection forests.

**Author Contributions:** Conceptualization, methodology: S.-H.L. and Y.-C.C.; investigation, Y.-C.C.; analysis, Y.-C.C. and P.-C.K.; writing—original draft preparation, Y.-C.C. and S.-H.L.; writing—review and editing, S.-H.L.; project administration, S.-H.L. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the Ministry of Science and Technology of Taiwan grant number MOST108-2410-H-003-110-SSS.

**Institutional Review Board Statement:** National Taiwan Normal University Certificate of REC Approval number 201903HM006.

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

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

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