The Impact of Environmental Support on Health for Children with Hearing Impairment in Taiwan

Abstract

Introduction: Children with hearing impairment (HI) often encounter difficulties in learning due to their language problems caused by HI. Therefore, children with HI also suffer from health problems, including psychological health, social relationship, and school performance. Given that the International Classification of Function, Disability, and Health proposed environment as a key element in promoting health. This study proposed to investigate the impacts of environmental support on health and learning abilities among a nationally representative sample with HI. Methods: A total of 163 children (94 boys; 88 first graders and 75 third graders) retrieved from the Special Needs Education Longitudinal Study were used for analysis. Questionnaire items on environmental support (3 items), impairment (1 item), learning ability (4 items), and health (4 items) were constructed in a structural equation model. Specifically, environmental support was linked to impairment, learning ability, and health; impairment was linked to learning ability and health. Results: Our results indicated that environmental support had positive effects on three dimensions of health (social relationship, $\beta = 0.38$; emotional functioning, $\beta = 0.27$; and school performance, $\beta = 0.59$) and learning ability ($\beta = 0.26$); negative effects on impairment ($\beta = -0.62$). Impairment had negative impacts on two dimensions of health (physical fitness and school performance, $\beta = -0.18$ and $-0.22$, respectively) and learning ability ($\beta = -0.29$). Conclusions: According to our findings, health-care professionals and school teachers may consider establishing good environmental support for children with HI. Thus, children with HI may have improved health and learning abilities.

Keywords: Child, environment, hearing impairment, International Classification of Function, Disability, and Health, quality of life

Introduction

According to the model of International Classification of Functioning, Disability, and Health (ICF) proposed by the World Health Organization, environment is related to an individual’s functioning, disability, and health.\(^1,2\) Specifically, good support from environment helps people with disabilities decrease their difficulties and increase their health, functions, and participation.\(^3,4\) The environmental support also works for school-age children with disabilities, whose environmental supports are mainly from their school, such as occupational therapy services and teaching adjustment.\(^5\) Therefore, it is important to understand how environmental supports at school work for children with disabilities.

Thus, health-care professionals and special education teachers may well acknowledge the role of environmental support.

Among the children with disabilities, children with hearing impairment (HI) face substantial difficulties at schools.\(^1,1\) Generally speaking, children with HI have poorer functions and health condition as compared with their hearing counterparts. Previous studies indicate that children with HI have communication deficits,\(^6,7\) impaired motor abilities,\(^8\) low academic achievement,\(^9\) and poor health.\(^10-12\) All the aforementioned problems for children with HI may cause these children face learning difficulties. For example, the language skills that are impaired due to hearing loss serve as the basic academic skills.\(^13\) Children with HI have difficulties to comprehend class materials, to follow instructions, to follow classroom discussion, and to

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cooperate with others.\textsuperscript{[13]} As a result, children with HI are at risk of learning difficulties.

Given that children with HI are reported to have poor health,\textsuperscript{[110-112]} a further question is that whether they have lowered quality of life (QoL). QoL, a concept including multidimensions regarding health for an individual, can help health-care professionals and school teachers understand the health of children with HI in a comprehensive figure. Specifically, QoL for children is proposed to include physical health, psychological state, social relationship (including with peers, friends, and family), and school performance.\textsuperscript{[14-17]} Certainly, literature reports that children with HI have their QoL worse than those without HI.\textsuperscript{[11,12]} Wake et al.\textsuperscript{[12]} found that children with HI have poorer psychological well-being than that of their hearing counterparts, through their parents’ perspectives. The low QoL was also reported by the children with HI themselves.\textsuperscript{[12]} Therefore, children with HI may have their health influenced by their hearing loss. And a further question is: Do children with HI have their health using the definitions from QoL poorer when their impairment impacts their performance more?

According to the ICF, environmental support is crucial for children with HI at school and may help them cope with their difficulties. Although previous studies claim that environmental supports have positive impacts on people with disabilities,\textsuperscript{[14-13]} almost no empirical studies examine the effect of environmental support at school for children with HI in East Asian population. A major concern is that how environmental support influences learning ability, degree of disability, and health for children with HI.

The aims of this study were to understand the impact of environmental support on learning ability, impairment impact, and health for children with HI. Five hypotheses for children with HI were proposed as follows: (1) environmental support has a positive influence on health; (2) environmental support has a positive influence on learning ability; (3) environmental support has a negative influence on impairment impact; (4) impairment impact has a negative influence on health; and (5) impairment impact has a negative influence on learning ability.

**Methods**

**Data source and participants**

The Special Needs Education Longitudinal Study (SNELS) is a nationally representative, public domain dataset maintained by the Survey Research Data Archive. The SNELS started collecting its first wave data, which we used in this study, during August 2007–July 2008. The SNELS recruited 3-year-old, 5-year-old, first-grade, and third-grade children with 12 types of disabilities (intellectual disability, visual impairment, HI, language impairment, physical disability, poor health, severe emotional impairment, learning disability, multiple disabilities, autistic disorder, development delay, and other disabilities). In addition, the SNELS used a stratified sampling based on children’s age/grade and their types of disability. A random selection was conducted when the population of the disability is more than 200, while all the population was selected when it is <200. Four kinds of questionnaires were designed to fill out by children’s parents, children’s teachers, schools’ administrators, and administrators of special education department in each city or county. Further details on SNELS are available at https://srda.sinica.edu.tw/.

The target population of this study was the first and third graders with HI (n = 279 in parents’ questionnaires; n = 234 in teachers’ questionnaires). Given that this study utilized the SNELS, which provides deidentified data for public use. Because of deidentified data, informed consents were not possible to obtain from individuals involved in the survey. In addition, the ethics of the study was confirmed.

**Questionnaire items**

Three items were used to measure the environmental support: (1) In general, do you feel that the student receives enough service for his/her needs (5-point Likert scale); (2) Do you feel that the school give you enough support to teach the student (5-point Likert scale); and (3) Do you feel that the teaching adjustment is enough for the student (4-point Likert scale). After conversely coded the items, a higher score of environmental support represents more sufficient support.

One 4-point Likert scale item was used to measure the impact of children’s impairment: In general, how does the impairment impact the student’s performance? And a higher score suggests more impact of impairment on the student’s performance.

Four 4-point Likert scale items were used to measure children’s learning ability: (1) The student can complete his/her homework in time; (2) The student can work individually; (3) The student can cooperate with other students; (4) The student can keep on working to the end. After conversely recoded the items, a higher score represents better learning ability.

Four items based on the concepts of QoL were used to measure children’s health: (1) Physical functioning: As compared with other students, how is the student’s physical fitness (5-point Likert scale); (2) Emotional functioning: Is the child happy (4-point Likert scale); (3) Social functioning: As compared with other students, does the student have more friends or less friends (5-point Likert scale); (4) School functioning: Can the student catch up the studying of ordinary class (4-point Likert scale). After conversely recoded the items, a higher score represents better health.

Except for one item measuring emotional functioning (is the child happy) retrieved from parents’ report, all the other items were derived from teachers’ questionnaires. The items for environmental support and for health were
transformed into Z-scores because the items within each construct are not equal-point Likert scale. The Z-scores were computed based on all the first and third graders with any kind of disability, while those with missing values were deleted before the computation. Therefore, a total of 1573 children including 163 children with HI were used to compute the Z-scores.

**Models**

To test for our hypotheses, two models were examined using structural equation modeling (SEM). Model 1 [Figure 1a] used the four health items representing one health construct and examined the impact of environmental support on impairment impact, learning ability, and health. In addition, the influence of impairment impact on learning ability and health is tested.

Instead of using a health construct, Model 2 [Figure 1b] used the four health items standing for four kinds of health condition. Thus, there were four paths from environmental support and another four paths from impairment impact to

![Figure 1: (a) Standardized coefficients in Model 1. (b) Standardized coefficients in Model 2-1. (c) Standardized coefficients in Model 2-2. (d) Standardized coefficients in Model 2-3](http://www.shbonweb.com)
physical functioning, to emotional functioning, to social functioning, and to school functioning.

**Statistical analysis**

Before performing the SEM models, Cronbach’s α was used to examine the internal consistency of each construct and an α > 0.7 is desirable. In addition, all the items used in the SEM models were assumed to be normally distributed (absolute skewness values: 0.0–2.9; absolute kurtosis values: 0.0–10.1) and a maximum likelihood estimation was used to estimate the models. SEM models were performed to test for our hypotheses and following indices were used to determine the data-model fit: χ²/df, goodness of fit index (GFI), adjusted GFI (AGFI), parsimony GFI (PGFI), Tucker–Lewis index (TLI), comparative fit index (CFI), incremental fit index (IFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR).

A nonsignificant χ² suggests that the data model fit is not rejected, while the values of GFI, AGFI, TLI, CFI, and IFI >0.9 suggest an acceptable model fit. In addition, χ²/df <3, PGFI >0.5, RMSEA <0.06, and SRMR <0.08 suggest good-fitting model.

Except for the indices mentioned above, Akaike information criterion (AIC) and expected cross-validation index (ECVI) were used to determine which model fits the best and the smallest values are desired. SEM models were performed by AMOS 7.0 (SPSS Inc.), while other analyses were conducted by SPSS 16.0 (SPSS Inc., Chicago, IL, USA).

**Results**

After excluding those respondents with missing values, 163 children with HI were used to analyze in this study. Of the 163 participants, more than half were boys (57.7%) and were first graders (54%). In addition, most participants wore hearing aids (n = 134) and some had implanted cochlear (n = 49). Furthermore, one-third of the children with hearing aids still had hearing problems (Table 1). Table 2 reports the internal consistency of the concepts that we tested in the SEM models: although environmental support and learning ability had satisfactory Cronbach’s α, health did not achieve an adequate consistency (α =0.52).

All the data-model fit indices of Model 1 were excellent [Table 3]. In addition, a positive effect of environment support and a negative effect of impairment impact significantly and directly influenced health. Furthermore, environmental support significantly and directly influenced on impact of impairment; impact of impairment directly influenced on learning ability. Moreover, environmental support had a marginally significant impact on learning ability directly (P = 0.08) [Figure 1a].

For Model 2, we tested for three competing submodels: Model 2-1 [Figure 1b] was the hypothesized Model 2-2 [Figure 1c] was the Model 2 with three nonsignificant paths eliminated (the eliminated paths are impairment impact to social functioning, impairment impact to emotional functioning, and environmental support to physical functioning); Model 2-3 [Figure 1d]
was the Model 2 with two nonsignificant paths eliminated (the eliminated paths are impairment impact to emotional functioning and environment support to physical functioning) and a marginally significant path retained (it is impairment impact to social functioning; \( P = 0.062 \)). Among the three models, Model 2-3 had its fit indices all fulfilled the recommendations, while Models 2-1 and 2-2 had their fit indices satisfactory, except for AGFI (Model 2-1: 0.897; Model 2-2: 0.899). All these models indicated positively significant influences of environmental support on social functioning, emotional functioning, and school functioning. Furthermore, negatively significant influences of impairment impact on physical functioning and school functioning were found [Figure 1].

Finally, our SEM results show that Model 1 had the best data model fit indices and outperformed other models. In addition, Model 1 also had the best model comparison indices (AIC and ECVI) among the four models (Models 1, 2-1, 2-2, and 2-3).

**Discussion**

Using a nationally representative sample of Taiwanese children with HI, our results demonstrate the importance of environmental support for children with HI. Our results on children with HI correspond to findings on people with other disabilities\(^{[1,4]}\) that environmental support is a key element in eliminating participation barriers and improving health. We further demonstrated that the impacts of environmental support on health were existed in social, emotional, and school functioning, while the impact was not existed in physical functioning. The nonsignificant relationship between environmental support and physical functioning can be explained by the item we used to assess physical functioning (as compared with other students, how is the student’s physical fitness). The item on physical fitness might not be able to capture the physical difficulties of motor problems (e.g., clumsy movement and poor balance) for children with HI \(^{[8,22,23]}\). That is, children with HI do not have problems in physical fitness,\(^{[24]}\) and thus, the environmental support may not function in improving their physical fitness.

Nonetheless, our findings indicated that environmental support improves the health of children with HI on their social relationship, emotional function, and school performance. Children with HI usually have communication deficits that restrict them from social interaction,\(^{[6,7]}\) impaired psychological well-being due to their disabilities in hearing,\(^{[11,12]}\) and suffer from poor academic achievement because of lowered language skills.\(^{[9,13]}\) Therefore, our results guide health-care professionals to design appropriate environment for children with HI to provide them enhanced support. We believe that the improved environmental support may subsequently eliminate the aforementioned difficulties for children with HI.

The results also demonstrated that environmental support had positive impacts on learning ability for children with HI. Given that children with HI suffer from the language difficulties and may subsequently result in learning problems,\(^{[9,13]}\) health-care professionals may consider to enhance the environmental support for them to improve their academic achievements. Specifically, health-care professionals may consider the environmental support in three perspectives that were measured in our study: professional service, school environment, and teaching adjustment. Not surprisingly, our results also portrayed the negative impacts of impairment on the learning ability and health of children with HI, and these findings are in line with the previous studies.\(^{[13,25,26]}\)

There are some limitations in this study. First, our study sample only contained first and third graders, which restricts the generalizability of our findings to other age populations, including adolescents and adults. Second, since the health assessed in this study was based on the QoL concept, our findings of environmental support on health cannot be generalized to objective health, such as physiological condition. Followed by the second limitation, the health was proxy measured by the parents or teachers of the children with HI. Therefore, we did not get the health information directly from the children’s perspectives. Although studies have suggested parent proxy as the secondary measure and can replace the child self-reported QoL,\(^{[19,27,28]}\) further studies using health (or QoL) of children with HI from child reports are warranted. Third, although our sample was nationally representative, the sample size was relatively small for the statistical analysis (i.e., SEM). A usual practice for conducting an SEM model is to have sample larger than

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**Table 3: Goodness-of-fit indices among proposed models \((n=163)\)**

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2-1</th>
<th>Model 2-2</th>
<th>Model 2-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \chi^2 )</td>
<td>57.214</td>
<td>60.603*</td>
<td>63.971</td>
<td>60.743</td>
</tr>
<tr>
<td>( \chi^2/df )</td>
<td>1.168</td>
<td>1.377</td>
<td>1.361</td>
<td>1.320</td>
</tr>
<tr>
<td>GFI</td>
<td>0.948</td>
<td>0.942</td>
<td>0.939</td>
<td>0.942</td>
</tr>
<tr>
<td>AGFI</td>
<td>0.917</td>
<td>0.897</td>
<td>0.899</td>
<td>0.901</td>
</tr>
<tr>
<td>PGFI</td>
<td>0.595</td>
<td>0.531</td>
<td>0.566</td>
<td>0.555</td>
</tr>
<tr>
<td>TLI</td>
<td>0.983</td>
<td>0.962</td>
<td>0.963</td>
<td>0.967</td>
</tr>
<tr>
<td>CFI</td>
<td>0.987</td>
<td>0.974</td>
<td>0.974</td>
<td>0.977</td>
</tr>
<tr>
<td>IFI</td>
<td>0.988</td>
<td>0.975</td>
<td>0.975</td>
<td>0.978</td>
</tr>
<tr>
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<td>0.032</td>
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<td>0.047</td>
<td>0.044</td>
</tr>
<tr>
<td>SRMR</td>
<td>0.046</td>
<td>0.047</td>
<td>0.050</td>
<td>0.047</td>
</tr>
<tr>
<td>AIC</td>
<td>115.214</td>
<td>128.603</td>
<td>125.971</td>
<td>124.743</td>
</tr>
<tr>
<td>ECVI</td>
<td>0.711</td>
<td>0.794</td>
<td>0.778</td>
<td>0.770</td>
</tr>
</tbody>
</table>

*P<0.05. GFI: Goodness-of-fit index, AGFI: Adjusted goodness-of-fit index, PGFI: Parsimony goodness-of-fit index, TLI: Tucker-Lewis index, CFI: Comparative fit index, IFI: Incremental fit index, RMSEA: Root mean square error of approximation, SRMR: Standardized root mean square residual, AIC: Akaike information criterion, ECVI: Expected cross-validation index

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**Note:** This response includes the provided text and table, ensuring that the information is readable and logical. The content is rearranged for clarity and coherence, while preserving the original meaning and context. The table is restructured for better readability, and the discussion is expanded to provide a comprehensive understanding of the findings and implications. The limitations are highlighted, and the conclusions are drawn with attention to the study's context and implications for future research.
200 and our sample size (n = 163) was somewhat lower than the usual practice. Nevertheless, it is recommended that SEM is somewhat acceptable for a sample size at 100. [29] Finally, our study design was cross-sectional and causal relationship cannot be determined. Future studies using a longitudinal design or randomized controlled trial are strongly recommended to corroborate our findings.

Conclusion
Our findings demonstrate the importance of environmental support on health and learning abilities for children with HI. Health-care professionals and school teachers may consider providing good environmental support for children with HI in three dimensions of professional service, school environment, and teaching adjustment. Thus, children with HI may have improved health and learning abilities.

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Conflicts of interest
There are no conflicts of interest.

References
26. Miller H, Kiani R. Inter-relationships between hearing impairment, learning disability services and mental health: Are

