PREDICTING DENTAL TREATMENT NEEDS IN AN OLDER ADULT POPULATION USING THE ORAL HEALTH IMPACT PROFILE (OHIP)

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HEALTH MEASUREMENT AND EPIDEMIOLOGY
REPORT NO. 11

1996

ABSTRACT

A study was undertaken to assess the ability of a recently developed subjective oral health status indicator, the Oral Health Impact Profile (OHIP), to identify community-dwelling older adults who need dental treatment. It was based on data collected as part of an oral health survey of Ontarians aged 50 years and over. The associations between OHIP scores and clinically-defined dental treatment needs were assessed using statistics for determining the accuracy and predictive power of a screening test. Although there were statistically significant associations between OHIP scores and treatment needs, values for statistics such as sensitivity, positive predictive values and positive likelihood ratios were low. Although the OHIP did not perform well as a diagnostic test, it did identify a sub-group of individuals whose clinical conditions impacted significantly on daily life and who would probably benefit the most from dental treatment.

INTRODUCTION

During the last ten years, a number of investigators have developed and tested subjective oral health indicators (1-6). They measure the impact of oral disorders on functional, psychological and social well-being of an individual. In so doing, they draw on contemporary definitions of health and, therefore, complement the clinical, disease-based indicators conventionally used to determine oral health status and dental treatment needs (7).

The most technically sophisticated of these measures is the Oral Health Impact Profile (OHIP), which is being tested by research teams in Australia, Canada and the United States. It consists of 49 items which address the frequency with which an individual experiences problems in functioning and daily living as a result of oral conditions (Appendix A). The OHIP is based on a generic model of disease and its consequences derived from the World Heath Organization's International Classification of Impairments, Disabilities and Handicaps (ICIDH) (7). This model consists of the following concepts: impairment, functional limitation, pain and discomfort, disability and social disadvantage/deprivation. The model and concepts are presented in Appendix B. In order to conform to this theoretical model, the OHIP items are grouped conceptually into seven sub-scales: functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability and disadvantage. It has been shown that the OHIP has excellent psychometric properties(5,8,9).

While the rationale underlying the construction of sociodental scales is clear, investigators have not, in general, made explicit the potential applications of these measures. This is important because the technical requirements of a measure may vary according to the context in which it is used and the clinical, public health and research questions it is being used to answer (10).

Ware (11) has described a number of potential applications for subjective health status indicators. These are: 1) assessing the health needs of the population and its sub-groups; 2) monitoring the health status of populations; 3) clinical

assessment of patients and decisions about treatment strategies; 4) outcome measures in evaluations of alternative ways of organizing or financing health services; 5) outcome measures in clinical trials of new therapeutic interventions. To date, most subjective oral health status indicators have been used in population surveys, usually of elderly people.

Another important potential application of these measures is that of a screening instrument to identify individuals who need dental treatment. Such an instrument would be useful in a number of settings, such as collective living and day centres for the elderly, where it would provide a rapid and inexpensive way of determining who would benefit from professional attention.

Research investigating the associations between subjective and clinical oral health indicators indicates that the associations between these two types of measures are weak (6,8). Similarly, many studies have found a gap between professionally-defined oral health status and needs for dental treatment, and the perceptions of subjects with respect to the same (12,13,14,15). These suggest that the predictive power of subjective indicators in terms of identifying the presence or not of clinical conditions is likely to be low. However, the clinical indicators commonly used in oral health surveys measure cumulative disease experience (e.g. DMFT index), and are quite different from measures of treatment need. Consequently, there is merit in assessing the relationship between subjective indicators and clinically defined treatment needs.

This report presents the findings of a study to assess the ability of the OHIP to identify older adults who need professional dental care.

METHODS

Study design, study population, sample selection and data collection

The data used in this report were gathered as a part of the second phase of the Ontario Study of the Oral Health of Older Adults. This is a longitudinal epidemiological study of the oral health, denture quality and treatment needs of a random sample of non-institutionalized persons aged 50 years and over living in two metropolitan and two non-metropolitan Ontario communities, which included inner city, urban, rural and northern populations.

At baseline in 1989-1990, subjects were identified by means of a telephone interview based on a random digit dialling. In 1992-1993 all participants from baseline were followed up and invited to participate in the second phase of the study. This consisted of a detailed personal interview, a comprehensive clinical examination and a self-complete questionnaire containing the OHIP. A detailed description of the study design and research procedures have been presented in previously published papers (9,16,17).

The clinical examination, based on WHO methods, collected data on the presence of oral diseases, quality of prosthetic appliances and need for dental treatment. The presence and condition of all remaining teeth, except third molars, was recorded. The examination was conducted by three teams of calibrated experienced dental hygienists, using a mirror, explorer and pressure sensitive periodontal probe. Radiographs were not taken and calculus was not removed prior to the examination. Needs for restorative, prosthodontics, surgical and periodontal

treatment were determined at the end of the clinical examination. Need for periodontal treatment was defined as a need for deep scaling, root planing or extraction due to periodontal disease. Needs for immediate treatment, i.e. relief from existing or imminent pain or infection were also recorded.

Data analysis

The OHIP has a Likert-type response format, with the following response categories: never, hardly ever, occasionally, fairly often and very often (Appendix A). For the purpose of the analysis, the overall OHIP score for each individual was calculated by counting the number of statements with responses "very often" or "fairly often". The OHIP used one year as the reference period.

The analysis was conducted in two parts. In the first, the mean OHIP scores of those who did and did not need dental treatment were compared using t-tests. In the second, the performance of the OHIP as a screening instrument was determined by calculating the sensitivity, specificity, predictive values and likelihood ratios of OHIP scores when compared with the "gold" standard represented by the results of the clinical examination. Table 1 gives the definitions of sensitivity, specificity, predictive values and likelihood ratios.

In an initial analysis, subjects with an OHIP score of 0 were considered to be negative and those with a score of 1 or more were considered positive. Analyses were then conducted using OHIP scores of 2 or more and 3 or more as cut-off points. Analyses were conducted for five categories of treatment needs and treatment need overall. Only dentate subjects were included in these analyses.

RESULTS

Response rate and characteristics of subjects

Of the older adults (n=907) initially interviewed and examined in 1989, 67% (n=615) were successfully followed-up in 1992. If those known to have died are excluded, this represents a response rate of 70.4%. Study subjects, both dentate and edentulous, were representative of the baseline sample and the target population (18). Of these 615 subjects, 493 were dentate, and 446 or 90.5% of them returned usable OHIP questionnaires.

Mean OHIP score by treatment need

Table 1 shows mean OHIP scores according to clinically defined treatment needs. The results indicate that the subjects who needed dental treatment had higher scores than those who did not, the differences being statistically significant for three of the five categories of need examined.

Sensitivity, specificity, predictive value (PV) and likelihood ratio (LR) of the OHIP

Table 2 summarizes the relationships between OHIP scores, dichotomized into "negative" and "positive" at different cut-off levels, and clinically determined treatment needs.

Sensitivity and specificity varied markedly by treatment need and cut-off level. Overall, sensitivities were low, and declined as the cut-off point became more

stringent. The maximum observed sensitivity was 58.8%.

Specificities were high at cut-off levels 2 and 3, ranging from 80.7% to 87.8% and from 86.6% to 92.2%, respectively. However, this was achieved at the expense of low sensitivity.

Positive predictive values varied from 9.5% to 57.6%. Even where this represented a significant improvement over pre-test probabilities, as indicated by the prevalence rate of treatment needs (Table 2), it was again achieved at the expense of low sensitivity. For example, the pre-test probability for surgical treatment need was 7.8% and the positive predictive value, at a cut-off point of 3 or more, was 18.2%, a more than two-fold increase. However, the value itself was low and associated with a low sensitivity of 35.3%.

Positive likelihood ratios were also low. When sensitivity was at its maximum of 58.8%, for surgical treatment need using a cut-off point of 1, the positive likelihood ratio was only 1.4. This means that a positive result of this sort is only 1.4 times as likely to come from an individual with surgical needs than one without. The maximum positive likelihood ratio was 3.4 for prosthodontic treatment need at a cut-off level of 3 or more. However, the associated sensitivity was low at 30.2%.

DISCUSSION AND CONCLUSION

Although there was a significant association between OHIP scores and most categories of dental treatment need, this study demonstrates that the OHIP scale does not perform very well when used as a screening test among community-dwelling

older adults. Most of the measures used to assess the accuracy and predictive power of a diagnostic test were rather poor.

There are a number of reasons for this. First, the OHIP was not constructed for this purpose. Second, the reference period for subjects to complete the OHIP was the year prior to the clinical examination and this was undoubtably too long. Third, the fairly stringent definition of a positive response to OHIP items ("very often"/"fairly often") used in this study may have weakened the associations and reduced the power of the OHIP as diagnostic test. Fourth, it is increasingly recognized that professionally defined treatment need ("normative need") is not free of subjective judgements (19).

Since many of the conditions identified at the clinical examination were asymptomatic and, therefore, unknown to the individuals concerned, they would be unlikely to register on a psychosocial impact scale, even one as comprehensive and sensitive as the OHIP. Consequently, it may be that subjective indicators as a class of measures are not good indicators of treatment need. Given the sophistication of the OHIP, it is unlikely that the performance of other measures would have been better in terms of accuracy and predictive power.

Even though the OHIP did not perform very well as a diagnostic test when assessed in conventional terms, the information it provides is, nevertheless, of value. For example, using a cut-off score of 3 or more, the OHIP identified only 19% of those needing dental treatment. However, this 19% constitutes a sub-group whose oral conditions have a considerable impact on daily life. Arguably, these individuals will

be more likely to benefit from the provision of dental care than others. In this regard, the OHIP itself is a measure of need and useful in identifying those whose oral conditions result in disability or handicap.

As Sheiham (19), Gilbert (13), Kay (20) and Ware (11) have indicated, health indicators such as the OHIP complement, rather than substitute for, traditional clinical indicators of health status and treatment needs. In this study, of those who had not been found to need treatment when clinically examined, 37.8% had positive OHIP scores (≥1), and 6% had score of at least 3. This indicates that for the accurate assessment of oral health status and treatment needs determination of the functional, psychological and social dimensions of dental disease is necessary. Advances in the understanding of the health status of populations, needs for professional care and the effectiveness of interventions will come from studies which use both clinical and subjective indicators.

REFERENCES

1. CUSHING A, SHEIHAM A, MAIZELS J. Developing socio-dental indicators - the social impact of dental disease. Comm Dent Health 1986; 3: 3-17

2. ROSENBERG D, KAPLAN S, SENIE R, BADNER V. Relationships among dental functional status, clinical dental measures and generic health measures. J Dent Educ 1988; 11: 653-657

3. ATCHISON K, DOLAN T. Development of the Geriatric Oral Health Assessment Index. J Dent Educ 1990; 54: 680-687

4. LOCKER D, MILLER Y. Evaluation of subjective oral health status indicators. J Public Health Dent 1994; 54: 167-176

5. SLADE G, SPENCER A. Development and evaluation of the oral health impact profile. Community Dent Health 1994; 11: 3-11

6. LEAO A, SHEIHAM A. Relationship between clinical dental status and subjective impacts on daily living. J Dent Res 1995; 74: 1408-1413

7. LOCKER D. Measuring oral health: a conceptual framework. Community Dent Health 1988; 5: 3-18

8. LOCKER D, SLADE G. Association between clinical and subjective oral health status in an older adult population. Gerodontology 1994; 11: 108-114

9. LOCKER D, LEAKE J, HAMILTON M, HICKS T, LEE J, MAIN P. The oral health status of older adults in four Ontario communities. J Can Dent Assoc 1991; 57: 727-32

10. PATRICK D, DEYO R. Generic and disease specific measures in assessing health status and quality of life. Med Care 1989; 27(Suppl): S178-189.

11. WARE J. Measures for a new era of health assessment. In Stewart A, Ware J (eds). Measuring functioning and well-being. NC: Duke University Press, 1992.

12. REISINE S, BAILIT HL. Clinical oral health status and adult perceptions of oral health. Soc Sci Med 1980; 14A: 597-605

13. GILBERT L. Determining dental needs: self-assessment of oral health in relation to a clinical examination

14. DRAKE CW, BECK JD, STRAUSS RP. The accuracy of oral self-perceptions in a dentate older population. Spec Care Dent 1990, 10: 16-20

15. GILBERT GH, HEFT MW, DUNCAN RP, RINGELBERG ML. Perceived need for dental care in dentate older adults. Int Dent J 1994; 44: 145-153

16. LOCKER D, LEAKE J. Periodontal attachment loss in a population of independently living Canadians aged 50 years and over. J Public Health Dent 1993; 53: 6-11

17. LOCKER D. The burden of oral disorders in a population of older adults. Community Dent Health 1992; 9: 109-24

18. PAYNE BJ, FORD JC, LOCKER D. Loss to follow-up in a longitudinal oral health survey of older adults. Community Dent Oral Epidemiol 1995; 23: 297-302

19. SHEIHAM A, MAIZELS JE, CUSHING AM. The concept of need in dental care. Int Dent J 1982, 32: 265-270

20. KAY EJ. Patients' Needs - More Than Meets The Eye. Br Dent J, Mar20, 1993; 174(6): 212-14

TABLE 1

Definitions of sensitivity, specificity, predictive values and likelihood ratios

		Gold standard: Positive	Gold standard: Negative
Screening test: Positive		A True positive	B False positive
Screening test: Negative		C False negative	D True negative

SENSITIVITY — Proportion of subjects with the characteristic under study who have a positive test result: A/A+C

SPECIFICITY — Proportion of subjects without the characteristic under study who have a negative test result: D/B+D

PREDICTIVE VALUE (PV) — Probability of the characteristic under study in a subject given the test result

Positive PV — Probability of the characteristic in a subject with a positive test result: A/A+B

Negative PV — Probability of the characteristic in a subject with a negative test result: D/C+D

LIKELIHOOD RATIO (LR) — Indicates how many times a given test result is more likely to occur in a subject with than without the characteristic under study

Positive LR — Ratio of the probabilities for a positive test result to occur in a subject with than without the characteristics: [A/(A+C)] / [B/(B+D)]

Negative LR — Ratio of the probabilities for a negative test result to occur in a subject with than without the characteristics: [C/(A+C) / D/(B+D)]

TABLE 2

Mean OHIP score by clinically-defined treatment needs

Treatment need	Mean OHIP score
Restorative	
Yes	1.8 (4.1)
No	1.2 (2.9)
Prosthodontics	
Yes	2.8 (5.3)**
No	0.9 (2.0)
Surgical	
Yes	3.0 (4.0)*
No	1.3 (3.3)
Periodontal	
Yes	1.4 (2.5)
No	1.3 (3.5)
Immediate	
Yes	3.4 (7.0)*
No	1.3 (2.9)
One or more	
Yes	1.8 (4.0)*
No	0.8 (1.7)

Figures in parentheses - standard deviations
* $p<0.01$, t-test
** $p<0.001$, t-test

TABLE 3

Sensitivity, specificity, PPV+[a], PPV-[b], LR+[c] and LR-[d] of the OHIP score in relation to clinically defined treatment needs

Treatment need	Prevalence of treatment need (%)	Cut-off point	Sensitivity (%)	Specificity (%)	PV+ (%)	PV- (%)	LR+	LR-
Restorative	38.7	≥1	45.6	59.0	41.2	63.2	1.1	0.9
		≥2	25.4	82.1	47.3	63.6	1.4	0.9
		≥3	18.9	87.7	49.2	63.2	1.7	0.9
Prosthodontics	28.8	≥1	53.2	61.1	35.6	76.3	1.4	0.8
		≥2	38.1	85.9	52.2	77.4	2.7	0.7
		≥3	30.2	91.0	57.6	76.3	3.4	0.8
Surgical	7.8	≥1	58.8	58.4	10.6	94.4	1.4	0.7
		≥2	50.0	81.4	18.5	95.1	2.7	0.6
		≥3	35.3	86.6	18.2	94.1	2.6	0.7
Periodontal	31.5	≥1	45.2	59.4	39.6	64.8	1.1	0.9
		≥2	27.4	83.0	48.7	66.0	1.6	0.9
		≥3	18.5	88.2	48.1	64.7	1.6	0.9
Immediate	6.1	≥1	58.1	58.6	9.5	94.9	1.4	0.7
		≥2	41.9	80.7	14.0	94.9	2.2	0.7
		≥3	35.3	86.7	16.7	94.7	2.6	0.7
One or more	64.8	≥1	45.2	62.2	68.9	37.9	1.2	0.9
		≥2	25.5	87.8	79.6	38.8	2.1	0.8
		≥3	19.0	92.9	83.3	38.2	2.7	0.9

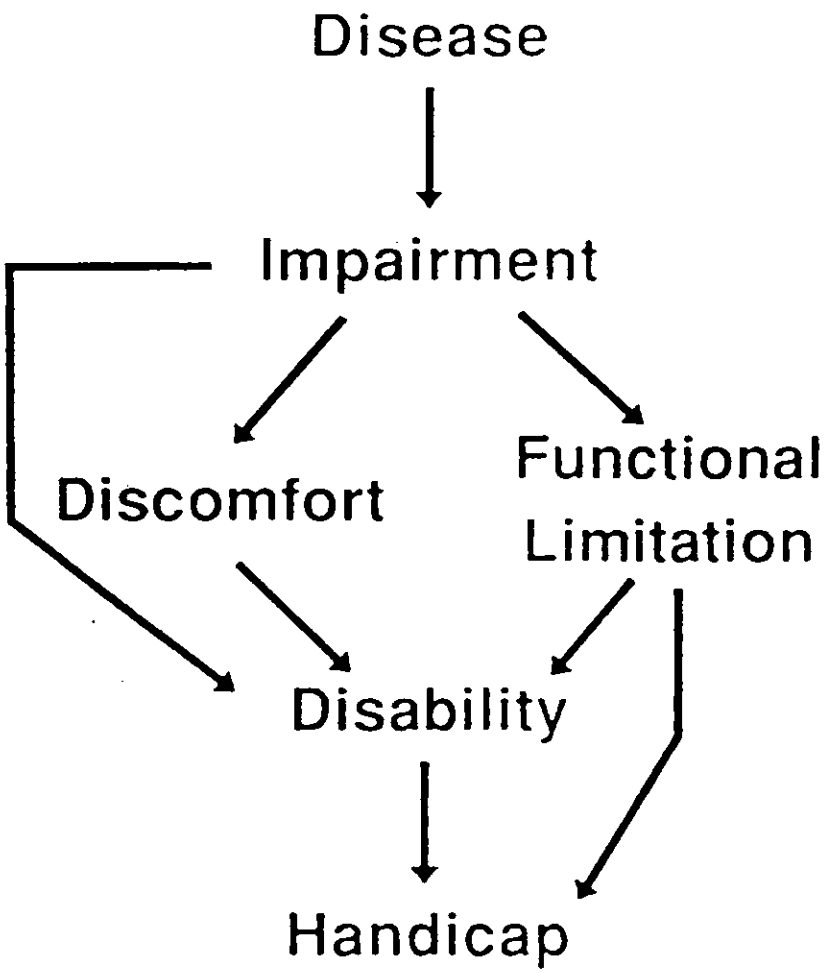
PV+ = Positive Predictive Value PV- = Negative Predictive Value
LR+ = Positive Likelihood Ratio LR- = Negative Likelihood Ratio

Appendix A **Oral Health Impact Profile (OHIP) Scale**

How often (have you) (has) (have you had) ..... during the last year, because of problems with your teeth, mouth or dentures?

	Very often	Fairly often	Occassionally	Hardly ever	Never
Functional limitation					
Difficulty chewing any foods					
Trouble pronouncing words					
Noticed a tooth which doesn't look right					
Felt that your appearance has been affected					
Felt that your breath has been stale					
Felt that your sense of taste has worsened					
Had food catching in your teeth or dentures					
Felt that your digestion has worsened					
Felt that your dentures have not been fitting properly					
Pain					
Had painful aching in your mouth					
Had a sore jaw					
Had headache					
Had sensitive teeth with hot or cold food or drinks					
Had toothache					
had painful gums					
Found it uncomfortable to eat any foods					
Had sore spots in your mouth					
Had uncomfortable dentures					
Psychological discomfort					
Been worried by dental problems					
Been self-conscious					
Been miserable					
Felt uncomfortable about your appearance					
Felt tense					
Physical Disability					
Speech been unclear					
People misunderstood some of your words					
Felt there has been less flavour in your food					
Been unable to brush your teeth properly					
Had to avoid eating some foods					
Had an unsatisfactory diet					
Been unable to eat with your dentures					
Avoided smiling					
Had to interrupt meals					
Psychological Disability					
Your sleep been interrupted					
Been upset					
Found it difficult to relax					
Felt depressed					
Your concentration been affected					
Been embarrassed					
Social Disability					
Avoided going out					
Been less tolerant of your spouse or family					
Had trouble getting on with other people					
Had difficulty doing your usual jobs					
Handicap					
Felt that your general health was worsened					
Suffered any financial loss					
Been unable to enjoy other peoples' company					
Felt that life in general was less satisfying					
Been totally unable to function					
Been unable to work to your full capacity					

Appendix B **Model of Oral Health**



From: Locker, 1988