

The relationship of medical and dental factors to perceived general and dental health

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Abstract - Objective: To determine the relative importance of dental and medical features in relation to perceived oral and general health in a sample of 31-year-old individuals. Subjects and methods: The present study used information collected from the longitudinal Cardiff Survey, which commenced in 1981. The initial sample consisted of 1018 11-year-old Caucasian schoolchildren. Three hundred and thirty-seven individuals attended the latest examination in 2001 (aged 31 years). For every individual who attended in 2001, the following information was collected: perceived general and oral health recorded on a five-point Likert scale; self-reported medical history; SF-36v² questionnaire; assessment of dental features; and the Index of Complexity, Outcome and Need (ICON). Results: Ninety-four and 82% of individuals reported good-excellent general and oral health, respectively. Females reported a higher level of physical health than males as measured using the SF-36v². Four medical conditions were associated with perceived poor general health: mental [odds ratios (OR); 95% confidence limits (95% CI): 4.5; 1.1-18.4], gastrointestinal (OR 3.4; 95% CI 1.2-9.5) and genitourinary disorders (OR 7; 95% CI 1.6-30.2), and conditions that did not readily fit into a defined category or system (OR 12.8; 95% CI 3.9-42.3). The highest prevalence of dental factors was gingivitis followed by gingival recession and plaque. Photographically assessed dental factors associated with self-reported poor/fair oral health were fillings (OR 0.45; 95% CI 0.2-0.9), root caries/abrasion (OR 0.37; 95% CI 0.1-0.9) and gingivitis (OR 0.31; 95% CI 0.1-0.9). There was a statistically significant association between oral and general health. Of those individuals reporting fair-poor oral health (18%), the proportion also reporting fair-poor general health was 63.6%. Unexpectedly, perunit increase in ICON score was also significantly associated with fair-poor general health (OR 0.97) with clinically relevant increases of 7 ICON units producing an OR of 0.82. Conclusion: The relative importance of the various dental and medical conditions has been identified. Further studies are required to explore the importance of ICON in perceived medical health and importance of the various conditions on oral and general health over different age groups.

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For more than half a century, it has been recognized that health is not merely the absence of disease or infirmity but is a state of complete physical, mental and social well-being (1). The limitations of the medical model of health are recognized and health is now regarded as an allencompassing continuum that is relative to other individuals of similar age, with similar perceived health, medical and oral signs and symptoms, which might be associated with acute/chronic and or fatal/nonfatal conditions (2). The nebulous nature of health is illustrated by the fact that individuals with chronic disability disorders adjust to their condition and can rate their quality of life higher than individuals who do not report any serious medical conditions (3–5). This illustrates the complex nature of associations between individual clinical parameters, whether assessed from

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a clinical or lay perspective, and overall reported health status.

The relationship between oral health and general health are equally complex. While systemic disease can obviously have oral manifestations, there has in recent years been renewed interest in the effect of oral disease on health, in general. Building on the concepts of 'focal infection' prevalent in the early 20th century, there have recently been numerous reports regarding the relationship between oral health and heart disease (4–7), although this has been refuted (8, 9). Periodontal disease as a risk factor for preterm low-birth-weight babies has also been proposed (10) and rejected (11) as further evidence of the close relationship between oral and general health.

It is therefore apparent that the relationship between oral and medical conditions is complex as is the potential relative contribution of a specific sign or disease to perceptions of overall health, be it considered from an oral or general point of view.

Determining the relative importance of various oral and medical conditions from an individual's perspective would lead to further understanding of this complex area. This study reports the relationship between oral and medical features in relation to perceived oral and general health in a sample of 31-year-old individuals.

Subjects and methods

Sample

The present study used information collected from the longitudinal Cardiff Survey, which commenced

Table 1. Actual and normalised scores for SF36 factors

in 1981 (12). The initial sample consisted of 1018 11year-old Caucasian schoolchildren. Three hundred and thirty-seven individuals attended the latest examination in 2001 (aged 31 years). For every subject who attended in 2001, the following information was collected.

Perceived general health

The subjects were asked to record their own perceived health on a five-point scale as follows. In general, would you say your health is: excellent (1); very good (2); good (3); fair (4); poor (5).

Self-reporting medical conditions

A self-administered medical history was completed by the subjects to determine their general state of well-being (Appendix). The reported medical conditions were classified according to International Classification of Disease (ICD-9) (13) and subsequently collapsed into five broad medical systems categories.

$SF-36v^2$

The subjects completed the SF- $36v^2$ questionnaire. The SF- $36v^2$ covers a wide range of areas. Scores are reported in eight dimensions which relate either to physical or to mental health. This index reports on a scale of 0–100 with high scores indicating better health status. The scale can be transformed/normalized, where 0 represents the normal population (Table 1). Component scores for physical and mental health were calculated according to the SF- $36v^2$ protocol. This measure was chosen as it contains items that are considered to be more sensitive to lower levels of disability (14, 15). Furthermore, normative data were available for SF- $36v^1$ for 31-year olds in West Glamorgan (16, 17).

	Mean	Median	Minimum	Maximum	SD
Actual scores	92.54	100.0	5.00	100.0	15.06
Physical Functioning	91.32	100.0	6.25	100.0	17.46
Role Limitations Physical	82.01	84.0	12.00	100.0	21.02
Bodily Pain	75.71	77.0	15.00	100.0	16.87
General Health Perception	60.24	62.5	0	100.0	17.43
Vitality	85.45	100.0	12.50	100.0	20.61
Social Function	90.42	100.0	0	100.0	16.05
Role Limitations Emotional	74.64	80.0	25.00	100.0	15.59
Mental Health					
Normalised scores					
Physical Functioning	0.04	0.44	-5.39	0.54	0.90
Role Limitations Physical	0.06	0.44	-4.01	0.57	0.90
Bodily Pain	-0.04	0.18	-4.07	0.88	1.04
General Health Perception	0.09	0.16	-3.14	1.38	0.88
Vitality	0.15	0.31	-2.82	2.34	0.90
Social Function	0.11	0.66	-2.86	0.84	0.90
Role Limitations Emotional	0.22	0.59	-3.84	0.76	0.78
Mental Health	0.19	0.35	-3.01	1.69	0.88

Factors related to perceived dental and general health

This enables a comparison between the current sample and normative population.

Perception of oral health

The subjects were asked to record their own perceived oral health on a five-point scale. In general, would you say your oral health is: excellent (1); very good (2); good (3); fair (4); and poor (5).

Assessment of dental factors

The anterior dentition was photographed using a digital camera (Fig. 1). Two of the authors independently examined the digital images to determine the range of categories of dental features that could be detected. In total, 15 categories were identified: caries, crowns, discolouration, fillings, fractured teeth, gingival recession, gingivitis, hypoplasia, plaque, prosthetic replacement, root caries/abrasion, small teeth, staining, teeth missing and tooth wear.

A simple scoring method was developed for each of the dental anomalies for the anterior 12 teeth; 0 - not present; 1 - present for one tooth only and 2 - present for more than one tooth.

The two judges undertook two calibration training sessions on 30 cases to improve intra-rater and inter-rater reliability. They independently recorded the scores for the total sample of 337 31-year olds. The scores were compared and where there was conflict, consensus was attained. Examples of the scoring system are shown in Fig. 1.

Index of Complexity, Outcome and Need

Although the various dental conditions have been recorded, the overall alignment and fit of the teeth needs to be assessed. The Index of Complexity, Outcome and Need (ICON) was chosen as it has been shown that it is the most reliable and valid of currently used occlusal indices (18–25). Dental casts of the individuals were measured to assess the severity of the occlusion. Examples of ICON scores are shown in Fig. 1.

Statistical analyses

Parametric or non-parametric tests were used where appropriate for continuous measures (Mann–Whitney or *t*-tests). Associations between categorical variables were examined using chisquared tests. Agreement between examiners' rating of dental features was determined using kappa statistics and percentage agreement. Oral health perception was reclassified as good–excellent and fair-poor for logistic regression analyses. Multivariate logistic regression was used to determine a model of independent factors from significant variables identified in univariate tests.

Results

The sample consisted of 337 participants – 146 males and 191 females.

Perceived general health

Overall, 93.4% of the subjects reported good to excellent health. There was no statistically significant association between levels of self-reported health status and gender using this measure.

Self-reported medical conditions

Seventy-one per cent of the subjects who reported good–excellent health and 95% of those reporting fair–poor health had at least one medical condition. Table 2 gives the proportions of self-reported medical conditions by health status. Diseases of the digestive system were more common or frequent, but the disparity between the proportion reporting good and poor health (P < 0.05) were because of neoplasms, mental disorders, gastrointestinal disorders, genitourinary disorders and conditions which did not readily fall into a defined disease category or system.

$SF-36v^2$

Summary statistics for the eight standardized SF- $36v^2$ scales are shown in Table 1. There was a statistically significant difference in physical health score between males and females (P = 0.033), with females showing higher levels for physical health (data not shown). There was no statistically significant difference in mental health component scores.

 $SF-36v^2$ and self-reported medical conditions

The component 'mental' and 'physical' health summary scores from the SF- $36v^2$ in those subjects recording one or more medical conditions were compared with those in subjects where the medical history was clear. There was a statistically significant difference in physical component score (P < 0.001) but not for the mental health summary scores (P = 0.206).

The use of the $SF-36v^2$ validates reporting of medical conditions in that reporting of one or more medical conditions resulted in a statistically signi-



	Score
Prosthetic replacement	
Caries	
Discolouration	
Teeth missing	
Small teeth	
Fractured teeth	
Root caries/ abrasion	
Crowns	
Hypoplasia	
Fillings	
Staining	
Plaque	
Ginigival recession	2
Tooth wear	
Gingivitis	



	Score
Prosthetic replacement	
Caries	
Discolouration	
Teeth missing	
Small teeth	
Fractured teeth	
Root caries/ abrasion	
Crowns	
Hypoplasia	2
Fillings	2
Staining	
Plaque	
Ginigival recession	1
Tooth wear	
Gingivitis	



	Score
Prosthetic replacement	
Caries	
Discolouration	
Teeth missing	
Small teeth	
Fractured teeth	
Root caries/ abrasion	2
Crowns	
Hypoplasia	
Fillings	
Staining	2
Plaque	
Ginigival recession	2
Tooth wear	2
Gingivitis	

ICON score = 29

Fig. 1. Examples showing the use of assessing anterior dental anomalies.

ficant higher $SF-36v^2$ physical component score. The $SF-36v^2$ scores were higher in the current 31-year-old sample compared with a normative

sample collected in West Glamorgan. The current sample scores were higher than the comparative West Glamorgan data for eight domains with the

ICON score = 17

	Health		
	Good-excellent (%)	Poor-fair (%)	<i>P</i> -value
Diseases of the digestive system	21.7	45.5	0.011
Symptoms, signs and ill-defined conditions	5.1	36.4	0.000
Mental disorders	4.8	22.7	0.001
Diseases of the musculoskeletal system and connective tissue	11.8	18.2	0.379
Diseases of the respiratory system	9.3	18.2	0.175
Diseases of the genitourinary system	3.8	18.2	0.002
Complications of pregnancy, childbirth, and the puerperium	14.4	9.1	0.490
Injury and poisoning	5.8	9.1	0.523
Diseases of the circulatory system	3.2	9.1	0.150
Neoplasms	1.9	9.1	0.033
Infectious and parasitic diseases	5.1	4.5	0.907
Diseases of the nervous system and sense organs	7.7	0	0.178
Diseases of the skin and subcutaneous tissue	3.5	0	0.371
Endocrine, nutritional and metabolic diseases, and immunity disorders	2.2	0	0.478
Diseases of the blood and blood forming organs	0.6	0	0.707
Certain conditions originating in the perinatal period	0.3	0	0.791
Congenital abnormalities	_	_	_

Table 2. Self-reported medical conditions (ordered on poor health)

exception of vitality and bodily pain (16, 17). The Mann–Whitney test indicated a statistically significant difference between mental and physical component scores for the two samples (P < 0.05). There was no significant difference between male/female proportions.

Perceived oral health

In total, 82% of subjects reported good–excellent oral health; gender was not significantly associated with self reported oral health. Of those reporting fair–poor oral health (18%), the proportion also reporting fair–poor general health was 63.6%. The association between perceived oral and general health was statistically significant (P < 0.001).

Dental factors

Kappa was initially used to assess agreement for the rating of dental features (mean kappa 0.42; range 0.17–0.79). However, because of kappa's inherent weakness for unbalanced numbers, percentage agreement provides a better guide of concurrence (mean percentage agreement 81.2%; range 48.6–98.8%; Fig. 2). The prevalence of agreed dental factors is shown in Table 3. The most common anomaly affecting more than one tooth was gingivitis (72.6%), followed by tooth wear (54.6%), gingival recession (48%) and plaque (36.3%).

Medical and dental factors related to perceived oral health

Using univariate analyses to explore the influence of dental and medical features on patient's percep-



Fig. 2. Bar chart of percentage agreement for the 15 dental features.

tions of their oral health; the following dental factors were statistically significant (P < 0.05): fillings, staining, caries, fractured teeth, root caries/abrasion and gingivitis. The ICON score was close to statistical significance (P = 0.064). The only medical factor that was statistically significant was mental health.

Using multivariate logistic regression analysis, three of the above factors were found to be independently associated with oral health: fillings (Table 4) [odds ratio (OR) 0.45, P = 0.021], root caries/abrasion (OR 0.37, P = 0.036) and gingivitis (OR 0.31, P = 0.022). The interpretation of the ORs is that the odds of having good/excellent oral

	Not present (%)	Present on one tooth (%)	Present on two or more teeth (%)
Gingivitis	23.8	3.6	72.6
Tooth wear	37.5	8.0	54.6
Ginigival recession	40.7	11.3	48.0
Plaque	56.6	7.2	36.3
Staining	62.7	9.1	28.2
Hypoplasia	76.1	7.6	16.3
Fillings	75.9	11.5	12.6
Crowns	88.1	3.2	8.7
Root caries/abrasion	90.5	4.0	5.5
Small teeth	94.5	0.8	4.7
Discolouration	95.3	1.6	3.2
Caries	95.7	2.8	1.6
Teeth missing	94.9	3.5	1.6
Fractured teeth	91.3	7.5	1.2
Prosthetic replacement	98.4	1.2	0.4

Table 3. Prevalence of dental factors (ordered according to dental condition being present on two or more teeth)

health are reduced by over half if fillings, root caries/abrasion or gingivitis are present.

Medical and dental factors related to perceived general health

Using univariate analyses to explore the influence of dental and medical features on general health; the following medical factors were statistically significant (P < 0.05): neoplasms, mental disorders, disease of the digestive system, disease of the genitourinary system, signs and symptoms and illdefined conditions. The only dental factor that was statistically significant was the ICON score.

Table 4. Multiple logistic regression analysis to assess association of dental factors and perceived oral health

	OR	95% Lower CI	95% Upper CI	<i>P</i> -value
Gingivitis Fillings Root caries/ abrasion	0.31 0.45 0.37	0.12 0.22 0.14	0.85 0.89 0.94	0.022 0.021 0.036

Using multivariate logistic regression analysis, four factors were found to be independently associated with general health (Table 5): disease of the digestive system (OR 3.37, P = 0.02), mental disorders (OR 4.47, P = 0.038), disease of the genitourinary system (OR 7.0, P = 0.009), signs and symptoms of ill defined conditions (OR 12.82, P < 0.0001) and ICON score (OR 0.97, P = 0.036). Therefore, the odds of having good health is 3–12 times more likely if the diseases are not present and less likely for each unit increase of the ICON score. For a change of 7 in ICON score, the OR is 0.82.

Discussion

The 31-year-old population in this study provides an opportunity to look at the relationship between perceived medical and oral conditions in a group of relatively healthy individuals. At this stage in life, they can reasonably be expected to have started or planning families, to have undergone or be undergoing social and career advancement and to have experienced medical and oral care for themselves and their families. Ninety-three per cent of the individuals reported perceived good to excellent health in contrast to 82% reporting perceived goodexcellent oral health. There was a significant association between individuals reporting perceived fairpoor oral health and general health and this supports previous studies (3-6), although there is no suggestion of a causal link. Although reporting perceived good/excellent medical and oral health, it is clear that some of the individuals had or recently experienced debilitating medical conditions, and it seems that some individuals in agreement with previous findings compensate for any disability (2).

The higher physical health score for SF-36v² in women can be explained by more men than women likely to report 'injury and poisoning' and 'diseases of the musculoskeletal system and connective tissue' possibly as a result of sporting activities.

Table 5. Multiple regression analysis to assess the relative contributions of medical conditions to perceived general health

	OR	95% Lower CI	95% Upper CI	<i>P</i> -value
Disease of the digestive system (ICD9)	3.37	1.19	9.49	0.022
Mental disorders (ICD5)	4.47	1.09	18.35	0.038
Disease of the genitourinary system (ICD10)	7.00	1.63	30.16	0.009
Signs and symptoms of ill-defined conditions (ICD16)	12.82	3.88	42.33	0.000
ICON score	0.97	0.95	0.99	0.036

Interestingly, univariate analysis highlighted the reporting of mental conditions in association with poorer perceived oral health. The use of multivariate analysis highlighted that a higher prevalence of fillings, root caries/abrasion and gingivitis indicated poorer perceived oral health.

The factors associated with perceived poorer general health were mental disorders (OR 4.5), diseases of the digestive system (OR 3.4), genitourinary system (OR 7) and signs and symptoms of ill-defined conditions (12.8). These ORs are relatively high, indicating a significant contribution to perceived general health. Interestingly, the only dental factor which was found to be associated with perceived poor general health was the ICON score (OR 0.97). Therefore, the odds of having good health is 3-13 times more likely if the diseases are not present and less likely for each unit increase in ICON score. The OR for a change of 7 ICON units is 0.82, meaning that the odds of having good health are reduced by nearly 20% for each clinically relevant change in ICON score. The ICON scores the alignment and fit of the teeth, and the greater the score the greater the malalignment. Usually, incremental increases of 5-10 units are important in alignment terms. However, a small increment in unit ICON score having an effect on general health is unexplained. In another study, 7% of the variance for self-esteem was explained by the ICON score (24). Various dental factors were explored to see if the ICON score was acting as a proxy for perceived oral health. Using multiple regression, gingival recession and fillings were related to ICON but the *P*-values for *t*-tests were only 0.058 and 0.068 so the association is weak. Hypoplasia and fractured teeth only had P-values close to 0.1. If the ICON score is associated with general health, improvement in dental alignment should improve general health. However, orthodontic treatment did not have a statistically significant effect on the perceived oral or general health. Therefore, the reason why ICON is related to general health is unclear and warrants further investigation.

Using chi-squared analyses, perceived general and oral health was statistically significantly related which may indicate a close association between perceived oral and general health.

Conclusions

There is a statistically significant association between oral and general health. Of those

Factors related to perceived dental and general health

individuals reporting fair–poor oral health (18%), the proportion also reporting fair–poor general health was 63.6%. This study also identified the four features of general health, which in this sample of 31-year olds were significantly related to perceived poor general health namely: mental, gastrointestinal and genitourinary disorders, and conditions that did not readily fall into a defined category system. There were three dental factors which were significantly related to perceived poor oral health: fillings, root caries/abrasion and gingivitis.

The only oral factor to be significantly related to general health was ICON. The present analysis has however, served to emphasize the complex relationship between medical and oral features and subjective opinions of general and oral health.

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Appendix: Medical History Form

Medical History

Prior to undertaking the examinations we need to know about your general state of well-being

1.	Have you had any serious illnesses?	Yes	No	If yes please st	tate
		0	0	, ,	
2.	Have you had any heart or chest trouble?	Yes	No	If yes please state	
		0	0	, ,	
3.	Have you ever had			Yes	No
		a) Rheumatic fev	er	0	0
		b) Pnuemonia		0	0
		c) Bronchitis		0	0
		d) Diabetes		0	0
		e) Bleeding disorders or		0	0
		bruising			
		f) Epilepsy		0	0
4.	Have you ever had a blood transfusion?	Yes	No		
		0	0		
5.	Are you allergic to any drugs or antibiotics?	Yes	No		
		0	0		
6.	Do you suffer from			Yes	No
		a) Asthma		0	0
		b) Hayfever		0	0
		c) Eczema		0	0

7.	Have you been in hospital or had any operations?	Yes	No	If yes	
		0	0	please	state
8.	Are you currently taking any tablets or medication?	Yes	No	If yes	
		0	0	please	state
9.	Have you been to see your Doctor recently?	Yes	No	If yes	
		0	0	please	state
10.	Are you a carer (looking after a sick or disabled	Yes	No		
	member of your family)?	0	0		
11.	How many children do you have?	Number of Children		Are all	1
				your	
				childre	en
				health	y?
		0	0	Yes	No
		1	0	0	0
		2	0		
		3	0		
		4	0		
		more than 4	0		
12	Is there anything else about your medical history that	you want to tell us about?			

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