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Screening, rubella vaccination, and childhood hearing impairment in Taiwan

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ABSTRACT

Childhood hearing impairment (CHI) is a major developmental disability, but data at the national level are limited, especially those on the changes in the prevalence over time. In Taiwan, the government began to certify disabled residents for providing various services in 1980 and maintains a registry of certified cases, which provides a rare opportunity for studying the trends of CHI prevalence. Using the registry data, we estimated the prevalence of CHI by age and severity and explored factors affecting its changes over time. From 2000 to 2011, the registered cases under 17 years old ranged from 3427 to 4075. The overall prevalence increased from 2000 to 2006, but then decreased till 2011. While the prevalence of mild CHI increased over the years, such a pattern was not observed in moderate or severe CHI. In general, the overall prevalence increased over the years in the age groups <3 years, 3–5 years, and 6–11 years ($p < 0.01$), and the largest increase was observed in the age group <3 years, particularly after the promotion of screening by the government in 2003. The decrease after 2006 was mainly attributable to decreases in the age groups 12–14 (with a decreasing trend from 2001, $p < 0.01$) and 15–17 years (with a decreasing trend from 2004, $p < 0.01$). The timing was related to the implementation of a nationwide rubella vaccination program. Similar decreases had been observed in countries with rubella vaccination programs.

1. Introduction

Hearing impairment is a global problem, and the World Health Organization estimated that 360 million people worldwide have disabling hearing loss (World Health Organization, 2014). In children, hearing impairment usually associates with difficulties in the development of language, speech production, and cognition, which in turn affect academic performance, vocational attainment, and socioemotional competence (Connor & Zwolan, 2004; Hintermair, 2006; Niskar et al., 1998; Petrou et al., 2007). The cost of rehabilitation and special education associated hearing impairment can impose a

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heavy social and economic burden on the family, community, and country (Mohr et al., 2000; Olusanya & Newton, 2007; Schroeder et al., 2006). Mohr et al. (2000) estimated that in the United States, severe to profound hearing impairment was associated with a lifetime cost of more than $1 million.

Early identification and management of congenital hearing impairment can decrease the impact (Watkin et al., 2007). Universal newborn hearing screening is regarded as the most effective way to identify the infants with hearing loss immediately after birth (White & Maxon, 1995). In Taiwan, the Bureau of Health Promotion (2011) has also been promoting the neonatal hearing screening services, but the time trend in the prevalence of childhood hearing impairment (CHI) has not been extensively studied.

In order to make responsible national policy, determine resource allocation, and ultimately decrease the individual and public health burden of hearing impairment, reliable epidemiological data on CHI are needed (Mehra, Eavey, & Keamy, 2009). Many studies have been conducted on the prevalence of CHI, but the reported prevalence varies widely (Lin, Huang, Lin, Lin, & Wu, 2004; Mehra et al., 2009; Niskar et al., 1998; Van Naarden, Decouflé, & Caldwell, 1999). The variations may be attributable to factors including the differences in case definition, age range, and case-finding method (Durkin, 2002).

In 1980, according to the Disabled Welfare Act (1980), the local governments in Taiwan began to certify the disabled residents and provide various services, and the Ministry of Health and Welfare keeps a registry of certified cases and publishes summary data annually (Ministry of Health and Welfare, 2014) (before the re-organiztion of the government in 2013, these tasks were performed by the Ministry of the Interior). The registry data present a rare opportunity for studying the epidemiology of CHI at the national level. Therefore, we adopted the data to assess the changes in prevalence of CHI in Taiwan over the years and explore the factors affecting the changes.

2. Methods

2.1. The disability registry system in Taiwan

In 1980, the Disabled Welfare Act (1980) was promulgated in Taiwan, which led to the establishment of the disability registry. The local governments began to certify seven types of disabled residents, including "hearing impairment or balance disability." In 1997, "Disabled Welfare Act (1980)" was changed to "Physically and Mentally Disabled Citizens Protection Act (1997)" and "hearing impairment or balance disability" was divided into two different types of disabilities: hearing impairment and balance disability.

The disability registry in Taiwan was established mainly for facilitating services. Individuals can make applications for certification through the local government in the residential area and obtain a certificate if they are determined as fitting the criteria by an accredited doctor (Department of Health, 2006b, 2008). The local governments report certified cases to the central government, and the Ministry of Health and Welfare maintains a registry of cases (before the re-organiztion of the government in 2013, the registry was maintained by the Ministry of the Interior).

2.2. Case definition

When a child is suspected to have hearing impairment, parents or guardians can apply for certification. In order to obtain the disability benefits, a child should have had a measured, unaided, pure-tone hearing impairment at frequencies of 0.5, 1 and 2 kHz (pure-tone average, PTA) in the better ear (better ear hearing level, BEHL) averaging 55 decibels (dB) or more and been confirmed by a otolaryngologist accredited by the government (Department of Health, 2006b, 2008). For the estimation of hearing levels in malingering or difficult-to-test children, auditory brainstem response is used to evaluate the function of the auditory nerve.

The determination of the degree of hearing impairment was based on the most recent audiogram. The severity of hearing impairment is defined as "mild" with PTA $\geq$55 dB BEHL and $<$70 dB BEHL, "moderate" with PTA $\geq$70 dB BEHL and $<$90 dB BEHL, and "severe" with PTA $\geq$90 dB BEHL (Department of Health, 2008).

2.3. Data collection

The Department of Statistics of Taiwan Ministry of Health and Welfare publishes Statistical Yearbook each year (Ministry of Health and Welfare, 2014) (before the re-organiztion of the government in 2013, the reports were published by the Ministry of the Interior), which includes numbers of cases by age. The yearbooks do not include the number of CHI cases under 17 years old by severity, but we obtained the information from the Department of Statistics of Ministry of the Interior, which is available since 2000, and analyzed the data till 2011. To calculate the prevalence, we obtained data on the numbers of total population in each age group from the Monthly Bulletin of Interior Statistics (Ministry of the Interior, 2011).

2.4. Statistical analysis

For each age group, we estimated the prevalence of CHI by dividing the number of cases by the number of individuals in each year and evaluated the trend over the years. According to the yearbooks (Ministry of Health and Welfare, 2014), we categorized the age into five groups ($<$3 years, 3–5 years, 6–11 years, 12–14 years, and 15–17 years) and reported the overall