



Does the introduction of newborn hearing screening improve vocabulary development in hearing-impaired children? A population-based study in Japan



Shuheï Ohmori^{a,c}, Akiko Sugaya^{a,*}, Naomi Toida^c, Etsuji Suzuki^b, Masato Izutsu^{b,d},
Tomoko Tsutsui^c, Yuko Kataoka^a, Yukihide Maeda^a, Kunihiro Fukushima^{a,e},
Kazunori Nishizaki^a

^a Department of Otolaryngology, Head & Neck Surgery, Graduate School of Medicine, Dentistry, and Pharmaceutical Sciences, Okayama University, 2-5-1 Shikata-cho, Kita-ku, Okayama 700-8558, Japan

^b Department of Epidemiology, Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama University, 2-5-1 Shikata-cho, Kita-ku, Okayama 700-8558, Japan

^c Okayama Kanariya Gakuen, Auditory Center for Hearing Impaired Children, 321-102, Nisifurumatsu, Kita-ku, Okayama 700-0927, Japan

^d Health Policy Bureau, Ministry of Health, Labour and Welfare, 1-2-2 Kasumigaseki, Chiyoda-ku, Tokyo 100-8916, Japan

^e Shinkurasiki Ear, Nose, and Throat Clinic, 3-120-1 Shinkurashikiekimae, Kurashiki-shi, Okayama 710-0253, Japan

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ABSTRACT

Objective: Permanent hearing impairment has a life-long impact on children and its early identification is important for language development. A newborn hearing screening (NHS) program has started in Okayama Prefecture, Japan, in 1999 to detect hearing impairment immediately after birth. We aim to examine the effect of this screening program on vocabulary development in pre-school children in a before and after comparative study design.

Methods: A total of 107 5-year-old children who graduated from Okayama Kanariya Gakuen (an auditory center for hearing-impaired children) between 1998 and 2011 were enrolled in this study. The pre-NHS group ($n = 40$) was defined as those who graduated between 1998 and 2003, while the post-NHS group ($n = 67$) was defined as those who graduated between 2004 and 2011. The primary outcome was receptive vocabulary, which was assessed by the Picture Vocabulary Test [score <18 (low) vs. score ≥ 18 (high)]. The secondary outcome was productive vocabulary, or the number of productive words, which was assessed by an original checklist [<1773 words (low) vs. ≥ 1773 (high)]. We calculated odds ratios and 95% confidence intervals for vocabulary development and compared both groups.

Results: The adjusted Picture Vocabulary Test score and number of productive words were significantly higher ($p < 0.01$) in the post-NHS group than the pre-NHS group. Odds ratios were 2.63 (95% confidence interval: 1.17–5.89) for receptive vocabulary and 4.17 (95% confidence interval: 1.69–10.29) for productive vocabulary.

Conclusions: The introduction of NHS in Okayama Prefecture significantly improved both receptive and productive vocabulary development in hearing-impaired children.

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1. Introduction

Permanent childhood hearing impairment (PCHI) has a lifelong influence on language development in hearing-impaired children

[1–3]. Late identification of PCHI in children results in language delay and consequently affects their performance in academics or other activities. Thus, the social and economic impact of PCHI is immeasurable and great effort has been put into its early identification. Recent progress in newborn hearing screening (NHS) has enabled hearing impairment to be identified just after birth and has therefore led to early diagnosis of PCHI [4–7].

Mishina et al. [8] organized an NHS research group in Japan in 1998 and in 2000, they developed practical guidelines for NHS.

* Corresponding author. 2-5-1, Shikata-cho, Kita-ku, Okayama 700-8558,

Tel.: +81 86 235 7307; fax: +81 86 235 7308.

E-mail address: sugaya-a@cc.okayama-u.ac.jp (A. Sugaya).

Although the official NHS program in Japan started in 2001, actual arrangements for implementing the program began in several districts, including Okayama where the first NHS system was prepared in 1999 [9]. Although more than a decade has passed since the program's initiation, no quantitative studies have been conducted to date to examine its effects.

Accordingly, we planned this study to examine the effects of NHS on language development in hearing-impaired children since its introduction in Okayama Prefecture. We examined vocabulary development as a measure of language because vocabulary is an important language domain that develops in children of all school ages, and it is one of the most fundamental abilities of language. Vocabulary consists of receptive vocabulary (i.e., how children understand the meaning of spoken words) and productive vocabulary (i.e., how children voluntarily speak words). We hypothesized that the introduction of NHS contributed to better development of both receptive and productive vocabulary in children with PCHI.

2. Participants and methods

2.1. Study design

Children who entered *Okayama Kanariya Gakuen* between the 1993 and 2011 academic years were enrolled in this study. *Okayama Kanariya Gakuen* is an auditory center for hearing-impaired children which was established in Okayama, Japan in 1969; this center uses the auditory-verbal method in children with hearing aids or cochlear implants from age 0 to 6 years [10]. The children received 60 min of individual and 60 min of group auditory-verbal training for two to three times a week using their

hearing devices (HA or CI). The training program was given by the speech–language–hearing therapists and teachers in a bottom-up approach. We applied a before and after comparative study design.

Five-year-old children who graduated from *Okayama Kanariya Gakuen* between the 1998 and 2003 academic years were defined as the pre-NHS group and the 5-year-old children who graduated between the 2004 and 2011 academic years were defined as the post-NHS group (Fig. 1). The children were divided into these two groups with 2003 as the dividing line because no graduates received NHS prior to 2003 while a considerable portion of the graduates after 2004 did receive NHS (Table 1). The aim of this study was to evaluate the total change in one particular district as a result of the introduction on NHS rather than a personal change after receiving NHS. Because the introduction of NHS is technically a political decision, changes were evaluated in a district-based study.

This study was approved by the Okayama University ethics commission on November 27, 2012.

2.2. Measures

As a primary outcome measure, we assessed receptive vocabulary by using the Picture Vocabulary Test (PVT), which is a localized version of the Peabody Picture Vocabulary Test for Japanese language users. In this test, the children were seated facing a speech language therapist in a sound-attenuated chamber and scored according to the test manual. Children receiving PVT-adjusted scores ≥ 18 were considered to have demonstrated age-appropriate vocabulary development according to the manufacturers' instructions for the test [11]. Thus, we divided the subjects into a lower receptive vocabulary group (scores < 18) and higher receptive vocabulary group (scores ≥ 18).

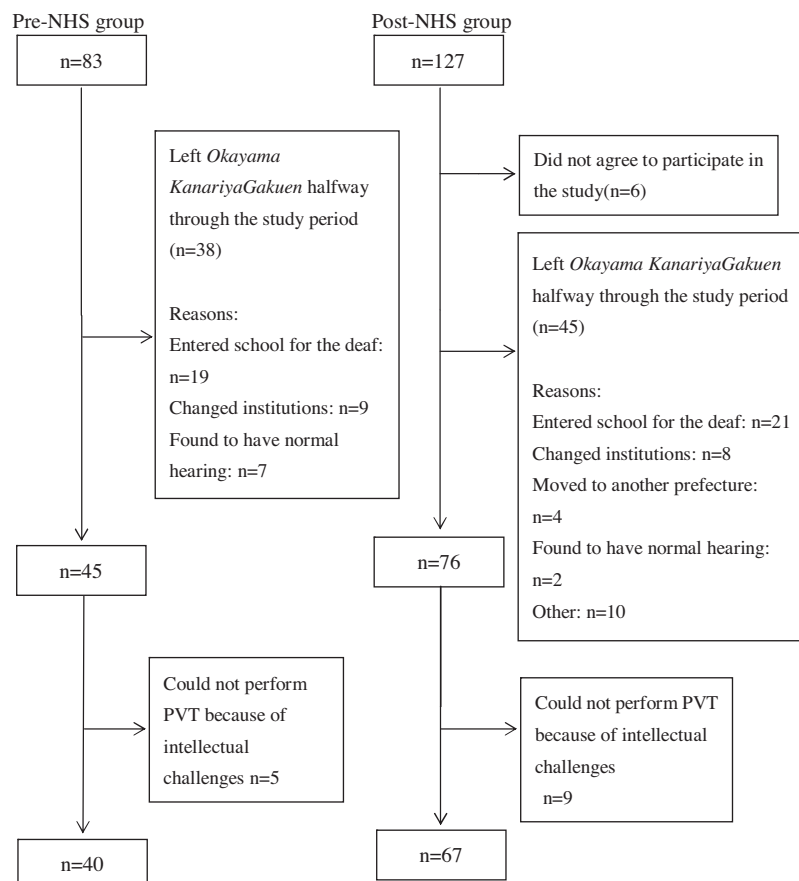


Fig. 1. Participant flow. PVT: Picture Vocabulary Test.

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