***Original Research Article***

# The effect of oral health instruction on knowledge, attitude and performance of pregnant women (Mashhad-Iran)


## Abstract

**Aim:**The current study investigated the knowledge and attitude of pregnant women regarding the importance of oral hygiene, considering its importance during pregnancy and its effect on maternal and fetal health.The effect of educating mothers about oral hygiene was also assessed.

**Methods and materials:** This study was performed on 203 pregnant women in Mashhad, Iran. The subjects were divided into two groups:102 in the control group and 101 in the intervention group. First, both groups completed a designed questionnaire on the field of knowledge and attitude, and then the DMFT index, Gingival Index (GI), and Plaque Index (PI) were calculated for each participant.Thenthe intervention group received oral health education. After three months, both groups completed the questionnaire, and the PI and GI were again calculated and compared with the initial values. The results were analyzed by the software SPSS version 11.5.

**Results:**Educational intervention significantly increased the knowledge (P = 0.017)of the participants, improved attitude (P = 0.045), and decreased PI (P = 0.005). However, mean reduction of GI was not significant (P = 0.113). In the control group, none of the variables showed significant change. At the beginning of the study, the variables of knowledge, attitude, PI, GI, and DMFT had a significant relationship with the level of the participants' education. Also, oral health indicators at baseline were significantly related to their knowledge and attitude.

**Conclusion:** Providing oral health education to pregnant women will improve their knowledge, attitude, and health performance.



**Keywords:** Pregnant women, Oral health instruction, Knowledge, Attitude, Gingival index



UNDER PEER REVIEW


## 1.Introduction:

Pregnancy is a physiological condition that is accompanied bymanyphysiological changes in the body,including various changes in the oral cavity(1, 2). These changes, including an increase in sexhormones, predispose pregnant women to oral infections and periodontal diseases(1-7), and

poor oral hygiene during pregnancy can affect the health of the mother and her child(6, 8, 9). For example, periodontal diseases increase the risk of complications of pregnancy, including preterm labor, premature birth, low birth weight, and preeclampsia(1-3, 7, 8, 10).Changes in quality and quantity of saliva during pregnancy, lack of oral hygiene due tonausea and mood swings(4), and inappropriate diet such as an increased tendency to eat carbohydrate(4, 7), also leads to an increase in dental caries in mothers(4).Conclusive evidence also exists stating that the transmission of cariogenic bacteria from mother to child leads to early childhood caries in children(1, 6, 11-13). Hence, maintaining good oral health and preventing oral diseases before, during, and after pregnancy, is an important aspect of general health for the mother and child(11). In addition, most mothers have misconceptions about losing their teeth during pregnancy and believe that each pregnancy causes the loss of one tooth(12). Therefore,proper knowledge, attitudes, and behaviors related to the oral health of pregnant womencan reduce oral problems, their complications during pregnancy, and eradicate wrong beliefs(1).

So far, many studies have been conducted on the knowledge and attitudes of pregnant womenregarding the importance of oral health during pregnancy. Although the results of these studiesvary, most of them have indicatedthat, globally including in Iran, pregnant women have little knowledge in this field. A study by Marc et al. in Australia has found that pregnant women consider general health to be more important than oral health, with only 35% seeking dental care during pregnancy(12). In a study by Adeniyi Abiola et al. in Nigeria, most of the study's subjects had demonstrateda reasonable level of knowledge and a positive attitude towards oral health, which could be due to the high education level of the study participants;however, the knowledge and attitudes of pregnant women were not reflected in their oral hygiene practices(11). A study by Ajesh George et al. in Sydney has found that very few pregnant women receive enough information about the importance of oral healthcare during pregnancy and monitoring their oral health was not a priority. In that study, the main reasons for not seeing a dentist included a lack of knowledge, concerns about the safety of dental treatment, and its high cost(7).

In Iran, some studies have been done aboutthe knowledge and attitudes of pregnant women regarding the importance of oral health during pregnancy. For example, Haji Kazemi et al. in a study in Shahriar, has shown that only a very small percentage of pregnant women haveadequate knowledge of oral healthcare, while most of them had a negative attitude(10).Also, the results of

UNDER PEER REVIEW

a study by Dr. Hosseinkazemi et al. in Babol have shown that although pregnant women were somewhat aware of their oral health status, they refused to see a dentist due to misinformation(4). The study ofBahri et al. in Mashhad has shown the positive effect of an oral health instruction on the knowledge, attitude, and short-term performance of pregnant women(14).

Several factors have motivated this study, such as the results of the above researches, the lack of a similar study conducted in Mashhad, the importance ofthe impact of oral hygine on maternal and fetal health, and the need to have information about the level of knowledge and oral hygiene of pregnant women for future planning of the health system. Therefore, this study was conducted to assess the knowledge and attitude of pregnant women about the importance of oral health and to examine the effect of education on the level of knowledge, attitude, and health performance of pregnant women.

## 2.Methods and materials

### 2.1. Sample and allocation

This study was an interventional study and was conducted from August 2018 to March 2019 in Mashhad, Iran. Sample size was calculated according to the results of the study of Bahri et al.(14), by considering $\alpha$=0.1 and $\beta$=0.2. The sample size in each group was 76 (152 in total), and due to possiblymissingthe follow-upsession (20%), the study was designed based on 90 subjects for each group (180 people in total) and performed on 203 subjects, of whom 54 participated in the follow-up session.The sample size was distributed within five main healthcenters of Mashhad according to the number of pregnant women. Then, the subjects studied in each center were selected by systematic sampling method. Thus, pregnant women were divided into two groups according to the day of referral, the intervention group on even days and the control group on odd days. The sample size was 101 in the intervention group and 102 in the control group, who were selected based on the inclusion and exclusion criteria. Inclusion criteriawere: living in Mashhad, absence of diseases affecting periodontal status (e.g., diabetes and coagulation disorders)(5, 14), not using medications that affectgingival health or cause abnormal bleeding (such as phenytoin, nifedipine, cyclosporine, enoxaparin, corticosteroids, calcium channel blockers, warfarin, and antibiotics over the past three months), no smoking, absence of previously known oral diseases(4), being in the first trimester of

UNDER PEER REVIEW

pregnancy,andhaving at least a primary school education(4, 5, 14).Exclusion criteria were: employment in professions related todentistry or medicine(5), failure to complete the questionnaire completely(4), and complications such as miscarriage, preeclampsia, bleeding and rupture of membranes(14).

### 2.2. Procedure

To protect the personal information of the participants and to prevent bias, every study subject was given a code. Participants completed the questionnaire after signing theinformed consent. The score of this questionnaire was recorded as the score of the pre-test questionnaire. A self-made questionnaire was used in the current study that was designed based on previous studies and credible references.Six oral and maxillofacial medicine specialists examined the questionnaire and confirmed its validity. The re-test method was used to check the reliability of the questionnaire. In this way, twenty pregnant women completed the questionnaire twice with three weeks interval, the correlation coefficient between the responsesin two stages was obtained r = 0.77 for the awareness section and r = 0.84 for the attitude section;which indicated the reliability of the questionnaire. The first section of the questionnaire included demographic characteristics such as age, month of pregnancy, order of pregnancy, education level, occupation, medical history, and history of drug use.The next two sections included questions that assessed participants' knowledge and attitudes toward oral healthcare during pregnancy. The knowledge section consisted of ten questions designed as a three-choice answer (yes, no, don't know) and its score was between -10 and +10. The attitude section consisted of eight phrases that were designed based on the four-point Likert scale (strongly agree, agree, disagree, and strongly disagree) and its score was between -16 and +16. The classification of the questionnaire score is shown in Table 1.

After completing the questionnaire, an oral examination was performed and DMFT, Gingival Index (GI), and Plaque Index (PI) were calculated for each participant according to the method that will be mentioned. The score of GI and PI was recorded as the score of pre-test oral health indicators.The GI and PI werecalculated by the Loe-Silness method(15) and the Turesky modification of the Quigley Hein method(16), respectively.The scoring scheme of these methods is shown in Table 2. According to the standard, GI = 0 healthy gum, GI = 0.1-1 mild

**Comment [SG1]:** WILL BE MENTIONED? Please mention it.

**Formatted:** Highlight

UNDER PEER REVIEW

inflammation, GI = 1.1-2 moderate inflammation, and GI = 2.1-3 severe inflammation were considered.

In the next step, the intervention group received oral health education in a combination of two methods of written (educational pamphlet) and verbal (face-to-face), whichbeing considered themost effective method for Iranians(17), they also received training on the proper method of toothbrushing and flossingusing an educational model by a final year dental student. The illustrated pamphlet was designedand explained in simple language about the importance of oral hygiene during pregnancy, consequences of poor hygiene, safety of dental procedures during pregnancy, correct method of brushing and flossing teeth with color images and recommendations for taking care of baby's oral health. The contents of the pamphlet were reviewed and approved by oral and maxillofacial medicine specialists of the Mashhad Dental School. The control group did not receiveany education.

Participants in the two groups weregiventhree months, and the intervention group was asked to read the educational pamphlet during this time and to brush and floss their teeth based on the instructed method. Both groups were followed-up three months later (the second trimester of pregnancy), and after completing the questionnaire, the PI and GI were calculated again. These scores were recorded as post-test questionnaire scores and post-test oral health indicator scores.

**2.3. Statistical analysis**

The results of pre-test and post-test scores were analyzed by the software SPSS version 11.5, and the statistical tests:Kolmogorov-Smirnov, t-test, Mann-Whitney, chi squared, one-way ANOVA, Kruskal–Wallis, and Pearson correlation coefficient. A significant level of 0.05 was considered.

**3.Results**

In this study, 203 pregnant women, 101subjects in the intervention group and 102 in the control group, were evaluated.Despite pursuing and phone calling,only 54 subjects (37in the intervention group and 17in the control group) participated in the follow-upsession. The range of age was 16 to 44 years with the mean of 29.69 ± 6.43. In terms of education, 32% had less than a high school diploma, 37.4% were high school graduates, and 30.6% had a college education.Fifty-seven women were in theirfirst pregnancy and one hundred and forty-sixwomenhad experienced multiple pregnancies. First, the normality of data distribution was examined using the Kolmogorov-Smirnov test. Pre-test knowledge in the control group (P = 0.016) and the DMFT,

UNDER PEER REVIEW

D, M, and F indices in the total sample size at the beginning of the study (P <0.001 for all four variables) had an abnormal distribution, and the other variables studied had a normal distribution (P >0.05). Then, the homogeneity of participants between the two groups was examined at the beginning of the study. The two groups were matched in terms of age (P = 0.317), education (P = 0.969), and all pre-test variables. The values of the pre-test variables, in both groups and in the total number of participants are shown in Table 3.

Due to the excessive lossof follow-up, the analysis was performed again to check the homogeneity of the followed-up individualsbetween the two groups in terms of age and education. The two followed-up groups were also homogeneous in terms of age (P = 0.298) and education (P = 0.695) and did not have significant differences.

Then, to investigate the effect of education on the intervention group, the differences between the two groups in terms of post-test scores were examined. After the intervention, the subjects of the two groups did not have a significant difference in terms of all post-test variables. The values of the post-test variables, in both groupsare shown in Table 4,separately.

In addition, the rate of changes of variables between the first and follow-up session was assessed in both groups using the paired t-test. According to Table 5, it was observed that in the intervention and control groups, knowledge and attitude scoresincreased in the post-test compared to the pre-test, but the increase was significant only in the intervention group (). In both groups, the post-test GI insignificantly decreased compared to the pre-test.In both groups, the post-test PI decreased compared to the pre-test, but the reduction was only significant in the intervention group.

Also, the rate of changes of variables in both groups,related to education levels, was investigated using the one-way ANOVA test. It was observed that different education levels did not show a significant difference for any variable in terms of the rate of changes of variables (P>0.05).

At the beginning of the study, the relationship between knowledge, attitude, and indicators of oral health with the education levels was examined for all participants (203 people) (Fig. 1).It was observed that there was a positive correlation between higher education levels and mean of knowledge, attitude and F index, and negative correlation between education levels and mean of

UNDER PEER REVIEW

GI, PI, DMFT, D and M indices.There was a significant difference between the different education levels regarding all variables (P <0.001) except the F index (P=0.056).

Also, at the beginning of the study, the relationship between the level of knowledge and attitude and with the indices of oral health was evaluated for all 203 participants. According to Table 6, knowledge and attitude had a positive significant correlation with each other (P <0.001), knowledge and attitude had a negative significant correlation with GI, PI, DMFT, D, and M indices (P <0.05), and knowledge and attitude had a positive insignificant correlation with the F index (P=0.824 and P=0.242 respectively).

The DMFT index was calculated at the beginning of the study for all 203 participants. The average of the DMFT, D, M, and F indices were 7.99 ± 3.42, 3.89 ± 2.34, 1.35 ± 1.64, and 2.75 ± 2.74, respectively. Since these indicesare not influenced by educationover a course of three months, they were not calculated after the intervention.

**4. Discussion**

In this study, oral health instruction improved knowledge and attitude and the meanoral health indices in the intervention group, although there was no significant difference between the two groups.This result could be due to participants missing in thefollow-up session or it could be related tothe improvement ofvariablesstudied in the control group due to obtaining information in this field through various sources such as mass media. Despite the improvement of variables in both groups, neither change in the control group was significant, but in the intervention group, all studied variables, except GI, improved significantly. Education level did not affect the rate of improvement of the variables, so probably the most effective factor in improving variables was the imparting of education to the intervention group.

Today, the use of systematic teaching methodsto improve health-related behaviors is increasing. The present study showed that most of the studied pregnant women did not have enough knowledge about the importance of oral hygiene during pregnancy, which could be due to the lack of adequate information of healthcare providers. In addition, the activity of mass media and print media, such as posters, brochures, health education pamphlets, is inadequate in this field and to date, their greatest focus has been on children and teenagers. Hence, it can be said that the vulnerable group of pregnant women has been somewhat neglected in this regard.

UNDER PEER REVIEW

Bamanikar et al. in India has stated that although 96.8% of the women studied knew that they had to have dental checkups by a dentist during pregnancy, only 55.9% of them had actually done so, indicating poor performance of pregnant women.Furthermore, 78.8% of the pregnant women had a positive attitude towards receiving a dental checkup after pregnancy(18).Two studies conducted in Iran have shown that most pregnant women had a negative attitude towards oral hygiene and dental procedures(10, 19). According to one of the studies, only 5.6% of those surveyed had adequate knowledge of oral hygiene, and there was a statistically significant relationship between knowledge with attitude, and knowledge and attitude with performance(10).

According to the results of our study, most pregnant women had low to moderate knowledge at the beginning of the study. Although the levels of knowledge in the intervention group improved significantly after being edified, post-test knowledge was not statistically significantly different between the two groups. Also, more than half of the studied subjects had a negative attitude and only 22.7% of pregnant women had a positive andcompletely positive attitude.Post-test attitude in the intervention group improved significantly and the participants' overall attitudes shifted from neutral and negative to positive. However, regarding knowledge, there was no statistically significant difference between the two groups regarding post-test attitude. It is important to note thatdifferent educationlevels, the difference insocial and economiclevels and the excessive loss of follow-upcan affect the results.For example, in the control group, only 17 out of 102 subjectsparticipated in the follow-up, signifying they valued oral health. Hence, their knowledge, attitude, and oral health indicators were better than the other studied subjects.

A study by Yalcin et al. in Turkey showed that PIand GI increased continuously in the pregnant womendue to an increase in progesterone during pregnancy(20).According to the results of the present study, despite teaching the correct method for usinga toothbrush and floss and a significant reduction in the PI in the intervention group, the rate of reduction of the GI was not significant. This can be due to an increase in sex hormonesand its possible effect on pregnancy gingivitis(2, 4-7).

According to the results of two studies (one inside and another outside of Iran), the health-related behaviors of pregnant women and the score of clinical indices were related to their level of education, so asthe education level increased, a decrease in GI and PI was observed(5, 20). The findings of the present study also showed that the level of knowledge, attitude, PI, and GI (as a

UNDER PEER REVIEW

representative of the oral health status) have a significant relationship with the level of education of individuals. In this way, aseducation level increased, mean knowledge and attitude increased andmean GI and PI decreased, indicating better oral hygiene.It can be assumed that having a higher education level is a way to get information and a better understanding of the importance of health and health concepts, leading to improved oral health practices. However, according to the findings of this study, the effectiveness of edification and the rate of improvement in knowledge, attitude, and indicators of oral health, had no relationship with the subjects' education levels. This result can be attributed to the small number of subjects who participated in the follow-up.

Bakhtiar et al. has reported that the DMFT index number in different cities of Iran is at a range of 5.2 ± 4.83 to 7.7 ±3.27. They stated that there is a positive relationship between oral health and the DMFT index, so that for each unit of increase in oral health, a 5% improvement in the DMFT index has been reported(21). In the present study, the mean of the DMFT index for those with a high school diploma or lower is higher than 8 and for the college educated group, it is close to 7. The value of this index is inversely related to the subjects' education levels. Also, the average of this index for all pregnant women studied was 7.99 ± 3.42.Comparing the value of this index in Mashhad with other cities in Iran and with other countries such as India (wherein the average DMFT index in a study of pregnant Indian women was 4.44 ± 3.68)(18), indicates that the mean DMFT index of pregnant womenis higher in Iran, particularly in Mashhad, and it needs more detailed research to introducepractical solutions.

In addition to the overall DMFT index, the relationship between D, M, and F indices and education has been evaluated separately. According to the results, the values of D and Mindices are inversely related to the level of education; thus, as the level of education increases, the average number of decayed teeth and extracted teeth due to decay decreases significantly. Unlike the previous indices, the F index has a positive relationship with education level, but this relationship is not significant. It can be said that people with higher education are more likely tocare fortheir decayed teeth, than not treating or extracting teeth. This shows that people with higher education pay more attention to maintaining their teeth.

The results of the present study show a significant positive relationship between knowledge and attitude and a negative relationship between knowledge and attitude with indices of oral health

UNDER PEER REVIEW

(GI, PI, DMFT). Therefore, increasing people's knowledge and improving attitude can positively affect their oral health.

Another issue to discuss is the large loss of follow-up due to the study subjects'lack ofparticipation.As mentioned earlier, 149 participants (64 in the intervention group and 85 in the control group) did not come for follow-up. Some of the reasons for not coming included: absolute rest, spontaneous abortion, inability to leave their workplace, and not coming despite agreeing to the allotted appointment.The last one, was the main reason for the high number of sample loss in both groups. This indicates that most pregnant women, even in the intervention groupdespite the education provided, did not understood the importance of oral health, which could be due to cultural issues and the lack of public media coverage such as television and magazines.

Therefore, it was concluded that the subjects' education levels did not affect their willingness to participate in follow-up session. In both groups, mothers with a second or more pregnancy had the highest rate of not participating in the follow-upas compared to the women who experienced their first pregnancy. Probably, women who had their first pregnancy were more concerned about their child's health and were more likely to come for follow-up.

According to a study by Michie, presenting the theory of behavior change wheel, health interventions should be done concurrently so as toreplace a previous behavior or habit. Therefore, a single intervention in a health center can increases the knowledge of pregnant women and changes their behavior in the short term. However, it requires simultaneous intervention in the national media, such as television and newspapers, the production and availability of educational programs and healthcare products, and supportive behaviors of healthcare providers, to help individuals understand the importance of this issueto guarantee the long-term sustainability of new behaviors(22).

UNDER PEER REVIEW

**5. Conclusion**

The results of this study showed that most of the pregnant women studied had low levels of knowledge and poor attitude about the importance of oral hygiene during pregnancy. It was also concluded that providing oral health education can be effective and improve the knowledge, attitude, and to some extent the oral health practices of individuals. Also,it was observed that the

level of knowledge and attitude were directly related, and oral health indicators were inversely related to the level of the participants' education. Therefore, people with more education have more knowledge about the importance of oral hygiene during pregnancy and better observe their oral hygiene. The advantage of the intervention in this study was that in both groups, regardless of the educationlevel, the intervention improved oral health indicators. Therefore, such interventions can be effective in reducing health inequalities, which is a goal of many health systems. So, it is recommended that oral health instruction be included in the guidelines for the care of pregnant women.

**References**


1. Ibrahim H, Mudawi A, Ghandour I. Oral health status, knowledge and practice among pregnant women attending Omdurman maternity hospital, Sudan. EMHJ. 2016;22(11):802-9.
2. Naseem M, Khurshid Z, Khan HA, Niazi F, Zohaib S, Zafar MS. Oral health challenges in pregnant women: Recommendations for dental care professionals. SJDR. 2016;7(2):138-46.
3. Mitchell JK, May RM, Arce R. Oral care for nurse educators part 3: Pregnant and perinatal patients. Teaching and learning in nursing. 2017;12(4):316-7.
4. Hosseinkazemi H, Zeinalzadeh M, Farsam F, Khafri S, Matloubi N. Pregnant women's self-report of oral health condition and its relation with oral clinical status. IJOGI. 2016;18(186):9-16.
5. Shamsi M, Hidarnia A, Niknami SH. Predictors of oral health care in pregnant women based on health belief model. HSR. 2012;11(3):624-34.
6. Thomas NJ, Middleton PF, Crowther CA. Oral and dental health care practices in pregnant women in Australia: A postnatal survey. BMC pregnancy and childbirth. 2008;8(1):13.
7. George A, Johnson M, Duff M, Ajwani S, Bhole S, Blinkhorn A, et al. Midwives and oral health care during pregnancy: perceptions of pregnant women in south-western Sydney, Australia. JCN. 2012;21(7-8):1087-96.
8. Radha G, Sood P. Oral care during pregnancy: Dentists knowledge, attitude and behaviour in treating pregnant patients at dental clinics of Bengaluru, India. JPFA. 2013;27(4):135-41.
9. Da Costa EP, Lee JY, Rozier RG, Zeldin L. Dental care for pregnant women. JADA. 2010;141(8):986-94.
10. Hajikazemi E, Hosseinmohseni SH, Oskouie SF, Haghani H. The association between knowledge, attitude and performance in pregnant women toward dental hygiene during pregnancy. IJN. 2005;18(43):31-8.
11. Adeniyi A, Agbaje O, Braimoh M, Ogunbanjo O, Modupe S, Olubunmi O. A survey of the oral health knowledge and practices of pregnant women in a Nigerian teaching hospital. AJRH. 2011;15(4):14-9.
12. Keirse MJ, Plutzer K. Women's attitudes to and perceptions of oral health and dental care during pregnancy. JPM. 2010;38(1):3-8.


UNDER PEER REVIEW

13. George A, Johnson M, Blinkhorn A, Ajwani S, Ellis S, Bhole S. Views of pregnant women in South Western Sydney towards dental care and an oral-health program initiated by midwives. HPJA. 2014;24(3):178-84.
14. Bahri N, Iliati HR, Sajjadi M, Boloochi T, Bahri N. Effects of oral and dental health education program on knowledge, attitude and short-time practice of pregnant women (Mashhad-Iran). Journal of Mashhad dental school. 2012;36(1):1-12.
15. Löe H, Silness J. Periodontal disease in pregnancy I. Prevalence and severity. Acta odontologica scandinavica. 1963;21(6):533-51.
16. Turesky S, Gilmore ND, Glickman I. Reduced plaque formation by the chloromethyl analogue of victamine C. Journal of periodontology. 1970;41(1):41-3.
17. Mohebbi S, Virtanen JI, Vahid-Golpayegani M, Vehkalahti M. A cluster randomised trial of effectiveness of educational intervention in primary health care on early childhood caries. Caries research. 2009;43(2):110-8.
18. Bamanikar S, Kee LK. Knowledge, attitude and practice of oral and dental healthcare in pregnant women. OMJ. 2013;28(4):288.
19. Gharizadeh N, Haghighizadeh MH, Sabarhaji W, Karimi A. A study of DMFT and oral hygiene and gingival status among pregnant women attending Ahvaz health centers. JSMJ. 2005(43):40-7.
20. Yalcin F, Eskinazi E, Soydinc M, Basegmez C, Issever H, Isik G, et al. The effect of sociocultural status on periodontal conditions in pregnancy. Journal of periodontology. 2002;73(2):178-82.
21. Bakhtiar K, Gharouni K, Gharouni B, Bastami F, Almasian M, Hosseintalai M. DMFT and OHIS indexs in the pregnant mothers: An explanation based on the health belief model. JCHR. 2018;7(1):1-10.
22. Michie S, Van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implementation science. 2011;6(1):42.

UNDER PEER REVIEW

Table 1: Classification of the questionnaire score

| Variable | Condition | Score |
|---|---|---|
| Knowledge | Very good | +7 to +10 |
| | Good | +3 to +6 |
| | Intermediate | -2 to +2 |
| | Poor | -6 to -3 |
| | Very poor | -10 to -7 |

| | | |
|---|---|---|
| **Attitude** | **Completely positive** | **+11 to +16** |
| | **Positive** | **+4 to +10** |
| | **Neutral** | **-3 to +3** |
| | **Negative** | **-10 to -4** |
| | **Completely negative** | **-16 to -11** |

Table 2: Gingival index and plaque index scoring

| Index | Status, Description | Score |
|---|---|---|
| **GI** | **Normal gingiva, no inflammation** | **0** |
| | **Mild inflammation: Slight changes in color, slight edema. No bleeding on probing** | **1** |
| | **Moderate inflammation: redness, edema. Bleeding on probing** | **2** |
| | **Severe inflammation: Marked redness and edema, ulceration, tendency to bleed spontaneously** | **3** |
| **PI** | **No plaque** | **0** |
| | **Separate flecks of plaque at the cervical margin of the tooth** | **1** |
| | **A thin continuous band of plaque at the cervical margin of the tooth** | **2** |
| | **A band of plaque wider than 1mm covering less than 1/3$^{rd}$ of the crown of the tooth** | **3** |
| | **Plaque covering at least 1/3$^{rd}$ but less than 2/3$^{rd}$ of the crown of the tooth** | **4** |
| | **Plaque covering 2/3$^{rd}$ or more of the crown of the tooth** | **5** |

Table 3: Values of pre-test variables in the intervention and control groups

| Variables | | Pre-test knowledge | Pre-test attitude | Pre-test GI | Pre-test PI |
|---|---|---|---|---|---|
| **Intervention group** | **Mean ± Std. Deviation** | **0.74 ± 2.18** | **0.24 ± 4.27** | **1.21 ± 0.56** | **3.07 ± 0.71** |
| | **Variation range** | **-5 to 6** | **-10 to 11** | **0.13 to 3** | **1.03 to 4.52** |
| **Control group** | **Mean ± Std. Deviation** | **1.16 ± 2.28** | **0.03 ± 3.88** | **1.23 ± 0.58** | **3.02 ± 0.82** |
| | **Variation range** | **-4 to 6** | **-10 to 12** | **0.00 to 3** | **1.25 to 4.84** |
| **Total** | **Mean ± Std. Deviation** | **0.95 ± 2.24** | **0.13 ± 4.04** | **1.22 ± 0.57** | **3.05 ± 0.77** |
| | **Variation range** | **-5 to 6** | **-10 to 12** | **to 3 0.00** | **1.03 to 4.84** |
| **P-value*** | | **0.129**** | **0.717*** | **0.779*** | **0.677*** |

*:T-test

**: Mann–Whitney test

UNDER PEER REVIEW

Table 4: Values of post-test variables in the intervention and control groups

| Variables | | Post-test knowledge | Post-test attitude | Post-test GI | Post-test PI |
|---|---|---|---|---|---|
| Intervention group | Mean ± Std. Deviation | 2.27 ± 3.02 | 1.78 ± 4.03 | 0.95 ± 0.66 | 2.58 ± 0.98 |
| | Variation range | -3 to 9 | -6 to 10 | 0.00 to 2.54 | 0.71 to 4.32 |
| Control group | Mean ± Std. Deviation | 1.18±1.67 | 0.59 ± 5.29 | 1.22 ± 0.48 | 2.65 ± 0.93 |
| | Variation range | -2 to 4 | -7 to 11 | 0.20 to 1.92 | 1.03 to 4.33 |
| P-value* | | 0.094 | 0.364 | 1.136 | 0.805 |

*: T-test

Table 5: Comparison of variable changes between pre-test and post-test in the studied groups

| Variables | Studied groups | P-value* |
|---|---|---|
| Knowledge changes | Intervention group | 0.017 |
| | Control group | 0.416 |
| Attitude changes | Intervention group | 0.045 |
| | Control group | 0.513 |
| GI changes | Intervention group | 0.113 |
| | Control group | 0.862 |
| PI changes | Intervention group | 0.005 |
| | Control group | 0.387 |

*Paired t-test

Table 6: Relationship between knowledge and attitude with oral health indices at the beginning of the study

| Variables | | Attitude | GI | PI | DMFT | D | M | F |
|---|---|---|---|---|---|---|---|---|
| Knowledge | Pearson correlation coefficient | 0.378** | -0.477** | -0.372** | -0.234** | -0.209** | -0.228** | 0.016 |
| | P-value | <0.001 | <0.001 | <0.001 | 0.001 | 0.003 | 0.001 | 0.824 |
| Attitude | Pearson correlation coefficient | | -0.312** | -0.356** | -0.142* | -0.151* | -0.218** | 0.083 |
| | P-value | | <0.001 | <0.001 | 0.044 | 0.032 | 0.002 | 0.242 |

**: Correlation is significant at the level of 0.01.

*: Correlationis significant at the level of 0.05.

UNDER PEER REVIEW

Figures

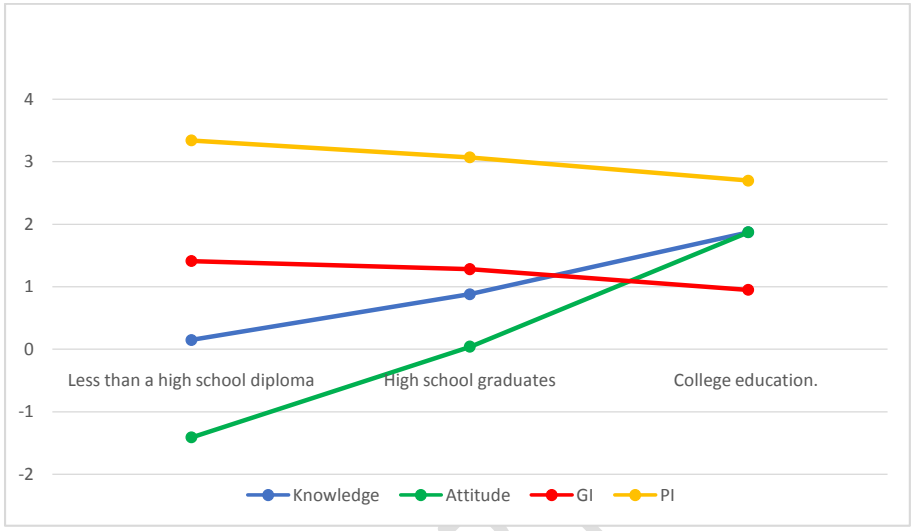


Figure 1. Comparison of the mean of knowledge, attitude, GI, and PI between different education levels

UNDER PEER