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# Development of a shortened Japanese version of the Oral Health Impact Profile (OHIP) for young and middle-aged adults

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***Objective*** The aim of this paper is to develop a short version of the Japanese OHIP (OHIP-J) appropriate for use in young and middle-aged adults, and to evaluate its properties using cross-sectional data. ***Method*** A study population of 8,658 workers aged 20-59 years rated their oral health by means of a self-administered questionnaire. Using a factor analysis approach, a shortened version of OHIP-J was derived. Internal consistency, floor effect, and construct validity were determined. ***Results*** We derived a subset of 18 items from OHIP-J (OHIP-JA18), grouped into four subscales: "functional limitation", "physical pain", "psychological discomfort", and "disability & handicap". All four subscales had acceptable internal consistency (Cronbach alpha > 0.79). OHIP-JA18 demonstrated an acceptable floor effect, which was determined by the proportion of subjects who obtained a 0 score (<30%); however, the floor effect of the ordinary shortened version based on OHIP-14 (OHIP-J14) was not acceptable. We confirmed the conceptual framework of OHIP-JA18 that "disability & handicap" is affected by "functional limitation", "physical pain" and "psychological discomfort", because the model fitted the data moderately well by structural equation modeling (SEM) analysis (GFI=0.90, RMSEA=0.08). ***Conclusions*** OHIP-JA18 demonstrated acceptable measurement parameters to justify its use in outcome assessment for oral health related quality of life (OHQOL) in young and middle-aged adults in Japanese workers. Further studies will be needed to evaluate an intervention such as worksite health promotion.

*Key words: Epidemiology, oral health, quality of life, questionnaire*

## Introduction

Oral health-related quality of life (OHQOL) reflects how people have experienced a dental disorder and how it has affected their life. The Oral Health Impact Profile (OHIP) is a comprehensive instrument to assess OHQOL in clinical settings and in epidemiologic studies. OHIP consists of 49 items, grouped into seven subscales: "functional limitation", "physical pain", "psychological discomfort", "physical disability", "psychological disability", "social disability", and "handicap" (Slade and Spencer, 1994).

Because some research settings are not suitable for long and time-consuming questionnaires, a short-form version of OHIP was derived, OHIP-14 (Slade, 1997b). Subsequently, for edentulous patients, a modified shortened (20-item) version was derived, OHIP-EDENT (Allen and Locker, 2002). A conventional method of deriving short-form is to use psychometric technique, factor analysis. OHIP-14 was derived by factor analysis and regression analysis.

A conceptual model indicates what is believed to cause the outcomes. OHIP is based on Locker's adaptation of the WHO's International Classification of Impairments, Disabilities and Handicaps (ICIDH) model of health for oral health (Locker, 1988), which is hierarchically ordered, ranging from primary symptoms at one end, to handicaps affecting a broad range of social roles at the other. However, to our knowledge, no reports have confirmed that OHIP fits into this conceptual model. When using subscales of OHIP as latent variables in a model, structural equation modeling (SEM) is appropriate when thinking in terms of models. SEM is a powerful statistical technique largely developed in the social sciences. In SEM, interest usually focuses on latent variables like "intelligence" which were observed only indirectly. Researchers are likely to use SEM to determine whether a certain model is valid. The basic statistic in SEM is covariance, and many standard statistical procedures such as multiple regression, canonical correlation, factor analysis, and ANOVA can be viewed as special cases of SEM (Kline, 1998).

We reported the reliability and validity of the Japanese OHIP (OHIP-J) (Ide *et al.*, 2002; Ide *et al.*, 2006). The main aim of this paper is to develop a shortened version of the OHIP-J relevant to young and middle-aged adults. The structural validity of how it fitted to the underlying conceptual structure was given particular consideration in this study.

## Methods

### *Survey*

The questionnaire survey has been described in detail in a separate paper (Ide *et al.*, 2002; Ide *et al.*, 2006). Briefly, the survey was conducted as part of worksite oral health promotion programme between July 2000 and June 2001. The main purpose of collecting the data was to ascertain oral status for planning the health promo-

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tion program. They worked at scattered offices in one prefecture located in southwestern Japan, which covered both rural and urban areas. Of the 10,202 questionnaires distributed, 9,114 were completed, representing a response rate of 89.3%.

The questionnaire included OHIP-J, self-rated oral health, gender and age. OHIP-J has been described in detail in a separate paper (Ide *et al.*, 2002; Ide *et al.*, 2006). Briefly, the original OHIP was translated into Japanese by the authors. The response format was the same as in the original OHIP. For each item, people were asked how frequently they had experienced this problem in the preceding 12 months. Responses were recorded using a five-point Likert scale (0 = never, 1 = hardly, 2 = occasionally, 3 = fairly often, 4 = very often). OHIP-J reflected some modifications to OHIP, as deemed necessary after a pilot study. One of the OHIP-49 items (Q41, "Have you had trouble getting on with other people because of problems with your teeth, mouth, or dentures?") could not be adequately translated. So this item was excluded from the OHIP-J. Because there were few people that wore dentures in the 20-39 age bracket, we excluded three of the OHIP-J items referring to denture-related disorders as these do not apply to those without dentures. For 45 items of OHIP-J, the κ-value for each item was shown to be relatively stable, demonstrating good reproducibility. The Cronbach alpha coefficients for the seven subscales demonstrated good internal reliability. Consequently, we supposed that the 45 items for OHIP-J was an appropriate measure for cross-national research in young and middle-aged adults.

The present study was approved by the Ethics Committee of Medical Care and Research, University of Occupational and Environmental Health, Japan.

## Study subjects

A total of 9,114 completed the surveys. Subjects aged <20 years (n=17) or >59 years (n=307) were excluded. If more than 10 responses to questions (except for three denture-related questions) were left blank, the questionnaire was discarded (n=132). After the exclusions, data for 8,658 subjects remained. To avoid a circular argument, the short version of OHIP-J should not be evaluated using the same data that was used for developing it. For this reason, the subjects remaining were randomly split into two groups, Group A and Group B, after being stratified by gender, age and districts. The number of subjects in each group was 4,329, and the mean age was 41.3 years, and 72.8% were male. The above two groups, Groups A and B, were used for analysis in this study.

## Data analysis

OHIP summary scores were calculated by two methods (Slade, 1997a). Missing responses to individual items were replaced with the sample mean of the coded responses for that item, rounded to the nearest integer. The simple count method of scoring was used to compute the number of items to which a subject responded negatively 'occasionally', 'fairly often' or 'very often'. This reduced the response scale to a dichotomy. This was called the 'simple count method'. The second method summed the response codes for each statement, which took full account of the range of responses. This was called the 'additive method'.

All analyses were performed using the Statistical Analysis System (SAS) for Windows version 8.2 (SAS Institute Inc., Cary, NC, USA).

### *Derivations of a short version from the Japanese OHIP (OHIP-J)*

A short version of OHIP-J was derived using Group A. The first step in deriving the short version was to eliminate items that applied only to denture wearers, and items where < 8% of responses were marked with a negative response to prevent the floor effect. The remaining items were then subjected to an exploratory factor analysis, using principal factors and the promax rotation method. This analysis was carried out using the PROC FACTOR procedure. Over 0.4 was used as a threshold for moderate to high factor loading. The results of factor analysis should satisfy the following criteria: 1) there are at least three items with significant loadings on each retained factor. 2) the items that load on a given factor share some conceptual meaning. 3) the items that load on different factors seem to be measuring different constructs. 4) the factor pattern demonstrates a simple structure (Hatcher, 1994). Based on the results of factor analysis, subscales and the number of items in each subscale were elicited to reconstruct a conceptual model for a short version of OHIP-J. Finally we reviewed these groupings and selected the set that made the most sense to represent the various aspects of the dental impact.

### *Reliability and validity of the shortened version*

1) Internal consistency

Internal consistency was determined in Group B. Cronbach alpha for each subscale score was calculated. This analysis was carried out using the PROC CORR procedure.

2) Floor effect

Floor effect was determined in Group B. Overall score of the short version of OHIP-J was compared with OHIP-J14, where items were selected according to the original OHIP-14 using the simple count method. Floor effect was examined by the proportion of subjects who obtained the lowest possible score. The percentage distributions of the simple count method score from OHIP-J14 and OHIP-JA18 were compared.

3) Construct validity

Construct validity was determined in Group B. The conceptual model underlying our study is based partly on Locker's adaptation of ICIDH model of health for oral health. The model component shows items of a short version of OHIP-J measuring four subscales as latent variables: "functional limitation", "physical pain", "psychological discomfort" and "disability & handicap". Structural equation modeling (SEM) specifying the relationships between items and subscales were estimated. The factor loadings show the strength of the relationship between each item and subscale. In Fig. 2, one-heading arrows between latent variables represent regression

relationships, while two-heading arrows represent correlational relationships. In this analysis, the following fit indices were used, because the sample size was large: the Goodness of Fit Index (GFI) indicates the amount of variance in the data explained by the model. Values of GFI greater than 0.90 imply an acceptable model fit (Bentler and Bonett, 1980). The root mean squared error of approximations (RMSEA) expresses fit per degree of freedom of the model. Values of RMSEA less than 0.08 imply an acceptable model fit, and values less than 0.05 imply a good fit (Browne and Cudeck, 1990). T values greater than 3.291 are significant at $p<.001$. The standardized loadings greater than .60 were moderately large (Hatcher, 1994). This analysis was carried out using the PROC CALIS procedure.

## Results

### *OHIP-JA18*

We first excluded three items related to denture wearing and 13 items with a low negative prevalence (<8%) from OHIP-J (Table 1). Factor analysis using the eigenvalue-one criterion (Hatcher, 1994) identified four factors that summarized the 32 remaining items. The eigenvalues for components 4 and 5 were 1.241 and 0.939, respectively. Component 4 demonstrated eigenvalues greater than 1.00, so the criterion would lead us to retain and interpret 4 factors. Approximately 62% of the variance is accounted for by components 1, 2, 3 and 4 combined. Twenty-eight items had factor loadings that exceeded 0.4 for one of the four rotated factors (Table 1). We reconstructed the new conceptual framework in the short version of OHIP-J, including four subscales (number of items): 1) “functional limitation” (5); 2) “physical pain” (5); 3) “psychological discomfort” (3); and 4) “disability & handicap” (5), with a hierarchical structure (Fig.2). We set up the number of items corresponding to the full version, except for the “disability & handicap” subscale. The logic behind the selection of specific items in each subscale is described in the following (Locker, 1988; Slade and Spencer, 1994): the “functional limitation” subscale represents the loss of the ability to perform ordinary daily tasks of the oral cavity, such as difficulty in eating or speaking, so we selected three items for eating and two items for speaking (Q1, Q2, Q6, Q8, and Q24). The “physical pain” subscale is regarded as an underlying pathological process of dental diseases. We selected four items with a high negative prevalence of over 40% (Q9, Q12, Q13, and Q14). Although Q10 for 'sore jaw' had a lower loading on all factors, it was added to the shortened version as an item on the “physical pain” subscale, because of its great importance to young adults. Another consequence of impairment is “psychological discomfort”, including that due to appearance. We selected three items (Q4, Q19, and Q20) avoiding overlapping contents in the items. A final consequence is “disability & handicap” subscale, described as the lack of ability to perform the activities of daily living and the consequent experience of disadvantage. To capture various aspects, we selected one item with a physical dimension (Q31), two items with a psychological dimension (Q34, Q36) and two items featuring a handicap (Q44 and Q45). Based on the prevalence of negative responses, the factor loadings for each item and the above logic of selection, we selected 18 items (Q1, Q2, Q4, Q6, Q8, Q9, Q10, Q12, Q13, Q14, Q19, Q20, Q24, Q31, Q34, Q36, Q44 and Q45). When we repeated factor analysis for the 18 items, the following factor pattern was confirmed (Table 1): five items (Q31, Q34, Q36, Q44 and Q45) were found to load on the first factor, which was named “disability & handicap”; four items (Q9, Q12, Q13 and Q14) were found to load on the second factor, which was named “physical pain”; five items (Q1, Q2, Q6, Q8 and Q24) were found to load on the third factor, which was named “functional limitation”; three items (Q4, Q19 and Q20) were found to load on the fourth factor, which was named “psychological discomfort”.

### *Internal consistency*

OHIP-JA18 demonstrated acceptable internal consistency. Cronbach's alpha coefficients were 0.85 for the “functional limitation” subscale, 0.79 for “physical pain” subscale, 0.82 for “psychological discomfort” subscale and 0.86 for “disability & handicap” subscale.

### *Floor effect*

Fig. 1 shows that the percentage distributions of the simple count method score from OHIP-J14 and OHIP-JA18 were different: 33.1% reported no negative response using OHIP-J14, while 15.1% reported no negative response using OHIP-JA18. This indicated that OHIP-JA18 had an acceptable floor effect (< 30%). Differences in the distribution between OHIP-J14 and OHIP-JA18 scores were reflected in their medians of 1 and 4, respectively.

### *Construct Validity*

As shown in Fig. 2, the new conceptual framework in the short version of OHIP-J indicates that (1) “disability & handicap” is affected by the other primary subscales (“functional limitation”, “physical pain” and “psychological discomfort”), and (2) every primary subscale is correlated with every other primary subscale. The model testing statistics suggested that the model fits the data moderately well (GFI=0.90, RMSEA=0.08). Standardized path coefficients and factor loadings appear on single-headed arrows between latent variables, while covariances appear on curved double-headed arrows. All path coefficients, covariances and factor loadings shown in Fig. 2 were significant at $p< 0.001$. These standardized factor loadings ranged in size from 0.43 to 0.91, and only two (Q10, Q12) were under 0.60. It could therefore be said that these loadings were moderately large. The standardized path coefficient from “functional limitation” to “disability & handicap” was highest of the three paths and demonstrated a relatively strong relationship.

## Discussion

This short version of OHIP (OHIP-JA18) captures four subscales that are based on a new conceptual framework, a simplified Locker's adaptation for oral health of the ICIDH model of health. It was considered that this study sample was representative of Japanese workers in general. OHIP-JA18 demonstrated acceptable measurement parameters (internal consistency, floor effect and construct validity) to justify its use in outcome assessment for the

**Table 1.** Prevalence and factor analysis for OHIP-J items

| | | *Prevalence: % negative response* [a] | *Factor loading* [b] *F1* | *(F1)* | *F2* | *(F4)* | *F3* | *(F2)* | *F4* | *(F3)* |
|---|---|---|---|---|---|---|---|---|---|---|
| **Functional limitation** | | | | | | | | | | |
| Q1 | Difficulty chewing | 33.2 | | | | | | | 0.52 | (0.44) |
| Q2 | Trouble pronouncing words | 13.7 | | | | | | | 0.79 | (0.97) |
| Q3 | Noticed tooth that doesn't look right | 43.7 | | | 0.82 | | | | | |
| Q4 | Appearance affected | 30.3 | | | 0.81 | (0.46) | | | | |
| Q5 | Breath stale | 55.3 | | | | | | | | |
| Q6 | Taste worse | 13.4 | | | | | | | 0.62 | (0.50) |
| Q7 | Food catching | 72.2 | | | | | 0.42 | | | |
| Q8 | Digestion worse | 14.0 | | | | | | | 0.59 | (0.47) |
| Q17 | Denture not fitting | 4.0 | * | | * | | * | | * | |
| **Physical pain** | | | | | | | | | | |
| Q9 | Painful aching | 44.1 | | | | | 0.76 | (0.77) | | |
| Q10 | Sore jaw | 12.6 | | | | | | | | |
| Q11 | Headaches | 14.0 | | | | | | | | |
| Q12 | Sensitive teeth | 64.0 | | | | | 0.69 | (0.68) | | |
| Q13 | Toothache | 51.7 | | | | | 0.78 | (0.86) | | |
| Q14 | Painful gums | 41.5 | | | | | 0.59 | (0.59) | | |
| Q15 | Uncomfortable to eat | 32.4 | | | | | | | 0.44 | |
| Q16 | Sore spots | 21.8 | | | | | 0.46 | | | |
| Q18 | Discomfort (Denture) | 4.7 | * | | * | | * | | * | |
| **Psychological discomfort** | | | | | | | | | | |
| Q19 | Worried | 32.8 | | | 0.58 | (0.80) | | | | |
| Q20 | Self-conscious | 48.4 | | | 0.64 | (0.91) | | | | |
| Q21 | Miserable | 18.3 | | | 0.56 | | | | | |
| Q22 | Appearance | 26.5 | | | 0.79 | | | | | |
| Q23 | Tense | 10.8 | 0.48 | | | | | | | |
| **Physical disability** | | | | | | | | | | |
| Q24 | Speech unclear | 12.8 | | | | | | | 0.71 | (0.74) |
| Q25 | Others misunderstood | 6.2 | ** | | ** | | ** | | ** | |
| Q26 | Less flavor in food | 4.8 | ** | | ** | | ** | | ** | |
| Q27 | Unable to brush teeth | 7.1 | ** | | ** | | ** | | ** | |
| Q28 | Avoided eating | 10.6 | | | | | | | 0.61 | |
| Q29 | Diet unsatisfactory | 8.9 | 0.49 | | | | | | 0.53 | |
| Q30 | Unable to eat (Denture) | 3.0 | * | | * | | * | | * | |
| Q31 | Avoid smiling | 9.7 | 0.50 | (0.55) | | | | | | |
| Q32 | Interrupt meals | 6.4 | ** | | ** | | ** | | ** | |
| **Psychological disability** | | | | | | | | | | |
| Q33 | Sleep interrupted | 7.5 | ** | | ** | | ** | | ** | |
| Q34 | Upset | 15.2 | 0.92 | (0.85) | | | | | | |
| Q35 | Difficult to relax | 13.4 | 0.97 | | | | | | | |
| Q36 | Depressed | 18.0 | 0.87 | (0.80) | | | | | | |
| Q37 | Concentration affected | 13.1 | 0.90 | | | | | | | |
| Q38 | Been embarrassed | 13.0 | 0.59 | | | | | | | |
| **Social disability** | | | | | | | | | | |
| Q39 | Avoid going out | 2.1 | ** | | ** | | ** | | ** | |
| Q40 | Less tolerant of others | 6.3 | ** | | ** | | ** | | ** | |
| Q41 | Trouble getting on with others | § | – | | – | | – | | – | |
| Q42 | Irritable with others | 2.7 | ** | | ** | | ** | | ** | |
| Q43 | Difficulty doing jobs | 5.0 | ** | | ** | | ** | | ** | |
| **Handicap** | | | | | | | | | | |
| Q44 | Health worsened | 8.5 | 0.58 | (0.76) | | | | | | |
| Q45 | Financial loss | 8.6 | 0.61 | (0.74) | | | | | | |
| Q46 | Unable to enjoy people's company | 4.5 | ** | | ** | | ** | | ** | |
| Q47 | Life unsatisfying | 5.9 | ** | | ** | | ** | | ** | |
| Q48 | Unable to function | 1.8 | ** | | ** | | ** | | ** | |
| Q49 | Unable to work | 3.3 | ** | | ** | | ** | | ** | |

[a] Negative response means to report item occasionally, fairly often or very often. [b] Factor loadings < 0.4 are not listed. The factor loadings from the second factor analysis is indicated in ( ). * Questions were excluded because of denture related. **Questions were excluded because of low prevalence for 8% or less. §Q41was excluded because it could not be adequately translated.

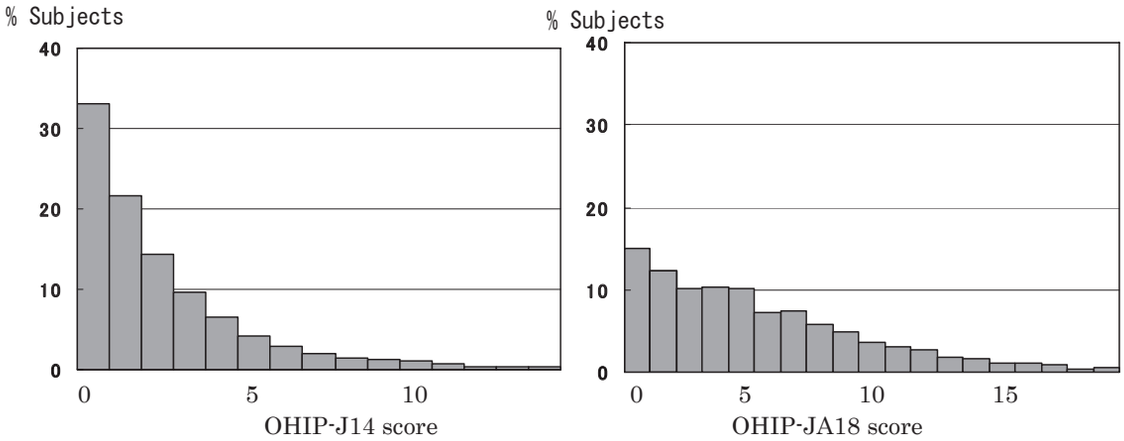


**Figure 1.** *Percentage distribution of subjects according to number of items reported negative impact for OHIP-J14 and OHIP-JA18*

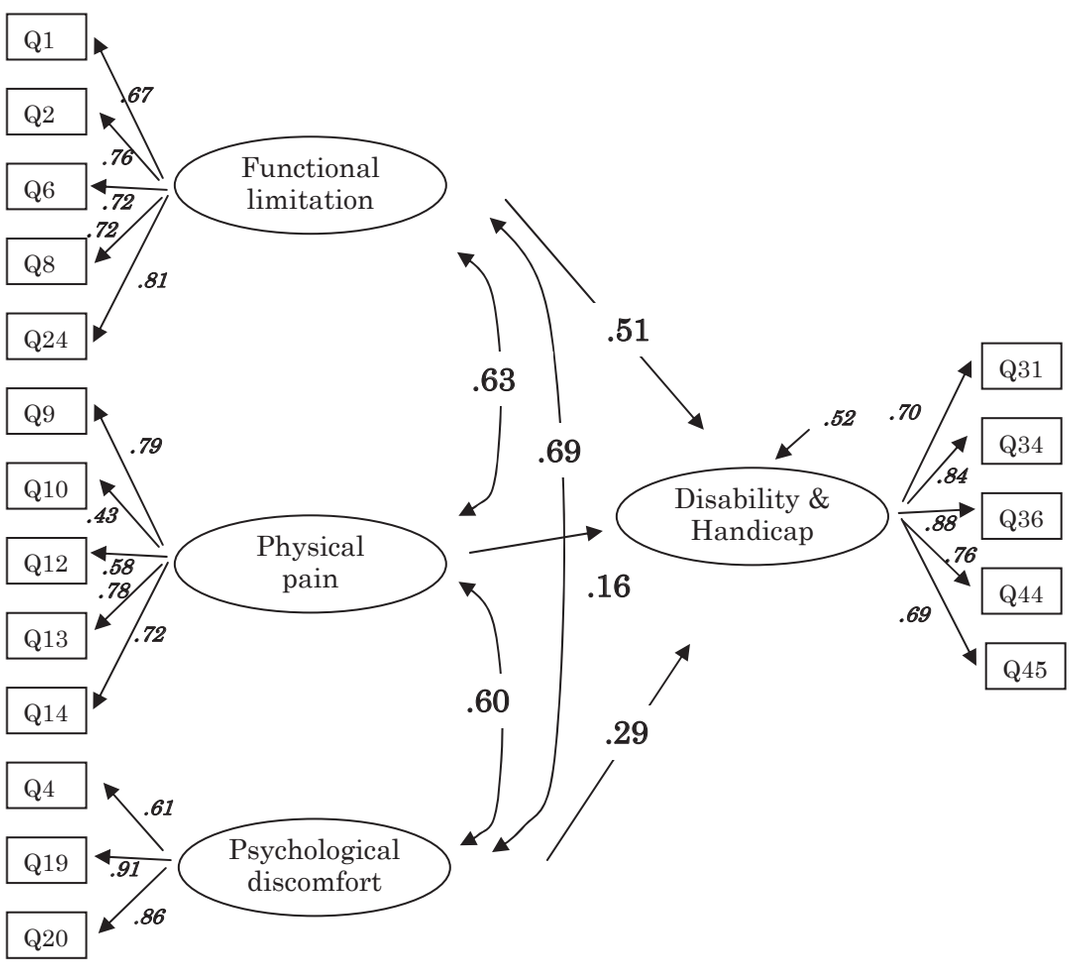


**Figure 2.** *Standardized path coefficients, factor loadings and covariances for the conceptual framework of OHIP-JA18*

OHQOL of young and middle-aged Japanese workers. However, in constructing OHIP-JA18, we did not consider clinical indicators of common oral disorders such as missing teeth, dental decay and periodontal disease. To use OHIP-JA18 successfully in a clinical setting, it is necessary to explore the relationship between measures of clinical indicators and OHIP-JA18 scores.

OHQOL is a multidimensional concept, so measurement of OHQOL should contain various aspects influenced by oral disorders. Furthermore, it is important to construct a theory about how an intervention will affect the condition. Both OHIP-14 and the General Oral Health Assessment Index (GOHAI) are constructed with many items relevant to mastication (Atchison and Dolan, 1990; Slade, 1997b). In our study, factor analysis has been used to identify key domains, that is, subscales. Items having a high prevalence of negative response were selected. As shown in Table 1, the prevalence of items located early

in OHIP-J ("functional limitation", "physical pain" and "psychological discomfort") tended to be higher than those of items occurring later. OHIP-JA18 consists of 18 items with little overlap, grouped into four subscales: “functional limitation”, “physical pain”, “psychological discomfort”, and “disability & handicap”. The 'sore jaw' item did not load highly for any factors, however, it was derived to measure a symptom of temporomandibular disorders.

A critical step in developing an outcome study is the creation of a conceptual model. In essence, the conceptual model identifies the factors that are believed to cause the outcome (Kline, 1998). This necessarily leads us to a meaningful interpretation of outcomes by measurement. Factor analysis identified key domains that might be formed into a hypothetical model structure. The original OHIP has seven domains (Slade and Spencer, 1994), however, we identified four factors derived from 32 items of OHIP-J. This is the same number of dimensions that appear in the study for the Oral Health Impact Profile (German version) (OHIP-G) using factor analysis (John *et al.*, 2004). Their dimensions were named “Psychosocial impact”, “Orofacial pain”, “Oral functions”, and “Appearance”. We confirmed that the Locker's adaptation of the ICIDH model of health for oral health with seven dimensions was not supported, so we constructed a new conceptual framework with four subscales based on that model. To our knowledge, this study is the first to use the SEM technique to confirm the pathways based on an underlying conceptual model for OHIP. An advantage of this procedure is the ability to assess the fit of the hypothesized model to the observed data. Findings from this study indicate that OHIP-JA18 conformed to the new conceptual framework, a modified Locker's adaptation of the ICIDH model for oral health, as shown in Fig. 2, and that the covariances between “functional limitation”, “physical pain” and “psychological discomfort” subscales were all quite strong. The “functional limitation” subscale appeared to be most relevant to the “disability & handicap” subscale.

In our study, there was a significant floor effect for OHIP-J14, but not for OHIP-JA18 (Fig. 1). In the development of OHIP-JA18, the items having low negative prevalence were excluded to prevent the floor effect. Because of the substantial impact in higher age groups, items having about 8% negative prevalence could not be discarded. OHIP-J14 included three items for which the prevalence of negative response was very low in Group A. This suggested that a subset of items in OHIP-J14 was not appropriate for young and middle-aged adults. Similarly, a previous study using the simple count method in elderly people reported that 15.1% had a GOHAI score of zero, and 45.8% had an OHIP-14 score of zero (Locker *et al.*, 2001). The floor effect may limit its ability to specify an effect of an intervention due to weak measurement discrimination.

OHIP has primarily been utilized in studies involving elderly patients and populations. The shortening of health-related quality of life measurements should be considered in order to reduce the burden of answering lengthy questionnaires. It has been proposed that a shorter form of OHIP may be needed, depending on the purpose of the investigation, the population and the context (Locker and Allen, 2002). From a social perspective, OHQOL should also be studied in people of working age.

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