Physical Health of Mothers of Children with Hearing Loss

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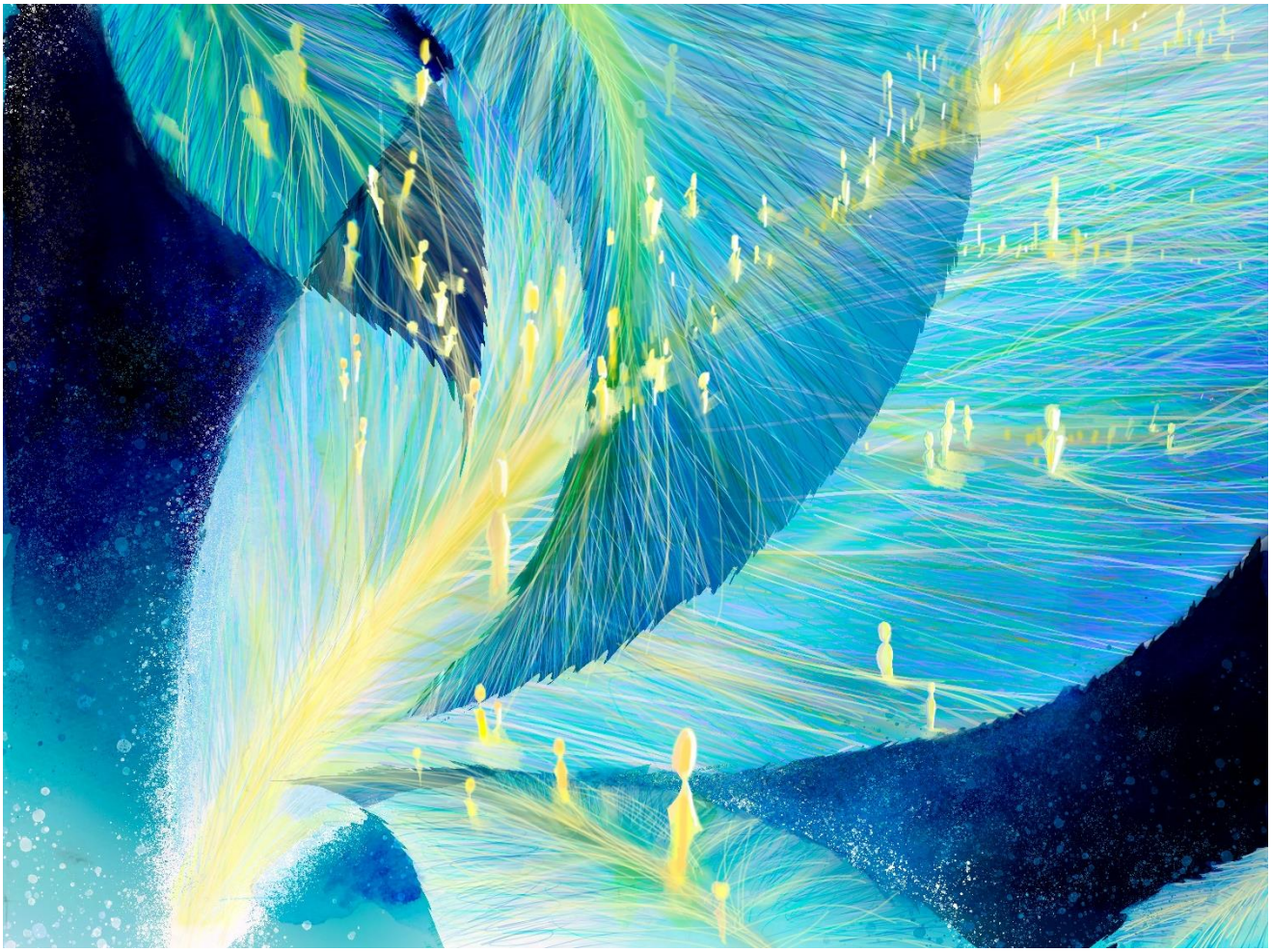

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ORIGINAL ARTICLE

Physical Health of Mothers of Children with Hearing Loss

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ABSTRACT

Parents, particularly mothers, of children with disabilities often experience mental stress. Various interventions have been used to reduce stress and increase support. As regular physical activity/exercise is beneficial for various health conditions, it could reduce stress in mothers. The purpose of this study was to clarify the physical health status of mothers of children with hearing loss. Participants were 10 mothers of children with hearing loss (mean age: mothers: 36.7 ± 3.3 years). Participants' muscle strength, muscle endurance, flexibility, agility, and exercise tolerance were tested. Step counts were recorded using a triaxial accelerometer and amount of activity time was measured using metabolic equivalents (METs). Time spent on moderate-to-vigorous physical activity (MVPA) ≥3.0 METs per day was assessed. Standing posture was determined using a photographic lateral view and classified according to Kendall's posture types. Participants' performance was compared with the national average for similar-aged women. There was no significant difference in muscle strength, muscle endurance, flexibility, and exercise tolerance. However, participants' agility ($p = 0.013$) and number of daily steps (4,913 ± 1,414; $p = 0.006$) were significantly lower. MVPA time was 49.6 ± 22.8 minutes per day, 44.9 minutes of which were MVPA ≥3.0 METs. Some mothers exhibited a kyphotic posture, and most complained of shoulder stiffness and low back pain. The physical fitness of mothers of children with hearing loss was the same as the national average. Mothers should maintain their physical health by participating in more vigorous daily physical activity and increasing their awareness of posture.

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I. Introduction

Parents bringing up children with disabilities, particularly mothers as the main child caretakers, experience substantial mental stress, including self-reproach and anxiety. Various interventions and sources of support have been developed for such mothers (Dykens, Fisher, Taylor et al., 2014; Carlson & Miller, 2017).

Mothers of children with hearing loss (HL) often experience mental stress. Jean, Mazlan, Ahmad et al.(2018) identified the following resources that can moderate parental stress: the child's progress, mother's characteristics, professional support (from audiologists, speech therapists, occupational therapists, and pediatricians with expert knowledge about, for example, HL prognosis), and social support from family and online support groups. The impact of hearing disorders on development of communication skills can be minimized by early detection and intervention (American Academy of Pediatrics, Joint Committee on Infant Hearing, 2007). Currently, screening for hearing loss begins in the neonatal period and if the diagnosis of a hearing problem is confirmed, intervention starts by 6 months of age at the latest. However, treatment in a medical institution is insufficient; a child with HL also requires a home program designed and supervised by a speech-language-hearing (SLH) therapist to develop his/her communication ability. The parents of a child with HL carry out tasks at home under the SLH therapist's instruction that fit their child's current speech/language ability (Yokogawa, Notoya & Madokoro, 2017). Although such parental activities help to develop the child's communication skills, they impose an extra burden on parents compared with regular childcare.

Parents must also accompany their child to hospital consultations/treatments. Most mothers transport their child by car (Yokogawa, Notoya & Madokoro, 2017). Frequent use of a car may lead to a reduction in physical activity (PA). There is evidence of an inverse relationship between regular PA/exercise and health problems such as cardiovascular disease, stroke, diabetes mellitus, breast cancer, and depression (American College of Sports Medicine, 2018). There is a need to investigate the physical health of mothers of children with HL. In addition to the resources advocated by Jean, Mazlan, Ahmad et al. (2018), PA may help to reduce stress in such mothers. There is little research on physical health in mothers of children with disabilities (Raina, O'Donnell, Rosenbaum et al., 2005; Muammer, Demïrbaş, Muammer et al., 2013). The purpose of this study was to clarify the physical health status of mothers of children with HL. It was hoped that the findings would encourage discussions of family support for parents of children with HL, particularly mothers.

II. Methods

This was a cross-sectional study of mothers of children with hearing loss. The study was conducted at Kanazawa University between November 2016 and December 2016.

1. Participants

Participants were 10 mothers. The mean age was 36.7 ± [standard deviation] 3.3 years (range, 32–42 years), mean height was 158.6 ± 5.5 cm, mean body weight was 49.6 ± 7.8 kg, and mean body-mass index was 19.8 ± 3.6 kg/m^2. The sample size was determined as all mothers of children regularly attending the Department of Otorhinolaryngology, Kanazawa University hospital, Japan, who met the following criteria: a) their children were aged 2–6 years old, b) their children did not have multiple disorders such as additional intellectual disability, developmental disability, or autism spectrum disorder, c) they resided in Ishikawa Prefecture (where the hospital was located). The degree of HL (American Speech-Language- Hearing Association: Degree of Hearing Loss, 1981) of the 10 children was as follows: one moderate, one moderately severe, three severe, and five profound. Five of the children wore hearing aids and the other five had cochlear implants. Mothers were asked to provide approximately 2 hours a day to prepare for and carry out the home program for the children's speech/language development. They received a 40–60-minute professional consultation twice a month, where advice was given about speech/language and the home program. All children were brought by car to the hospital (a 1–3-hour round trip). The Kanazawa University Medical Ethics Committee approved the study (approval No.698). This study was conducted in accordance with the ethical principles of the Helsinki Declaration of 1975, as revised in 2000. Written informed consent was obtained from all participants.

2. Physical function

Testing of participants' physical fitness was based on the fitness test recommended by the Japanese Ministry of Education, Culture, Sports, Science and Technology (1999) and the exercise guidelines recommended by the Ministry of Health, Labour and Welfare (2006). Physical function characteristics tested were muscle strength (handgrip), muscle endurance (sit-ups), flexibility (sit & reach), agility (side-stepping), and exercise tolerance (3-minute walk).

Handgrip strength was assessed using a Smedley-type handheld dynamometer (GRIP-A; Takei, Niigata, Japan). With the participant standing, alternate measurements were taken twice for both hands. The higher value was selected for each hand and averaged for the analysis.

For the sit-up test, the participant was in a supine position with both arms crossed in front of the chest and knees flexed at a right angle and fixed by the examiner. She was then asked to raise her head, shoulders, and upper trunk until the elbows touched the thighs, and then return to the floor quickly. The number of sit-ups in 30 seconds in a

single trial was recorded.

For the sit & reach test, two cardboard boxes (each with a width of approximately 22 cm, height of approximately 25 cm, and length of approximately 31 cm) were placed approximately 35-40 cm apart. A sheet of cardboard was fixed on top of them. The participant was asked to take off her shoes and sit on the floor with her legs stretched out to the front, keeping her head, back, and hips against the wall. The cardboard apparatus was placed over her lower legs and a scale was placed on the floor alongside the apparatus. She was instructed to straighten her elbows and place both hands with the crease of the palm on the nearside edge of the top of the apparatus. She was then instructed to reach forward, slowly pushing the apparatus as far away as possible without jerking. The distance the apparatus moved was measured. The higher score of two trials was recorded.

For the side-stepping test, the participant stood astride a center line, stepped 100 cm sideways and touched the line or went over it with the closest foot, then stepped back to the center. This was repeated on the other side. She tried to complete as many steps as possible in a 20-second period and was given one point whenever she passed each line, including returning to the center line. The test was performed twice and the higher score of the two tests was recorded.

To assess cardiopulmonary fitness, the 3-minute walking test (Cao, Miyatake, Aoyama et al., 2013) was carried out using a 20-metre flat surface in an unobstructed hallway. The participant was asked to walk to the marker, turn around, walk back to the starting line, and repeat this for a 3-minute period at her own pace. This procedure was rated by participants as “somewhat hard” (corresponding to Grade 13) on the Rated Perceived Exertion scale (Borg, 1998). At the end of the test, the total number of repetitions for the 3-minute walking distance (3 MWD) was recorded. The maximal oxygen uptake was calculated using the following estimated formula from Cao, Miyatake, Aoyama et al. (2013): [$VO_2max = 29.578 + 5.284 \times$ Sex (0 = women, 1 = men) $- 0.237 \times$ Age $- 0.564 \times$ BMI $+ 0.070 \times$ 3 MWD].

3. Physical activity

Following testing for physical status, the participant was asked to wear a triaxial accelerometer (Active style Pro HJA-750C; Omron Healthcare, Kyoto, Japan; 40 × 50 × 12 mm and 23 g including batteries) (Oshima, Kawaguchi, Tanaka et al., 2010; Ohkawara, Oshima, Hikihara et al., 2011; Tanaka, Fujiwara, Sakurai et al., 2013) on her waist at all times for 1 week (except during dressing and bathing) to monitor her PA. The accelometry data were uploaded 7 days later to a personal computer, from which the examiner retrieved the daily step counts and time spent on PA in metabolic equivalents (METs). METs determined by accelometry strongly correlate with METs measured using indirect calorimetry (Oshima, Kawaguchi, Tanaka et al., 2010). The “non-wearing time” shown on the accelometer indicated that no acceleration signal had been recorded for more than 20 consecutive minutes (Tanaka, Fujiwara, Sakurai et al., 2013; Mâsse,

Fuemmeler, Anderson et al., 2005). If the acceleration signal was more than 10 hours in a day, the data for that particular day were considered valid for analysis (Troiano, Berrigan, Dodd et al., 2008). The average daily step counts for the participant were also calculated from the data. The average time spent in PA was classified according to eight levels of exercise intensity: 1.0-1.9 METs, 2.0-2.9 METs, 3.0-3.9 METs, 4.0-4.9 METs, 5.0-5.9 METs, 6.0-6.9 METs, 7.0-7.9 METs, and over 8.0 METs; and determined by the 60-second epoch length for each MET18). PA with a moderate intensity or greater (≥3 METs) is defined as moderate-to-vigorous PA or MVPA (Tanaka, Fujiwara, Sakurai et al., 2013; Adachi, Kono, Iwatsu et al., 2018; Ainsworth, Haskell, Herrmann et al., 2011). MVPA is effective in reducing the risks of cardiovascular disease and all-cause mortality (Bucksch, 2005; Tanasescu, Leitzmann, Rimm wt al., 2002). In this study, the time spent on PA of ≥3.0 METs per day as measured by the triaxial accelometer was defined as MVPA time, and its average during the trial period was calculated for each individual.

4. Assessment of posture

A right and left lateral view of the participant's standing posture was bilaterally photographed using a digital camera (DSC-WX50; Sony, Tokyo, Japan). Drawing a vertical line through the right lateral view, posture was classified according to Kendall's posture types: ideal alignment, kyphosis-lordosis, flat-back, or sway-back (Kendall, McCreary & Provance, 1993). Participants were also asked if they had stiffness in their neck or shoulders and/or low back pain. Posture was assessed for nine participants; one participant missed the postural assessment, though she underwent all other assessment procedures.

5. Statistical analysis

All values are presented as mean ± standard deviation. For grip strength, sit-ups, sit & reach, and side-stepping, the one-sample t-test was used to determine whether the participants' mean was statistically different from the national average in 2016 for 35-39-year-old women (Portal Site of Official Statistics of Japan, 2016a). For the estimated VO_2 max from 3 MWD, the one-sample t-test was used to assess whether the participants' mean was statistically different from a mean of VO_2 max estimated using the national average distance for 35-39-year-old women in a 20-metre shuttle run (Portal Site of Official Statistics of Japan, 2016a).

For step counts, the one-sample t-test was used to assess whether the participants' mean values were statistically different from the national average in 2016 for 35-39-year-old women (Portal Site of Official Statistics of Japan, 2016b). Mean MVPA time was calculated for the different intensity levels. SPSS version 23.0J (IBM Corp., Armonk, NY, USA) was used for data analysis. The level of significance was set at $p = 0.05$.

III. Results

Participants' physical fitness is shown in Table 1. The mean grip strength, sit-ups, sit & reach, and estimated VO_2max showed no statistically significant difference from that of the national average for similar-aged women. Participants showed significantly fewer mean side-steps than the national average ($p = 0.013$; Table 1). The mean 3 MWD was 305 ± 33 m.

The mean step counts were 4,913 ± 1,414 steps/day, which was significantly fewer than for the national average for a similar-aged group of women (6,521 ± 3,569 steps/day) ($p = 0.006$; Table 2). The mean MVPA time was 49.6 ± 22.8 min/day, 44.9 minutes of which was at a PA level of ≥3.0 METs (Table 2).

<Table 1> Physical fitness of participants (n = 10)

	Participants' average	National average* (women, aged 35–39 years)	*p*-value
Grip strength (kg)	26.6 ± 4.3	29.0 ± 4.5	0.110
Sit-ups (repetitions)	15.0 ± 3.8	16.7 ± 5.0	0.188
Sit & reach (cm)	39.3 ± 10.9	42.5 ± 9.3	0.378
Side-stepping (score)	35.9 ± 6.0	41.8 ± 5.7	0.013
VO_2 max (ml/kg/min)	31.3 ± 4.1	32.3 ± 2.7	0.365

Mean ± SD. *Data were obtained from the 2016 Physical Fitness and Motor Skills Test (Portal Site of Official Statistics of Japan, 2016a).

<Table 2> Step counts and level of physical activity (n = 10)

	Participants' average	National average* (women aged 30–39 years)	*p*-value
Step counts (steps/day)	4,913 ± 1,414	6,521 ± 3,569	0.006
Total MVPA time (min/day)	49.6 ± 22.8		
3.0–3.9 METs (min/day)	44.9 ± 21.5		
4.0–4.9 METs (min/day)	4.0 ± 1.8		
5.0–5.9 METs (min/day)	0.5 ± 0.4		
6.0–6.9 METs (min/day)	0.1 ± 0.1		
7.0–7.9 METs (min/day)	0.1 ± 0.1		
>8.0 METs (min/day)	0.0 ± 0.0		

Mean ± SD. MVPA: moderate-to-vigorous physical activity; METs: metabolic equivalents. *Data were obtained from the 2016 National Health and Nutrition Survey (Portal Site of Official Statistics of Japan, 2016b).

Only two participants showed ideal postural alignment; six exhibited a kyphotic back. One-third of participants complained of stiffness in the shoulders and two-thirds complained of low back pain (Table 3).

<Table 3> Postural alignment and stiffness

Variable	n
Postural alignment (n = 9)*	
Ideal alignment	2
Kyphosis-lordosis	3
Flat-back	1
Sway-back	3
Not assessed	1
Muscle stiffness (n = 10)	
Shoulders	3
Lower back	6

*One participant was unable to attend the postural assessment session owing to lack of time.

Ⅳ. Discussion

The results showed that the physical fitness levels of mothers of children with HL were equivalent to those of a group of similar-aged women in Japan. The findings also indicate some potential negative aspects of mothers' PA and posture.

Of the PA parameters, participants had fewer step counts (Table 2) than the national average for similar-aged women (Portal Site of Official Statistics of Japan, 2016b). This suggests that participants have less opportunity to walk in their daily lives. In contrast, the average MVPA time for participants was 49.6 min/day (Table 2). The World Health Organization (WHO) recommends the following PA/exercise for individuals aged 18–64 years: a) a minimum of moderate-intensity aerobic PA for 150 minutes throughout a week; or b) a minimum of vigorous-intensity aerobic PA for 75 minutes throughout a week; or c) a combination of a and b (World Health Organization, 2010). Caution is needed when interpreting the accelometry results, as measured values can differ according to data processing settings (Mâsse, Fuemmeler, Anderson et al., 2005). The MVPA time results show that mothers' PA levels meet the criteria recommended by the WHO.

It is likely that the amount of time mothers spend with their children affects whether their MVPA meets the WHO criteria. Typically, caring for a child (mainly standing) requires 3.0 METs, playing (walking/running; moderate intensity) with the child requires 3.5 METs, and playing (walking/running; vigorous) with the child requires 5.8 METs (Ainsworth, Haskell, Herrmann et al., 2011). Mothers spend substantial time and energy on a child's upbringing, regardless of whether the child has a disability. Additional time and energy are required of mothers of children with HL, especially when administering

the child's home program for speech/language development. In this situation, a mother must move her body to solicit the child's attention, to convey the meaning of words, and to indicate motion/action. Mothers received advice and guidance from SLH therapists on how to position themselves and speak in front of their child at his/her eye level. This positioning required mothers to bend forward or squat. Motions such as bending forward or squatting are not included on the METs list. If one assumes that these motions correspond to "standing child care," this type of PA would correspond to 3.0 METs, which is equivalent to MVPA. Our observations show that these motions are characteristic of the PA of mothers of children with HL, and we believe that they affected the MVPA time of participants in this study. Although the level of participants' PA met the WHO recommendations (a), a closer look at the MVPA time showed that most PA corresponded to the 3 METs level (Table 2). These findings suggest that it is important for participants to include more vigorous PA in their daily lives to increase their health. For example, a brisk walk requires fairly high exercise intensity, which not only improves aerobic capacity, but also enhances physical agility, which was lower in study participants compared with similar-aged mothers. Participants' exercise tolerance, as measured by the estimated VO_2max, was within the level of that for similar-aged women (Table 1). Therefore, if mothers were to seek advice from a physiotherapist, a brisk walk may be a practical way of maintaining fitness.

Many participants showed poor postural alignment (Table 3). The prevalence of kyphotic posture observed in community-dwelling Japanese women aged 40 years and above was 22.1% (Tominaga, Fukuma, Yamazaki et al., 2016) and in healthy women aged 20 to 64 years, it was 35% (Cutler, Friedmann & Genovese-Stone, 1993). Bearing in mind that the evaluation methods are different, the proportion of participants who presented with kyphosis in our study (Table 3) was higher than that reported in previous studies (Tominaga, Fukuma, Yamazaki et al., 2016; Cutler, Friedmann & Genovese-Stone, 1993). According to a study that evaluated radiographs of healthy people, the degree of kyphosis was higher in women than in men, in an age-dependent manner, and the difference between the sexes became obvious after the age of 40 years (Fon, Pitt & Thies Jr., 1980). The average age in this study was 36.7 years, and it may be age of the beginnings of postural change. In addition, communication between mothers and children with hearing loss were eye-gaze sharing (Honda, 2018). If the mothers are many motions that involved "bending forward" while speaking to their children at their eye level, this may affect their posture in the long term. Mothers' physical awareness of their own bodies may be lacking because of their busy daily schedule. Therefore, support should be provided for the physical well-being of mothers.

If a certain motion is sustained, posture becomes worse, but an individual is often unaware of this pattern (Sahrmann, 2011). Moreover, even when the activity has ceased, the ideal alignment is not restored unless particular efforts are made to correct the posture (Sahrmann, 2011). Half the participants experienced shoulder stiffness or lower back pain (Table 3), which suggests that many mothers may exhibit movement system

impairment syndrome (Sahrmann, 2011). This may be because of their habitual daily posture and movement, which are likely to affect flexibility and muscle strength. Participants' flexibility was not significantly different from that of similar-aged women (Table 1). However, this study lacked information about flexibility other than for the low back and hamstrings (American College of Sports Medicine, 2018). The development of this kind of support requires a more detailed assessment of aspects of physical status such as habitual motion and anterior/posterior pelvic tilt. Unfortunately, such an assessment was not conducted in this study, so interpretation of these results is limited. Future studies should investigate posture in more detail.

A limitation of this study was that the sample and parameters for assessment were too small to generalize from the findings. More studies are needed to inform strategies to support the physical health of mothers of children with HL.

Ⅴ. Conclusion

The mothers of children with HL generally showed a healthy physical status. However, the findings suggest that efforts are needed to maintain mothers' health. The authors recommend the following: a) mothers engage in more vigorous daily PA; and b) mothers pay more attention to their own posture.

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