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Relationship of Locus of control with Plaque and Gingival status before and after Oral Health Education in a group of college students – An experimental study

Abstract: *Objectives:* In health psychology, several models are being constructed to understand human behaviour. Multidimensional health locus of control (MHLC) is one among them. We sought to know the relationship of MHLC with dental plaque and gingival status before and after oral health education programme among 286 college students, aged 18–21 years in Davangere city. *Methods:* Multidimensional health locus of control questionnaire consisting of questions measuring internal health locus of control (IHLC), powerful others health locus of control (PHLC) and chance health locus of control (CHLC) was administered to students. Dental plaque and gingival health status were recorded using Plaque Index (PLI) and Gingival Index (GI), 1967. Oral health education was provided using power point presentation after the baseline oral examination. After 10 weeks of intervention, the students were given the same proforma followed by the assessment of plaque and gingival status. *Results:* A negative correlation was observed between PHLC and IHLC with PLI and GI and positive correlation of CHLC with PLI and GI at a level of $P < 0.01$. The difference between 'pre-test' and 'post-test' mean PLI scores, GI scores, PHLC was found to be statistically significant at a level of $P < 0.05$. *Conclusion:* Oral health education was found to be effective and this could change the behaviour of individuals.

Key words: Gingival Index; multidimensional health locus of control; oral health behaviour; oral health education; Plaque Index

Introduction

Health of the people is in reality the foundation upon which all their happiness depends. Health is a basic human right that is essential for satisfying the basic needs and it largely determines the quality of life (1). Understanding the psychological and social factors influencing the health of individuals and society is a very complex process. Hence, these factors must be taken into consideration not only in defining and measuring health, but also in maintaining health. Health can be maintained and improved not only through the advancement and application of health sciences, but also through the intelligent lifestyle choices of individuals and society. Promoting such healthy lifestyle choices is the domain of public health. People are benefited from health promotion interventions

when given at an early age (2). Such interventions require an understanding of their attitudes, beliefs and behaviours pertaining to their health.

Health behaviour models are often utilized for understanding of a particular behaviour and its relationship with health. A myriad of factors influences the health behaviour and ultimately health status. Several attempts have been made to associate health-related behaviour including dental health behaviour with specific dimensions of a personality. Such studies have showed mixed results, although one such construct, health locus of control has shown some potential for predicting preventive health behaviours (3). Historically, most of the work linking perceived control and health evolved from Rotter's social learning theory. '*Locus*' the Latin word for 'place' was dichotomized by Rotter in to internal and external locus of control. Rotter's locus of control is designed to assess the beliefs people have regarding the control over what happens to them. Internal locus of control refers to the degree to which an individual perceives that events that occur to them are causally related to their own behaviour. When perception of a causal relationship is strong, the individual is described as high in internal locus of control. When events are perceived as determined by outside forces over which the individual has little or no control, then it is called as external locus of control. Another model which explains locus of control is 'multidimensional health locus of control' which was introduced by Wallston *et al*. in 1978. It is also divided into internal and external locus of control as in Rotters. Additionally, in this model, the external health locus of control is further divided as 'chance/luck health locus of control' which describes chance or luck of an individual in determining his/her own health and 'powerful others health locus of control' which includes family members and health professionals who are important in determining health of an individual (4). Locus of control beliefs could predict corresponding health behaviour.

General health and oral health influence each other. Studies have been conducted to know the association between general and oral health behaviours. In most of the studies, a strong association existed between them (5–8). Oral health problems are also related to the social, psychological, behavioural and environmental factors just like general health problems. Locus of control which is a general health-related psychological parameter can also be utilized to assess its relationship with dental health and disease. Multidimensional health locus of control is a general construct of overall health behaviour which was linked to dental caries and periodontal disease in some studies (9, 10).

A person's behaviour can act as a double-edged sword. It may be the cause of a health problem in some instances, and it may be the solution in some circumstances. Behaviours that are not appropriate might need modification and reinforcement of the desired behaviour. There is a need to identify health-promoting behaviours which can influence effectiveness of health care. Behaviour towards oral health can be identified using locus of control models as well as through other models (11, 12). Health education is a part of overall health promotion. It is a result of the efforts made on the part of the organized society to help people learn to live healthy (13). Its full scope covers many diverse areas, one of which is dental health. Dental professionals play an important role in promoting oral health through oral health education programme. Once the behaviour of individuals is identified by applying certain models like multidimensional health locus of control scale, then the goal of the researcher should be to encourage positive behaviour as well as to try for modifying the existing negative behaviour towards oral health. It could be performed by providing appropriate oral health education for different individuals. Effective utilization of the educational approach helps in widespread improvement of oral health (14). Literature search reveals that limited studies have been conducted relating multidimensional health locus of control with dental plaque and gingival health status before and after oral health education programme. Hence, an attempt was made to assess the relationship of multidimensional health locus of control with dental plaque and gingival health status before and after oral health education programme among 18- to 21-year-old college students in Davangere city.

Our null hypotheses (H_0) are as follows: (i) there is no relationship between multidimensional health locus of control with respect to dental plaque and gingival health status among 18- to 21-year-old college students, and (ii) there is no difference in multidimensional health locus of control with dental plaque and gingival health status before and after oral health education programme among the same study subjects.

Study population and methodology

This study is an experimental study (interventional, within-group design) conducted to assess the relationship of multidimensional health locus of control with dental plaque and gingival status before and after oral health education programme in a sample of 18- to 21-year-old college students in Davangere city.

Ethical clearance and consent

Ethical approval for the present study was obtained from the regional institutional review board. A voluntary written informed consent was then obtained from study subjects.

Preparation of special proforma

A proforma consisting of details of the study was prepared to collect the required data. The proforma was prepared in both English and in local language (Kannada) to facilitate better understanding of the questions by the study subjects. Back-translation method was used to make both the English and Kannada formats of the questionnaires consistent and identical. In case of inconsistencies, the necessary modifications were made in the Kannada proforma. The proforma was divided into four sections. In the first section, details of the

study and the investigator were given. It also had the provision to record the informed consent of the subject to participate in the study. The second section had questions related to the socio-demographic details of the subject such as age, gender, educational status, parents' education, income and occupation. The third section contained questions on multidimensional health locus of control scale (MHLC). The scale consists of 18 items comprising three-six-item subscales comprising internal health locus of control scale (IHLC), powerful others health locus of control scale (PHLC) and chance health locus of control scale (CHLC) on a response format of six-point scale which includes strongly disagree, moderately disagree, slightly disagree, slightly agree, moderately agree and strongly agree. The fourth section had a provision of recording Plaque and Gingival Index by Loe and Sillness, 1967, respectively.

Details of the pilot study

A pilot study was conducted to check the reliability of the multidimensional health locus of control scale (MHLC). Thirty college students aged 18–21 years were randomly selected from a degree college for the pilot study. The Cronbach's α value for internal consistency of the MHLC scale was 0.85 with a reliability coefficient $r = 0.78$ at $P < 0.01$.

Sample size estimation

Probability of committing type I error (α) was fixed at 5%, probability of committing type II error (β) was fixed at 20%, and power of the study was 80%. Minimum expected difference between 'pre-test' and 'post-test' value was 10%. The total number of subjects would be 219 according to standard table for sample size determination (15). Adjusting for anticipated non-response and partial response, the sample size was increased by 37% (300 students).

Eligibility criteria

College students pursuing for degree courses like Bachelor of Arts, Bachelor of Science, Bachelor of Commerce and Bachelor of Business Management courses studying in Davangere city belonging to age group of 18–21 years were eligible to participate in the study. Mentally ill subjects, subjects undergoing orthodontic treatment, subjects revealing history of any systemic disease which has an influence on oral health like diabetes mellitus and HIV, and those who did not give consent were excluded.

Sampling methodology

Simple random sampling (lottery dip method) was employed to select the three institutions/degree colleges in Davangere city. From each institution, two classrooms were randomly selected. Finally, in each institution, 100 students were chosen for the study based on selection criteria.

Calibration

The calibration of the examiner for recording Plaque Index and Gingival Index (Loe and Sillness, 1967) was done by recording PLI scores and GI scores by the examiner followed by recording PLI and GI scores by a faculty member for the same study subjects. The kappa coefficient scores were 0.77 and 0.75 with respect to PLI and GI. To reduce intra-examiner variability, some of the subjects were randomly selected and the same investigator administered test at baseline and after 48 h. The kappa coefficient scores were 0.81 and 0.76 with respect to PLI and GI.

Administration of the questionnaire and oral examination

The questionnaire was explained by the investigator before the subjects started answering it. Intra-oral examination was carried out by a single calibrated examiner. Oral examination was performed in the respective classroom of the research subjects. The subjects were made to sit comfortably on an ordinary chair, and the oral cavity was examined under natural lighting condition. The proforma had the provision to record Plaque Index and Gingival Index (Loe and Sillness, 1967). Instruments used for recording Plaque Index (PLI) and Gingival Index (GI) included straight probe/explorer and a mouth mirror. The tooth to be examined was air-dried. To assess plaque, the explorer or probe was passed across the tooth surface in the cervical third and near the entrance to the gingival sulcus. To assess gingivitis, a blunt straight probe was used to assess the bleeding potential of the tissues by gently passing the probe across the gingival sulcus. The four gingival areas of the each tooth are examined for both indices which included the distofacial, facial, mesiofacial and lingual surfaces. Each surface of a tooth was scored separately and added; then, it was divided by the number of surfaces examined. Third molars were not examined or scored. The data obtained were treated as a continuous scale based on the scores obtained from individual subjects. After obtaining the baseline data using questionnaires and oral examination, a specially prepared power point presentation was delivered by the examiner to all the selected students.

Oral health education

Health education was given for 100 people at each time, and a total of 300 students were provided with oral health education. The presentation contained information about the importance of teeth, types of dentition, aetiology of various oral diseases such as caries, gingivitis, malocclusion, oral cancer, dental trauma, dental fluorosis and periodontal disease. Information was also given regarding prevention and management of oral diseases which included information about how to use dentifrice, dental flossing technique, tooth brushing technique, about various preventive, restorative and rehabilitative services available and the role of self-care in attaining and maintaining good oral hygiene and thus good oral health as well as good

general health. After 10 weeks of intervention (power point presentation), re-examination was carried out by the same, single calibrated examiner to assess plaque and gingivitis among same individuals along with collection of data using same questionnaire. A total of 286 students were available at 'post-test'. Fourteen subjects (4.6%) dropped out from the study.

Data compilation and presentation

Data obtained were compiled systematically in Microsoft Excel sheet, and a master table was prepared. Statistical analyses were performed using SPSS version 11.5, (SPSS Inc, Chicago, IL, USA). Data comparison was made by applying specific statistical tests to find out the statistical significance of the obtained results. Depending upon the nature of the data, the statistical tests were chosen. Continuous data were analysed by applying Pearson's correlation coefficient test, unpaired t-test and paired t-test. Pearson's correlation coefficient test was applied to check the relationship of MHLC with PLI and GI. Paired t-test was applied to compare the 'pre-test' data with that of 'post-test' data.

Results

A total of 300 subjects were recruited for the present study at baseline (before oral health education programme). After oral health education programme (10 weeks), a total of 286 subjects were available. The final analysis was carried out among 286 subjects. All 286 participants provided the required data for analysis, and there was no missing data with respect to those participants. Information regarding age- and gender-wise distribution of study subjects is provided in Table 1. Socioeconomic status of the study subjects was calculated based on modified Kuppuswamy scale which considers education, occupation and per capita income of individuals (16). According to modified Kuppuswamy scale, five subjects (1.7%) belonged to upper social class, 21 subjects (7.3%) belonged to upper middle class, 125 (43.7%) to lower middle, 125 (43.7%) to upper lower and 10 subjects (3.5%) to lower social class. When different socio-economic classes were compared with the various subscales of MHLC scale as well as plaque and gingival status, no statistically significant differences were observed with $P > 0.05$.

Pearson's correlation coefficient test showed negative correlation of PHLC with PLI and GI with $r = -0.38$ and $r = -0.35$, respectively, at a significance level of $P < 0.01$, indicating that as the PHLC score increases, there is a decrease in PLI and GI scores. IHLC also showed a negative correlation with PLI and GI at a level of $P < 0.01$, indicating that with increase in IHLC score, there is a decrease in PLI and GI scores. There was a positive correlation between CHLC and PLI as well as GI scores (Table 2). There was a statistically significant difference between mean plaque score (PLI-1) at baseline as compared to plaque score at 'post-test' (PLI-2) at a level of $P < 0.05$. There was also a statistically significant difference between mean GI-1 score (1.35) at baseline as compared to mean GI-2 score (1.13) at 'post-test' (Table 3). A statistically significant difference was observed between mean PHLC-1 score at baseline as compared to mean PHLC-2 score (post-test) at a level of $P < 0.05$. There was no statistically significant difference between IHLC and CHLC scores at 'post-test' when compared to 'pre-test' scores (Table 4). Table 5 shows distribution of PHLC, IHLC, CHLC, PLI and GI scores with respect to males and females during 'pre-test' period. There was a statistically significant difference for PHLC, IHLC, CHLC, PLI and GI scores with respect to males and females at a level of $P < 0.05$.

Discussion

The Ottawa charter defines health promotion as the process of enabling individuals and communities to increase control over the determinants of health and thereby improve their health (17). More the individuals are empowered, more is the control they have towards their health. There is a need to identify how community-based programmes could be made effective in promoting health. In the present study a broader concept called multidimensional health locus of control is being utilized to assess its relationship with dental plaque and gingival health status before and after oral health education among 18- to 21-year-old college students in Davangere city.

Reason for selecting college students aged 18–21 years

WHO defines 'adolescents' as individuals in the 10- to 19-year age group and 'youth' as the 15- to 24-year age group. These two overlapping age groups are combined in the group 'young people' covering the age range 10–24 years (18). Adolescence

Table 1. **Age and gender distribution of study subjects**

Age (Years)	Gender		
	Males n (%)	Females n (%)	Total n (%)
18	54 (18.9)	54 (18.9)	108 (37.8)
19	52 (18.2)	59 (20.6)	111 (38.8)
20	26 (9.1)	20 (7.0)	46 (16.1)
21	14 (4.9)	7 (2.4)	21 (7.3)
Total (n%)	146 (51.0)	140 (49.0)	286 (100)

n = Number of individuals, % = percentage.

Table 2. **Correlation between PHLC, IHLC and CHLC scores with PLI and GI scores during 'pre-test' period**

	PLI	GI
PHLC	−0.38 (**)	−0.35 (**)
IHLC	−0.27 (**)	−0.25 (**)
CHLC	0.53 (**)	0.48 (**)

**Pearson's correlation coefficient is significant at $P < 0.01$ level (two-tailed).

Table 3. **Difference between 'pre-test' mean PLI-1, GI-1 and 'post-test' mean PLI-2, GI-2 scores in the study subjects**

	Mean ± SD	Mean difference ± SD (CI)	t	P value
PLI-1	1.60 ± 0.55	0.25 ± 0.44 (0.19–0.30)	9.42	0.00*
PLI-2	1.36 ± 0.48			
GI-1	1.35 ± 0.51	0.22 ± 0.41 (0.17–0.27)	9.08	0.00*
GI-2	1.13 ± 0.46			

*P value significant at < 0.05 level (two-tailed).

Table 4. **Difference between 'pre-test' mean PHLC-1, IHLC-1, CHLC-1 and 'post–test' mean PHLC-2, IHLC-2, CHLC-2 scores in the study subjects**

	Mean ± SD	Mean difference ± SD (CI)	t	P value
PHLC-1	3.85 ± 1.18	−0.23 ± 1.24	−3.12	0.002*
PHLC-2	4.08 ± 0.93	(−0.37 to −0.08)		
IHLC-1	3.74 ± 1.16	0.02 ± 1.11	0.23	0.82
IHLC-2	3.73 ± 1.06	(−0.11 to 0.14)		
CHLC-1	3.54 ± 1.35	0.00 ± 1.26	0.00	1.00
CHLC-2	3.54 ± 0.96	(−0.15 to 0.15)		

*P value significant at < 0.05 level.

Table 5. **Gender based distribution of PHLC, IHLC, CHLC, PLI and GI scores during 'pre-test' period among study subjects**

	Gender	Mean ± SD	P value
PHLC	Males	3.65 ± 1.29	0.003*
	Females	4.06 ± 1.03	
IHLC	Males	3.48 ± 1.23	0.000*
	Females	4.02 ± 1.02	
CHLC	Males	3.32 ± 1.41	0.004*
	Females	3.78 ± 1.25	
PLI	Males	1.54 ± 0.54	0.03*
	Females	1.67 ± 0.54	
GI	Males	1.29 ± 0.52	0.03*
	Females	1.42 ± 0.50	

*P value significant at < 0.05 level (two-tailed).

is a phase of rapid growth and development during which physical, sexual and emotional changes occur. In the present study college students aged 18–21 years were included because it is considered as an important phase of transition from adolescence to adulthood (19). This age group is accessible and also available as social units in the colleges. Health education when given at an earlier stage has an impact on life and a change in behaviour might be expected and it could be retained for a longer time period. A thorough search of available literature showed that there is scarcity of studies assessing the relationship between locus of control with plaque and gingival status among this age group. Hence, this study was conducted among students aged 18–21 years.

Reason for using PLI and GI in the present study

The Plaque Index (Loe and Sillness, 1967) used in this study is unique among indices because it ignores the coronal extent of plaque on the tooth surface area and assess only the thickness of the plaque at the gingival area of the tooth. It is most widely used and has demonstrated good validity and reliability (20, 21). As it is used for whole mouth including four surfaces of each tooth excluding third molars, this index is also more sensitive. It is difficult to subjectively estimate plaque. To overcome this, a single trained examiner should record the findings. In our study, a single calibrated examiner performed all the examinations. Gingival Index (Loe and Sillness, 1967) used in this study is utilized most widely in several studies. This index is valid and reliable (22, 23). It is also sensitive because four surfaces of all individual teeth are considered except for third molars. In this index, not only bleeding on probing but also the colour changes and oedema of gingiva are also measured.

Reason for giving 10 weeks period after Intervention before collecting post-test data

To check whether the study subjects have changed their oral hygiene habits and to appreciate whether there is a change in gingival health status and plaque status, this time period was felt sufficient. A study conducted by Stenstrom U also gave a gap of 10 weeks after health education before collecting post-test data (24).

Reliability and validity of MHLC scale

The MHLC scale utilized in the present study was checked for its validity in a previous study conducted by Stenstrom U et al. in which it was found to be valid (10). The multidimensional health locus of control scale is validated in several other studies (23, 24). In the present study, the English version of the MHLC assessed through the questionnaire was translated in to a Kannada format, which was back-translated in to English to check for the validity. A pilot study was conducted among 30 individuals in the present study to check for the reliability of the questionnaires utilized. In our study, the Cronbach's alpha for MHLC scale was 0.85 as compared to a study conducted by Astrom AN et al. where the Cronbach's alpha was found to be 0.76 (24).

In the present study, socio-economic status of the participants was calculated based on modified Kuppuswamy scale which is most commonly used in India (16). A majority of the participants belonged to lower middle and upper lower social class. In our study, there was no statistically significant difference seen between socio-economic status and subscales of MHLC which are contrary to a study conducted by Acharya et al.(25). The probable reason might be because of unequal representation of the study subjects in different socio-economic strata in our study.

In the current study, correlation was observed between various subscales of MHLC at 'pre-test'. In a study conducted by Galgut et al., there was no correlation between any of the dimensions of the MHLC and clinical results. Only the IHLC dimension showed positive correlation with gingivitis at

baseline, and the subjects showed more inflammation at baseline, but there was a reduction in gingival inflammation at 'post-test' after intervention (8). Our study results are contrary to these results. People who have strong powerful others locus of control does not imply that they have poor perceived control. Many patients may believe that transferring control to a benevolent or competent health professional is an efficient means of gaining control over their health (26). It was conjectured that patients being influenced by powerful external factors would be receptive to advice on preventive care and would be likely to accept professional advice about the benefits of the treatment or oral hygiene instructions (27). Those subjects whose loci of control relate strongly to internal factors would probably be amenable to a preventive regimen that requires active participation by individuals in performing oral hygiene measures on their own regularly. They regularly engaged themselves in a health-maintaining behaviour which supports with our study results (28). If high IHLC score is proved to enable an individual to enjoy better oral health, then the steps necessary to strengthen IHLC should be undertaken. Subjects who believe that chance exerts the major influence on oral health would seem unlikely to respond well to the challenge of participating in a preventive programme. Accordingly, they are more likely to engage in health-damaging behaviour than those with low scores for CHLC (29). Our study results are in line with respect to CHLC with these results.

In the present study, there was a significant reduction in Plaque and Gingival Index scores at 'post-test' as compared to 'pre-test' scores. The intervention provided was oral health education. A systematic review on dental health education conducted by Kay EJ *et al.* in the year 1996 suggested that dental health interventions had a small positive, but temporary effect on plaque accumulation. However, there was no noticeable effect on caries increment and a consistent positive effect on the knowledge levels (30). In the present study, a statistically significant difference between 'pre-test' and 'post-test' mean score was observed with respect to PHLC. An increase in PHLC score after oral health education indicates that these individuals would engage themselves in health-promoting behaviour, which in turn might improve their oral health status. As per thorough literature search, we could not find any similar studies assessing MHLC subscales before and after oral health education programme which makes this study unique. In a study conducted by Gaber S, higher level of education and lower level of internal beliefs were related to better knowledge and safer use of pesticides among Egyptian farmers. In that study, it was recommended that strategies for raising internal beliefs must be included in health education programmes that aim to improve pesticides use among farmers (31). A statistically significant difference was observed between males and females with respect to PHLC, CHLC and IHLC scores in our study. There are no exact comparable studies with respect to these above-mentioned findings. In a review conducted by Adrian C *et al.*, locus of control construct was compared with the two gender groups. The research

suggests that both males and females are becoming more external with respect to locus of control. Females, however, tend to be more external than males on most locus of control measures. There are also gender differences in perceptions of control across behavioural domains. Internality, for example, appears to be more related to achievement for males than females and is a better predictor of social adaptation for females than for males (32).

Limitations of the study

The validity of the MHLC scale was not assessed prior to the main study. However, a study conducted by Stenstorm U suggests that the MHLC scale is valid. This scale is already used on people belonging to diverse social, economic and political backgrounds. Some biases might have crept into the present study which includes maturation bias, social desirability bias and response bias. Mean scores were derived from MHLC. It is not usually advisable to derive mean scores for qualitative variables. However, if the scale is made more sensitive, then mean scores could be derived and compared. In our study, we treated the output on the scales as continuous data as they are on five- to six-point ordinal scale. There was no comparison group for the present study. We cannot solely attribute the changes in locus of control and oral health behaviours to oral health education. A concurrent parallel design would have been more appropriate for the present study.

Further studies are recommended in future which plan to circumvent the limitations of the current study. Very few studies conducted in this direction pose a constraint for arriving at concrete conclusions. The age group for the present study is narrow, and the study results can only be generalized to this particular age group and subjects residing in Davangere city. Subjects involving wider age groups with very large and diverse population could be included in future studies so that the results could be generalized for the whole population. More research is needed to validate the results of this study and to further explore the complex psychosocial interrelationship of MHLC with oral health.

Clinical relevance

Oral health behaviour and oral health status are interlinked. Major oral health problems are associated with improper maintenance of oral hygiene which in turn depends on health-seeking behaviour. The amount of control individuals have on their health depends on behaviour. Multidimensional health locus of control scale is one such scale which enables clinicians to know the underlying health behaviour of their patients. By knowing and understanding patient's attitude and behaviour, management becomes easier.

Conflict of interest

The authors declare that they have no conflict of interests.

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