Locus of control beliefs predicting oral and diabetes health behavior and health status

Mirka C. Kneckt, Anna-Maija H. Syrjälä and Matti L. E. Knuuttila

Institute of Dentistry, University of Oulu, Finland, Department of Periodontology, Institute of Dentistry, University of Oulu, Finland, and Oral and Maxillofacial Department, Oulu University Hospital, Finland

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Our study evaluates the correlation between dental and diabetes locus of control beliefs and the potentiality of locus of control beliefs in predicting oral health behavior, dental status, diabetes compliance, and HbA_{1c} level by using situation-specific locus of control scales and considering the value dimension. Data were collected by means of a quantitative questionnaire, a clinical oral examination and patient records. The research population comprised 149 insulin-dependent diabetics who had teeth of their own. Variables were the frequencies of tooth brushing and dental visiting, oral indexes, diabetes adherence, and HbA_{1c} level. Dental and diabetes locus of control beliefs correlated with each other. Dental locus of control associated with frequency of dental visiting, plaque index, decayed surfaces, and with root caries, but diabetes locus of control associated only weakly with adherence with diabetes self-care regimens and not at all with HbA_{1c} level. Correlations between dental locus of control and oral indexes were stronger among those having high value for dental care. Although there were correlations between dental and diabetes locus of control beliefs, only dental locus of control beliefs are practicable for determining health behavior and health status. It is therefore concluded that locus of control beliefs are health behavior specific. □ *Dental status; diabetes adherence; insulin-dependent diabetes mellitus; locus of control; oral health behavior*

Mirka Kneckt, Institute of Dentistry, Aapistie 3, FIN-90220 Oulu, Finland. Fax. +358 8 5375560, e-mail. mkneckt@hotmail.com

One widely used psychological theory for analysing health behavior is locus of control, according to which a person has an internal locus of control if he/she interprets events as being dependent on his/her own behavior or stable characteristics, and external control when he/she thinks that events are in some way contingent upon luck, fate, chance, or the influence of other powerful persons (1). Applying this theory to health settings, those who feel that they have control over their own health and place a high value on health are more likely to pursue health promoting behavior than those who feel that their health is contingent upon external factors.

Dental studies have shown that some relations have been found between locus of control and oral health status (2–4) and tooth brushing behavior (5, 6). Wolfe et al. (7) found a shift from external to internal locus of control beliefs as a consequence of oral hygiene intervention, whereas Scruggs et al. (8) did not. West et al. (9) could not show any correlation between locus of control beliefs and compliance with dental appointments. As far as diabetes researches are concerned, some investigations have shown that locus of control beliefs can predict some diabetes self-care practices (10), and metabolic control (11, 12), whereas others have not found these relations (13, 14). Reasons for these confusing results have been sought in misuse of the locus of control theory. Wallston et al. (15) drew attention to the fact that the value dimension must be taken into consideration when predicting health behavior with locus of control beliefs. Further, it has been proposed that locus of control is only part of a larger construct called perceived control, which also takes account of the person's capability for implementing health-promoting behavior (15). This might be a reason why locus of control beliefs cannot predict well health behavior.

Rotter (1) proposed that locus of control beliefs can be generalized from specific situations to similar or related ones. In this study, dental and diabetes locus of control beliefs are evaluated in the same study population, which is meaningful because the prevention and treatment of both these chronic diseases need daily persistent, goal-directed self-care, and adequate self-care practices are known to have a beneficial effect on actual health status in both respects. In addition, severe periodontal disease has been found to be a risk factor for metabolic control (16) and complications of IDDM (17). On the other hand, poor control of IDDM has been found to be related to periodontal diseases (18, 19) and dental caries (20).

As there is no psychological research available concerning diabetes self-care and oral health behavior together, we have begun a research project using various behavioral theories to analyse possible common factors. In this study we propose a hypothesis that there could be some similarity in dental and diabetes locus of control beliefs and that locus of control beliefs could predict corresponding health behavior and health status. The main aims here were to evaluate (i) the association between dental and diabetes locus of control beliefs, (ii) the associations of locus of control beliefs with reported oral health behavior, reported diabetes adherence, and actual oral and diabetes status, and (iii) the importance of the value dimension with respect to locus of control beliefs, health behavior, and health status.

Table 1. Baseline characteristics of study population ($n = 149$).

Variable	Range	Median	Mean ± SD
Age (y)	16–72	32	34 ± 12
Duration of IDDM (y)	0.5–49	15	16 ± 10
Mean HbA_{1c} level (%) in previous year	4.7–13.8	8.3	8.5 ± 1.8

Materials and methods

Study population

The research was a cross-sectional descriptive survey, comprising 149 IDDM patients (62 women and 87 men) who were consecutive eligible patients on sampling days. They had all had IDDM for at least 6 months and had their own teeth. Pregnant women and persons incapable of filling in the questionnaire were excluded. The subjects were recruited from diabetes clinic of Oulu Health Centers and the neighboring communities and from the diabetes clinic of the Department of Internal Medicine at the University Hospital in Oulu. Eighty percent of those asked to take part were willing to do so, a third of refusers giving as their reason the excessive distance to the clinic. The protocol was accepted by the ethics committees of the Medical Faculty at Oulu University and Oulu Health Center.

The characteristics of the study population are given in Table 1. As a background variable, basic education was classified as completion of high school ($n = 49$) and other ($n = 100$), and further education as attainment of a university or college qualification ($n = 59$), and some other form of further education or no further education ($n = 87$). (In Finland it is possible to qualify for a university or college degree without passing through high school.)

Clinical data

The mean glycosylated hemoglobin (HbA_{1c}) over the last year was gathered from patient records. For the analysis, the HbA_{1c} level was dichotomized ($\leq 8.5\%$, $n = 66$ and $>8.6\%$, $n = 58$) according to national instructions for the care of IDDM (21). The reference level for HbA_{1c} is 4–6% for non-diabetic persons (21).

The clinical oral examination included the following generally accepted recordings of actual oral status: visible plaque as an index of oral hygiene using the criteria of Ainamo and Bay (25), gingival bleeding after probing as an index of gingival inflammation and decayed surfaces and softened root surfaces as indexes of caries. The plaque and gingival inflammation indexes were scored as percentages of mesial, distal, buccal, and oral surfaces on all the teeth. Decayed surfaces were recorded by visual clinical examination and probing as the sum of all surfaces of all the teeth, and root caries as the sum of decayed root surfaces.

Mean number of teeth was 24.9 (SD ± 6.8); for decayed dental surfaces the number was 2.9 (SD ± 6.7) and for decayed root surfaces 0.9 (SD ± 2.1). Mean percentage of gingival bleeding index was 24.3 (SD ± 10.9) and visible plaque index 50.2 (SD ± 22.7).

Questionnaire

The data were collected by means of a self-completed quantitative questionnaire, which included items about diabetes and dental locus of control beliefs, diabetes adherence, and oral health behavior. The dental locus of control items was pre-evaluated by 31 non-diabetics, and the whole questionnaire, including both dental and diabetes locus of control items, was pre-evaluated by 21 diabetics. The dental locus of control scale (Table 2) was modified from the Dental Coping Belief Scale used by Wolfe et al. (3). Our diabetes locus of control scale (Table 2) was condensed from that used by Kuusinen (22), who obtained the original scale from the study of Ferraro et al. (23). Higher scores of both scales were regarded as indicating more internal locus of control beliefs.

To analyse the value dimension regarding oral health, there were three questions which dealt with the importance of regular dental visits, avoiding dental caries, and avoiding gingivitis. The four choices of answer were: very important, important, less important, or completely unimportant. A sum score was calculated for these oral health questions, and the subjects were classified into those with high or low valuations in relation to the median (range 6–12, median 10). Concerning the importance of diabetes health status, there was a question asking the subject's evaluation of the importance of maintaining a good metabolic balance. The answers were classified within two categories: those feeling it to be very important

Table 2. Dental and diabetes locus of control items.

Dental locus of control items:
I believe that only the dentist can prevent cavities.
I believe that by flossing my teeth I can prevent gingivitis.
I believe that if both of my parents have bad teeth, brushing and flossing will not help my teeth.
I believe that by brushing and flossing my teeth I am less susceptible to tooth decay.
I believe that I am responsible for preventing the loss of my teeth.
I believe that tooth loss is a normal part of growing old.
I believe that by brushing my teeth I can prevent gingivitis.
The health of my teeth is a matter of good luck.
Diabetes locus of control items:
My diabetes remains under control best if I meet other diabetics regularly.
If my diabetes is going to go out of control, it will do so no matter what I do.
If I take good care of myself my diabetes will stay under control.
If I am able to avoid complications, it will be because others (doctors, nurses, family, friends) have been taking good care of me.
Avoiding complications is largely a matter of good fortune.
I will probably develop complications no matter what I do.
I have so many worries in my life that my diabetes will not stay under control.
If my diabetes goes out of control it is usually by accident.

There were four choices of answer: I agree completely, I agree partly, I disagree partly, I disagree completely.

Table 3. Diabetes adherence items.

Assess how well you usually comply with your diabetes self-care advice.
Adapting insulin injections to meal-times.
Adapting insulin dosage to exercise.
Dietary instructions.
Regular mealtimes.
Exercise intructions.
Measuring blood sugar levels.

There were five choices of answer: not at all, poorly, moderately, quite well, completely.

($n = 70$) and those feeling it to be important, less important, or completely unimportant ($n = 57$).

The items regarding reported oral health behavior dealt with the frequency of tooth brushing and frequency of dental visiting. For the purpose of statistical analyses these variables were classified as follows: brushing at least twice a day ($n = 76$) versus less often ($n = 70$) and dental visiting at least once year ($n = 77$) versus less often ($n = 65$). The diabetes adherence scale (Table 3) was modified from that of Kuusinen (1994); α was 0.76.

Statistical analyses

Spearman's rank correlation coefficient (r_s) was used to analyse the correlations between the sum scores for the diabetes and dental locus of control scales, and those between the locus of control scales and age, duration of diabetes, oral indexes, and diabetes adherence. The Mann-Whitney U-test was used to analyse the relations of the sum scores on the diabetes and dental locus of control scales to sex, education, reported oral health behavior, HbA_{1c} level, and value dimensions. Stratified analysis was used when evaluating the effect of background variables on the correlation between locus of control scales, and when the significance of value level on the associations between locus of control beliefs and health behavior and health status was analysed. The level of significance was set at $p < 0.05$, and results at $p < 0.10$ were reported as trends. The statistical analyses were performed using SPSS for Windows, release 6.13 or 7.5.

Results

Relation of dental locus of control scale to diabetes locus of control scale

The main descriptive data of sum scores on locus of control scales are presented in Table 4. Sum scores on the dental locus of control scale correlated with those on the diabetes locus of control scale ($r_s = 0.42$, $p = 0.0005$, $n = 139$, Spearman's rank correlation). As given in Table 5, the sum scores for dental locus of control beliefs had a moderate positive correlation with those for diabetes locus of control in all groups when stratified by sex, age, basic and further education.

Table 4. Descriptive data of sum scores on locus of control scales.

Scale	Cronbach's α	Range	Median	Quartile limits
Dental locus of control	0.60	19–32	28	25 and 30
Diabetes locus of control	0.70	14–32	27	24 and 29

Relations of the value dimension to locus of control scales

It was found that those reporting higher value for dental health had a more internal dental locus of control than the others ($p = 0.008$, Mann-Whitney U-test). Correspondingly, subjects who reported a higher value for diabetes health had a more internal diabetes locus of control than the others ($p = 0.023$, Mann-Whitney U-test).

Relations of dental locus of control scale to demographic variables, reported oral health behavior, and oral indexes

The dental locus of control was found to be related to various demographic variables: the women had a more internal locus of control than the men ($p = 0.002$, Mann-Whitney U-test), and the younger had more internal locus of control than older ($r_s = -0.28$, $p = 0.001$, $n = 147$, Spearman's rank correlation). Also, those who had completed high school ($p = 0.001$, Mann-Whitney U-test) and those who had a university or college qualification ($p = 0.009$, Mann-Whitney U-test) had a more internal dental locus of control than the others.

The frequency of brushing was found not to have any association with dental locus of control, but those reporting a higher frequency of dental visits had more internal dental locus of control sum scores ($p = 0.040$, Mann-Whitney U-test). When analysing this association separately among those having high or low dental value, it was found that in the low dental value group those visiting the dentist at least once a year had more internal dental locus of control than those who visited the dentist less often ($p = 0.043$, Mann-Whitney U-test).

Furthermore, it was found that those having a more internal dental locus of control had better oral health, as reflected in negative correlations between oral indexes and

Table 5. Stratified Spearman's rank correlations (r_s) between the diabetes locus of control scale and the dental locus of control scale.

Scale	Stratification	n	Diabetes locus of control r_s	p-value
Dental locus of control	Men	82	0.41	0.0005
	Women	57	0.39	0.003
	16–26 y	45	0.48	0.001
	27–39 y	48	0.33	0.022
	40–72 y	46	0.44	0.002
	Lower basic education	94	0.39	0.0005
	Higher basic education	46	0.58	0.0005
	Lower further education	85	0.44	0.0005
	Higher further education	55	0.43	0.001

Table 6. Spearman's rank correlations (r_s) between the dental locus of control scale and dental indexes (non-stratified and stratified by reported value).

Dental index	Dental locus of control r_s (p-value) n	Dental locus of control – high dental value r_s (p-value) n	Dental locus of control – low dental value r_s (p-value) n
Gingival bleeding	−0.01 (0.890) 147	−0.11 (0.391) 63	0.04 (0.731) 80
Visible plaque	−0.18 (0.034) 147	−0.23 (0.066) 63	−0.04 (0.722) 80
Decayed surfaces	−0.23 (0.006) 146	−0.28 (0.026) 63	−0.14 (0.230) 79
Root caries	−0.22 (0.009) 147	−0.37 (0.003) 63	−0.13 (0.258) 80

dental locus of control. Significant correlations were found with visible plaque index, decayed surfaces and with root caries surfaces (Table 6). As also seen in Table 6, correlations between dental locus of control and dental caries and root caries strengthened among those having high value for dental health.

When analysing crossing effects of dental locus of control to diabetes adherence and HbA_{1c} level, there were no associations between these variables.

Relations of diabetes locus of control scale to demographic variables, reported diabetes adherence and HbA_{1c} level

The duration of diabetes was not associated with the sum scores for diabetes locus of control. As far as the demographic variables were concerned, only age associated with the sum scores on the diabetes locus of control scale ($r_s = -0.22$, $p = 0.010$, $n = 140$, Spearman's rank correlation) with the younger having a more internal locus of control than older persons.

The sum scores for diabetes locus of control correlated only weakly with reported diabetes adherence ($r_s = 0.17$, $p = 0.052$, $n = 139$, Spearman's rank correlation), and they did not correlate with the mean HbA_{1c} level ($r_s = -0.04$, $p = 0.641$, $n = 122$, Spearman's rank correlation). When stratifying by the value of diabetes health, no significant correlations were found between diabetes locus of control and adherence and HbA_{1c} level in any of groups.

There were no associations between diabetes locus of control and oral health behavior and oral indexes.

Discussion

One aim of this work was to evaluate the associations between dental and diabetes locus of control beliefs, and significant correlations between them support the proposal of Rotter (1) that locus of control beliefs may be generalized to other related forms of behavior. Locus of control beliefs could predict oral health behavior and dental caries quite well, but not diabetes variables. The correlations between dental locus of control beliefs and oral status are noteworthy, because the locus of control theory assumes the relationship only between locus of control beliefs and behavior.

Our results concerning significant, although low to moderate, relations between locus of control beliefs and dental caries as well as plaque index highlight the possible usefulness of oral indexes when analysing oral health behavior. This could be explained by the fact that items analysing reported health behavior concentrate on the frequency, the quality of behavior not being evaluated. Further, brushing the teeth is usually a habitual form of behavior which is learned in childhood and is not necessarily related to perceived health in adulthood (26). As far as diabetes is concerned, the complex nature of care, involving insulin injections, diet, exercise, and the measuring of blood sugar levels, and further the active participation of healthcare professionals in diabetes care, affects the relation between locus of control beliefs and diabetes adherence. HbA_{1c} level is also affected by adherence and by many biological factors, and it is not a surprise that locus of control beliefs do not significantly relate with it.

The other aim was to evaluate the importance of the value dimension. There were clear associations between more internal diabetes and dental locus of control beliefs and reported high values attached to care. However, consideration of the value aspect did not predict the reported diabetes and oral health behavior any better, in contrast to the proposal of Rotter (1). On the other hand, the associations between dental locus of control beliefs and oral indexes were strengthened when only persons with a high value were considered. According to our results, the value dimension may be useful to take into account at least when analysing associations between dental locus of control and dental health status. When developing the locus of control theory, Wallston et al. (27) proposed a multidimensional health locus of control scale, which includes also two kinds of external dimension in addition to internal beliefs, namely chance and powerful others. We have measured here the pure internal–external dimension, but our scale included items touching upon all these dimensions.

According to other studies (28, 31), it has been found that education and sex have relations with behavior and health status. We found relations between locus of control and both background variables, health behavior, and health status. There seems to be a complex correlation network in which it is difficult to specify the hierarchical position of a psychological factor, such as locus of control beliefs are. As a result, it is not relevant to use multivariate analysis with locus of control beliefs as an independent variable predicting health behavior.

The credibility of the results is dependent on the quality

of the scales, which was ensured here by using modified versions of the ones used and analysed earlier. The alpha reliability coefficients obtained for the scales here were moderate to good. Patients' answers may be realistic, but they may also reflect their ideal perceptions of self-care (22). Further, the patients' level of knowledge can lead to an overestimation or underestimation of their own health behavior. Social desirability may not be a major problem here, because the participants were not personal patients of the researchers. In addition, they were instructed to answer the questionnaire without thinking of what was the right or wrong way of doing things and answers were also coded anonymously. There is also some loss of information when dichotomizing the variables, but it was necessary for statistical analysis.

As far as the proposed hypotheses are concerned, it has been shown that there is indeed a similarity in dental and diabetes locus of control beliefs. But, predictive value of locus of control beliefs for health behavior and health status is questionable, especially with diabetes variables. Thus, it is proposed that locus of control beliefs seem to be quite health behavior specific.

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