Chapter 14

Oral Health

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1 Introduction

Dental diseases, particularly dental caries (cavities) and periodontal disease, are a significant burden to society, even though they are not fatal, and represent some of the most prevalent diseases in the world [1, 2]. In Japan, the national medical cost of dental diseases in 2015 amounted to 2,829,400 million yen, which was third behind the cost of cardiovascular diseases including hypertension (5,981,800 million yen) and neoplasms such as cancer (4,125,700 million yen). In particular, the cost of dental diseases for individuals younger than 65 years of age is highest compared with other diseases. In addition, recent studies have shown that oral health may affect general health. Accordingly, public health policies, such as the Health Promotion Campaign for the Twenty-First Century (Health Japan 21) and the “8020 Campaign” to retain 20 natural teeth by 80 years of age, have been promoted in Japan.

A difference in health status, such as variation of height among the population, maybe natural. However, it becomes a problem when such differences are considered

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to be avoidable health inequalities because they are caused by systemic differences in the social determinants of health, which are also found in dental diseases.

2 Health Inequalities in Dental Disease in Japan

Many reports have described health inequalities in dental diseases and medical conditions around the world [3–7]. This section introduces the health inequalities in dental diseases in Japan according to generation, disease, and condition.

Several studies have reported caries inequalities in preschool children [8–11]. The disease map of the caries prevalence for each municipality indicates that the prevalence rate was higher mainly in the areas of Hokkaido, Tohoku, Shikoku, and Kyushu (Fig. 14.1) [8]. In multivariate analysis of municipalities in these areas, the

Fig 14.1 Caries prevalence (%) for 3-year-old-children in Japan (2000, Empirical Bayes Approach). (Quoted and modified from Aida et al. [8])

percentage of university graduates most significantly contributed to this geographical difference, and the rate of higher education was inversely associated with the prevalence of caries. On the other hand, the association with dentistry-related indicators was weak. A study examining the life course trajectory of caries inequalities revealed inequalities in children aged 1.5–2.5 years, which widened following the growth of these children until 5.5 years of age at the end of the follow-up [10]. Caries inequalities in school-age children have also been reported [12, 13]. An ecological study reported that higher income level was associated with lower caries experience [12].

Inequalities in dental diseases among adults have also been reported. In a cross-sectional study involving 15,803 Japanese adults by Morita et al. [14], nonprofessionals were at significantly higher risk for periodontal disease than professionals, even after the data were adjusted for age, diabetes history, and smoking history. When professionals were scored as 1, the relative risk for other occupational groups were: drivers, 2.0 times; workers in service industries, 1.5 times; salespersons, 1.4 times; managers, 1.4 times. A cohort study also confirmed inequalities in periodontal disease related to occupation [15]. Such occupational “social gradients” can be also found in other oral health indicators. Similarly, in a study investigating caries experience in 16,261 adults, the condition of oral cavities was better in professionals, managers, and businesspersons than in workers in service industries and drivers [16].

The number of remaining teeth in older adults can be considered the result of experience with dental diseases and access to dental care throughout life. Aida et al. [17] reported that educational background—an index of socioeconomic status at a younger age—was significantly associated with dental status (remaining teeth) in older people even after adjustment for covariates. Interestingly, other studies have shown that not only individual income, but also community income levels, were associated with inequalities in having no teeth (edentulousness) [18].

3 New Viewpoint on Health Inequalities

The phrase “health inequality” evokes the image “the most deprived people have the poorest health condition.” However, health inequalities are not only a problem for the deprived, but also for the nondeprived. Nevertheless, health inequality has emerged as a “social gradient,” with a stepwise difference in health according to socioeconomic status. Here, recent viewpoints regarding health inequalities are introduced.

When considering the causes of differences in health among individuals, there are two viewpoints: compositional effects based on differences in members (because there is a group consisting mostly of individuals in poor health, and another consisting mostly of those in good health, health inequalities among groups are observed); and contextual effects based on differences in social circumstances (because some groups live under social circumstances that cause poor health and others that are not

affected by such environments, health inequalities arise). Social epidemiological studies using multilevel analyses have enabled us to distinguish compositional effects and contextual effects. For example, a study involving older Japanese adults determined individual and community-level income inequalities in edentulousness [18]. There was an individual-level social gradient: participants with lower incomes had a higher risk for edentulousness. Multilevel analysis also determined the association between community-level income (adjusted for individual-level income) and other covariates: regardless of individual-level income, income levels in communities were also associated with the possibility of edentulousness. This study suggested that dental status is partially determined by where individuals live because it is affected by the community social environment. As such, not only individual income, but also community income levels cause health inequalities.

Multilevel studies have suggested that an individual's health is determined not only by individual characteristics but also community-level environments. Individuals living in poorer areas possibly become poorer in health even if they are economically affluent. For example, an individual living in a poor area, where there are few dentists, may find it difficult to receive dental care. Other community-level environmental factors, such as social capital [19], income inequality [20], accessibility to grocery stores [21], and fluoride concentration in municipal water [22], have been reported to be associated with dental health. Therefore, health inequalities are an issue—not only for individuals—but society as a whole.

4 Causes of Oral Health Inequalities

Four theoretical models have been proposed to explain how social determinants influence inequalities in dental disease [23]. First, the “materialist explanation” posits that the availability of foods and medical services varies according to socioeconomic conditions, especially income. Second, the “cultural/behavioral explanation” is a model in which health behavior and culture, such as smoking, alcohol use, dietary habits, and tooth brushing, vary according to social strata, which leads to health inequalities. Third, in the “psychosocial perspective,” individuals in a lower social stratum experience various stresses: in the “direct model,” physiological mechanisms caused by stress increase the incidence of disease; and in the “indirect model,” increased smoking, alcohol use, and intake of sweet foods caused by stress increase the incidence of disease. Fourth, the “life course perspective” is a model in which factors related to the previous three explanations accumulate throughout life and affect health and disease in later life. The “accumulation model” describes health influences that gradually accumulate throughout life, while the “critical period model” targets the importance of a particular time point; for example, when one's lifestyle changes completely by leaving home in adolescence to begin a new phase of life living alone. Both models are supported by empirical research investigating dental diseases. In a cohort study from New Zealand by Poulton et al. [24], 980 individuals were followed for 26 years to examine the association between

socioeconomic conditions and general and oral health index at two key time points in childhood and adulthood. Participants who experienced poor socioeconomic conditions during childhood exhibited poorer general and oral health at 26 years of age. In comparing subjects in various socioeconomic conditions at the two time points, those with a higher socioeconomic position in childhood and a lower socioeconomic position in adulthood exhibited better dental health than those who were of lower socioeconomic status in childhood and higher socioeconomic status in adulthood. In other words, a lifestyle acquired in childhood may be difficult to change and may become greatly influential in subsequent years.

5 How to Tackle Oral Health Inequalities

5.1 Social Determinants and Population Strategy

Even if evidence-based methods are used, health inequalities cannot be eliminated unless social determinants are considered. Interventions primarily depend on the efforts of individuals which fail to improve health inequalities. Such interventions are usually more beneficial for healthy individuals who experience good social conditions and are at lower risk of disease, while those at higher risk of disease may find it difficult to benefit from these interventions. This issue is well known as the “inverse care law” or “inverse prevention law” [25, 26]. For example, an intervention through dental health education in 5-year-old children in the United Kingdom improved the oral health of those with higher socioeconomic status; however, oral health did not improve among those with lower socioeconomic status [27].

From this perspective, a population strategy that affects the entire population in a community or group is required [28, 29]. Fluoride application is a well-known preventive measure for dental caries throughout the world [30]. If it is applied only in dental clinics, the benefit reaches only those who can afford to visit a clinic. However, if fluoride is used in community/municipal water fluoridation, the fluoride concentration in tap water is adjusted to the same level as green tea (approximately 1 mg/L). All residents of areas where fluoridation has been established can receive benefits regardless of social condition, and health inequalities in dental caries are, therefore, reduced [31, 32]. The World Health Organization published a book summarizing public health programs that reduce health inequalities, including a chapter on oral health [33, 34]. Several measures, such as water fluoridation, smoking regulations, and removal of taxes for oral health products, were introduced. School-based health interventions can also be a population strategy for students. In the Philippines, the “Fit for School” program offers general and oral health interventions, including soap for hand washing and fluoride toothpaste for brushing, to students of public elementary schools [35].

5.2 *Reducing Dental Caries Inequalities in Japan*

Although water fluoridation is not established in Japan, school-based fluoride mouth-rinsing programs have been conducted as a population strategy since 1970 [36]. It is a gargling method that is conducted once per week at school using mouth rinse solution containing almost the same concentration of fluoride as fluoride toothpaste (Fluoride concentration = 900 mg/L). To reduce the risk for excessive intake of fluoride in preschool children, a mouth-rinse liquid with a lower concentration of fluoride (approximately 250 mg/L) is used five times per week. This school-based program enables all students to receive the benefits of fluoride regardless of socioeconomic status or attitude of caregivers.

School-based fluoride mouth-rinse programs reduce both caries and caries inequalities [12]. In Niigata Prefecture, fluoride mouth rinsing was launched in elementary schools for the first time in Japan in 1970, and its rate of dissemination has gradually increased [36]. Recently, 12-year-old children in Niigata Prefecture had the lowest rate of dental caries in 47 prefectures in Japan, although caries levels in Niigata among 3-year-old children before starting the mouth-rinse program ranked in the middle. In Japan, most toothpastes contain fluoride; however, the use of fluoride toothpaste is believed to be affected by socioeconomic status and the knowledge of children's caregivers. In contrast, school-based fluoride programs can overcome these types of barriers and reach all students. As a result, inequalities in caries have been reduced [12].

5.3 *Overcoming Opposition and Building a Healthy Society*

Generally, there is much opposition to public health interventions such as tobacco regulations [37], vaccination programs [38], and the use of fluoride for public health [39]. Gray [40] pointed out that if the magnitude of a health problem is large (many are affected), the strength of opposition to public health intervention is larger. Because public health interventions to reduce health inequalities require changes in social determinants that work as a population strategy, large numbers of individuals become concerned about the intervention(s) and opposition tends to become larger.

To overcome opposition, it is the responsibility of scientists not only to provide empirical evidence, but also to communicate with society [39, 41]. In the Ottawa Charter on health promotion, "Enable," "Mediate," and "Advocate" were described as the core activities [42–44]. Scientists need to advocate evidence to mediate conflict among groups to enable public health interventions. In the United States, following these efforts, the number of individuals with access to water fluoridation increased from 5.1 million in 1951 to 211.4 million in 2014 [39].

In Japan, school-based fluoride mouth-rinse programs have gradually increased since 1970. In addition to positions on fluoride, collaboration between the health and education sectors is also one of the barriers to implementing the program. To

promote the dissemination of this method, the Ministry of Health, Labour and Welfare in Japan issued the “Fluoride mouth rinsing guidelines” in 2003. As a result of continuous efforts, a total of 7479 schools and 777,596 children participated in the program in 2010 [36]. Fluoride mouth rinsing in schools is performed after informed consent is received from caregivers. In elementary schools in Date City, Hokkaido, the rate of participation in mouth rinsing gradually increased from 87% in 1990 to 97% in 2005 [45]. The majority of guardians recognized the significance of the program, thanks to appropriate explanations based on scientific evidence.

6 Summary

Dental diseases are prevalent, and inequalities exist from children to older adults. To reduce oral health inequalities, population strategies aimed at changing social determinants are required. Decision making regarding changes in social determinants is the responsibility of residents and politicians. Therefore, scientists and healthcare professionals must provide and advocate scientific evidence supporting these interventions to reduce inequalities in oral health.

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