Kerman Oral and Dental diseases research center

Kerman University of Medical Sciences and Health Services

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Haapasalo M, Qian W: Irrigants and Intracanal Medicaments. In: Ingle JI, Bakland LK: Endodontics6. 6th ed. BC Decker Inc, Hamilton; Ontario, Canada. 2008; Chapter 28: 997-9.

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Neville BW, Damm DD, Allen CM, Bouquot JE. Oral and maxillofacial pathology. 2nd ed. Philadelphia: W.B Saunders Co.; 2002. pp. 533–87.

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Table of Contents

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Cleansing and preparation of data for statistical analysis: A step necessary in oral health sciences research

Hossein Molavi Vardanjani MSc, PhD[1], Ali Akbar Haghdoost MD, MSc, PhD[2], Arash Shahravan DDS, MSc, PhD[3], Maryam Rad PhD[4]

Review Article

Abstract

In many published articles, there is still no mention of quality control processes, which might be an indication of the insufficient importance the researchers attach to undertaking or reporting such processes. However, quality control of data is one of the most important steps in research projects. Lack of sufficient attention to quality control of data might have a detrimental effect on the results of research studies. Therefore, directing the attention of researchers to quality control of data is considered a step necessary to promote the quality of research studies and reports. We have made an attempt to define the processes of cleansing and preparing data and determine its position in research protocols. An algorithm was presented for cleansing and preparing data. Then, the most important potential errors in data were introduced by giving some examples, and their effects on the results of studies were demonstrated. We made attempts to introduce the most important reasons behind errors of different natures; the techniques used to identify them and the techniques used to prevent or rectify them. Subsequently, the procedures used to prepare the data were dealt with. In this section, techniques were introduced which are used to manage the relationships established between the premises of statistical models before carrying out analyses. Considering the widespread use of statistical models with the premise of normality, such premises were focused on. Techniques used to identify lack of normal distribution of data and methods used to manage them were presented. Cleansing and preparation of data can have a significant effect on promotion of quality and accuracy of the results of research studies. It is incumbent on researchers to recognize techniques used to identify, reasons for occurrence, methods to prevent or rectify different kinds of errors in data, learn appropriate techniques in this context and mention them in study reports.

KEYWORDS: Cleaning; Preparation; Statistics; Data; Quality Control

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Research in the field of health, like other fields, consists of structured efforts to answer a question or solve a problem. The procedural steps of a study consist of designing, making sure of the quality of study procedures, implementation of procedures, collection, quality control and analysis of data, and finally reporting the results of the study.

It is obvious that if a study is designed and implemented in a more academic and more accurate manner, the probability of finding appropriate responses for research questions will increase. Therefore, the quality control of data in all the stages of the study is very important. It is possible to define critical points for quality control of data in the research process, which might include the

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procedures of data collection, classification, coding and entry into a software program.[1] If the researcher does not make an effect to control quality of data at each of the critical points, it is possible that the accuracy of the study results will be severity compromised. However, despite the efforts made by researchers to control the quality of data, it is possible that human errors, especially in multicenter and national studies, will not be completely eliminated.[2]

Quality control of data at each critical point consists of efforts to identify errors and their types and to determine the best technique to deal with them, considering the existing condition. Let's give easy examples to review the most important potential errors in epidemiologic studies:

Example A

Suppose that a researcher in trying to answer the following questions: "What is the mean serum cholesterol level of elementary school students (under 10 years of age) and how many hours do they watch TV?" To answer these questions, the researcher should take a blood sample from all the students using standard tools and record the number of hours each student watches TV. If for some reason or another the researcher is forced to first take blood samples from the students and then determine the number of hours they watch TV, what will happen? You might have guessed the answer correctly; the number of hours some students watch TV cannot be determined and they will be "missing."

Example B

Now suppose that the researcher is entering the serum cholesterol levels of the students in example A, which have been recorded on special laboratory sheets, into a software program. The researcher unknowingly types the last digit of the serum cholesterol level twice (1100 instead of 110). If we suppose that the normal range of serum cholesterol levels is a circle, it can be imagined that the value 1100 has been "thrown" out of the circle.

Example C

Suppose that a researcher wants to estimate the incidence of different cancers separately in Iran using the data of the National Data Center for Registering Cancer Cases. To this end, the researcher needs to list the cancer cases separately in relation to tumor location, age, and gender. After preparing the list, the researcher realizes that the gender of some prostate cancer patients has inadvertently been recorded as female. The researcher knows that female gender and prostate cancer are not "consistent."

In the examples above, three types of errors in data were explained. A large number of examples can be given in which each type of such errors occurs due to a reason other than the above. The technique used to deal with each error is dependent, to some extent, on its cause. Therefore, it is necessary for researchers to be acquainted with different kinds of errors in data, their etiologic agents and the appropriate techniques to tackle them. A set of activities carried out to identify errors, the type of error and the possible etiologic agent and finally the technique used to tackle the errors found in data is referred to as "data cleaning."[3] Cleansing of data is one of the most necessary steps after collection of data and before analysis of data.[4] In the sections to follow, we have made efforts to review the general framework of this vital step. To being, figure 1 presents the process and the steps to cleanse and prepare data for statistical analysis, followed by the review of each step in the text.

Inconsistent data

We direct our attention to the example "C" above, in which during registration of data, a female patient had been registered as having prostate cancer. In this example, based on definition of gender, having prostate cancer is inconsistent with being a female. In general, the inconsistency of data is divided into two groups: definition-based and data distribution-based.[5]

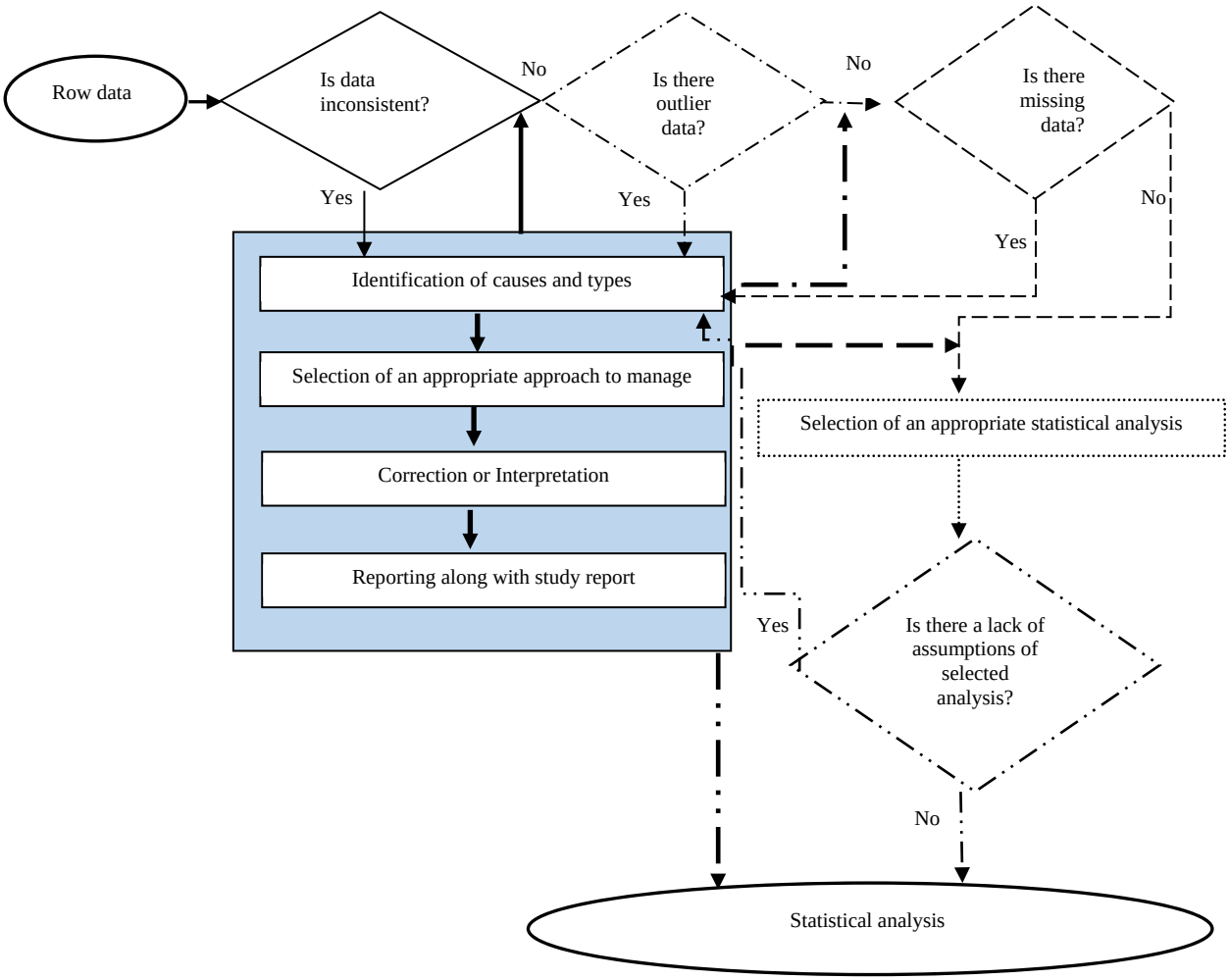

Figure 1. The process of cleansing and preparing data on health-related research

Therefore, outlier data, too, can be considered inconsistent data, which do not necessarily happen due to error. However, it is certain that inconsistency, based on definition of data, is due to errors. This type of error can cast doubts on the validity of study results. Therefore, it is necessary to evaluate the consistency of an individual's data with his/her other data and an individual's data with data from other individuals.

To evaluate the consistency of data, it is necessary to define and determine criteria for consistency of data before data collection and after entering data into the software program, consistency of data should be evaluated using the criteria defined. Such evaluation can be carried out with the use of crosstabs with qualitative variables. Drawing of such tables is very easy in many software programs, such as the following path in SPSS (SPSS Inc., Chicago, IL, USA):

SPSS → Descriptive Statistics → Crosstabs

In relation to quantitative variables, techniques can be used that are introduced in the section on outlier data and also on comparison of data with the possible minimum and maximum values for the variable.

SPSS → Descriptive Statistics → Descriptive

Errors during entering data into software programs

As disused previously, one of the critical points for the occurrence of errors in data is when the data are entered into a software program. The errors occurring at this stage can easily be identified and corrected. It is necessary to note that entering data into software programs does not always involve

entering data from forms or questionnaires into a software program. Sometimes, transfer of data between different software programs or combining data files can result in errors, especially in inconsistency between them. For example, suppose we have two files. In the first file, the gender has been defined as female = 1 and male = 2 and in the second file as female = 2 and male = 1. Although both files have undergone quality control before being combined, if the quality control of data is not carried out after they have been combined it is possible that all the previous efforts for the quality control of files will be compromised because finally data containing contaminated information will be used. Therefore, it is suggested that before combining or making any changes in data reassures be designed and implemented to prevent such errors.

Techniques used to prevent errors at the time of entering data into software programs are divided into two major groups.

1. Visual control of data: In this technique, the researcher compares the data entered with the data written on paper or data in the original file after entering all the data into the software program and corrects all the inconsistencies. A modified version of this technique is reading out data by one researcher and matching of data entered into the software program by another researcher.

2. Re-entering data: In this technique, the researcher enters the data twice into two separate files and then compares them and corrects the inconsistencies. Sometimes, a modified version of this technique is used, in which two researchers enter the data separately into the software program and then comparisons and corrections are made.

Both of the techniques above can initially be carried out for only a percentage of data and then decisions can be made to continue or stop the process.

Outlier data

In the example B above, 1100 mg/dl for serum cholesterol level is considered outlier data. Imagine that in the example B only one outlier data exists (1100 mg/dl = the serum cholesterol level of student X), and there are 100 students in the study, whose mean cholesterol serum level (n-1 = 99) is 120 mg/dl. With only this outlier data, the mean will increase from 120 mg/dl to approximately 130 mg/dl. It can be concluded that if similar cases of outlier data exist in this example the mean cholesterol levels will dramatically be overestimated.

If outlier data are not identified and corrected, they can influence the distribution of data, exerting detrimental effects on the results of the study. In summary, outlier data might increase variance and usually decrease the statistical power of analyses, alter the potential type I and type II statistical errors, decrease the normal distribution of data (if they occur in a non-random manner) and lead to bias in estimation of statistics.[6]

It should be pointed out that not all the outlier data occur due to errors.[7] In relation to the etiologic factors, outlier data can be classified into four groups as follows: due to errors in location, time and measuring technique and instrument, in reporting by the participants, in registering or in entering into the software program; due to sampling from different populations (If data of one population/group is erroneously entered into the data of another population/group, the data are called a "contaminant"); due to the skewness of the variable being measured (higher than the expected distribution for it); due to relatively rare occurrences(what mainly lead to influential observations).[8] After identification of outlier data, it is necessary to carry out further evaluations to identify their potential causes and make a proper decision about each outlier data based on these evaluations.

Various suggestions have been made in relation to the definition, identification and dealing with outlier data,[7] of which one useful suggestion is to classify these data into two groups of univariate and multivariate.

Univariate outlier data

In cases in which the amount of one variable for one subject is very different from the amount of the same variable for other subjects, that value is considered an outlier data (Example B).[4] One of the most common criteria for identification of such data in quantitative variables is to define ± 3 standard deviation (SD) from the mean value as a normal or expected range for the data (This value in the Schweinle method has been defined as 2.5-folds.). Based on this criterion, if one data is beyond the ± 3 SD range, it will be identified as an outlier data (This method will not be appropriate when the sample size is very small and the expected distribution of data is very different from the normal distribution). In other words, if the Z-score (Z-score is calculated by subtracting the numeric value of one variable from the mean of the same variable and the result is divided by the SD) of one data is > 3, it is considered outlier, requiring further evaluation. Why data beyond this range is considered outlier can be explained by the fact that if the distribution is normal, there is only a 0.26% probability that a data would be placed beyond this range. This percentage is a very low probability, and therefore, it is logical that the validity, mechanism of creation and accuracy of this data will be dubious.[9]

In addition to the calculation of the Z-score statistic, there are different other techniques, too, to identify outlier data. The most commonly used techniques are Grubbs' test, Dixon's Q-test, variance graphs, box histograms, and use of interquartile range.[10,11] The reader can refer to the relevant references for further details. Based on your choice for identification of outlier data, different pathways can be suggested in each software program. One of the easiest techniques in SPSS can be shown as follows:

SPSS → Analyze → Descriptive Statistics → Explore → Statistics → Outliers

Using this pathway, it is possible to request calculation of one of the robust methods to estimate a mean referred to as 5% trimmed mean.

Multivariate outlier data

A multivariate outlier data are a data which is not logical by considering several variables simultaneously.[4] For example, data of an individual with a height of 190 cm but a weight of 45 kg does not seem logical. Imagine the fact that in this example, having a height of 190 cm or a weight of 45 kg are not outlier data when considered separately. Leverage and discrepancy parameters are used to identify multivariate outlier data.

Leverage parameter shows how distant each observation is from other observations. However, this parameter cannot show whether an observation that is far from other observations is on the same track of other observations or not. In fact, the leverage parameter does not provide information about the direction of distance of one observation from other observations. To obtain this information, discrepancy parameter is used. Figure 2 shows how the two leverage and discrepancy parameters show the distance of one outlier data from other data.

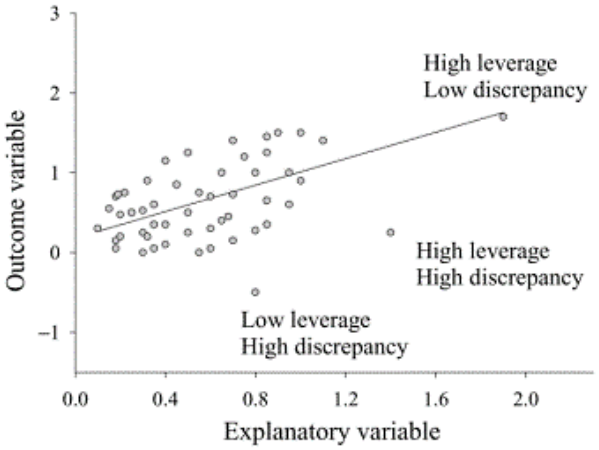

Figure 2. Leverage and discrepancy parameters for determining outlier data

Cook's distance (Cook's D) is a parameter which gives us a combination of leverage and discrepancy data. It tells us how much the regression coefficients will undergo changes if one observation is eliminated. To identify

influential outlier data through Cook's distance, the 4/(n−k−1) ratio is used, where "n" is the sample size and "k" is the number of independent variables.

How should outlier data be dealt with in your idea? As discussed above, it is necessary to carry out further evaluations to determine their etiologic factors and then take measures to correct, interpret or eliminate them. To this end, it is necessary to first check the accuracy of data by evaluating whether errors have occurred during measurements or during recording of data and whether errors have occurred during entering of data into the software program. If the answers to these questions are positive, it is obvious that it will be necessary to correct data. In the next stage, the following question is asked: "Has a subject out of the target population undergone a sampling procedure during sampling?" If the answer is "yes" one of the most acceptable techniques is to eliminate the outlier data from the analyses and pay attention to it at the data analysis stage.[5]

At this stage, the number of outlier data that cannot be corrected is of utmost importance. If the number of such data is insignificant relative to the sample size, e.g., one or two outlier data in a database with more than 100 samples, no significant changes will be observed in statistics and results. However, if there are multiple outlier data or if the sample size is small, other techniques should be used to mitigate the effects of outlier data, which include transformation of bases, truncation of distribution and use of robust methods.[12]

Missing data

Let's return to example A, where despite the attempts made by the researcher, it is not possible to collect data in relation to the number of hours some children watch TV. Statisticians call these data "missing data." It's no exaggeration if we claim that almost none of the quantitative data will be free of missing data (222-2-1801-2193). Missing data can result in serious bias in the results or a decrease in the power of statistical analyses.[13,14] The magnitude of such an effect depends on various factors, including the pattern of missing data and the reason for or mechanisms of their being missed and to a lower degree on the percentage of missing data.[15]

In general, missing data can be classified into three groups in relation to the mechanism of their occurrence. The "completely random missing" data occur when there is no regular difference between missing data and the observed data; in other words, the odds of being missed are equal for all the values of a parameter for all the participants in the study. Ignoring such missing data only results in a decrease in the statistical power of analyses, without any biases in the results. The premise of "completely random missing" data can only hold true for a limited number of cases. Lower levels of randomization can be found in "randomly missing" data.

The basis for defining the randomly missing data group is the fact that there are regular differences between the missing data and the observed data, but these differences can only be explained with the use of other variables which have been measured in the study. Remember example A. If we register the gender and age of all the students and can assume that missing of data on watching TV is only due to differences in the students' gender and age, the missing data in this example can be considered random. Certainly, the premise that all the missing data are random in all the studies is not rational, either. These data can be replaced with the use of a wide range of statistical techniques.[16,17]

In some studies, missing of data is dependent on variables which either have not been measured in the study or the values or measurements of some participants have been lost. This kind of missing data are referred to as "missing not at random" data. This type of error can significantly decrease the internal and external validity of the study results. A well-known example is the attrition

of participants in a clinical trial due to the side effects of the treatment modality used (in cases in which the side effects are not measured or evaluated). Different functional reasons lead to the missing of data, including a lack of response by participants to some specific questions, collecting data at more than one episode, incorrect sequence of measuring different variables, lack of familiarity of the researcher or interviewer with the techniques used to encourage cooperation and establish a constructive relationship, inappropriate conditions of the measurement environment, inattention to the cultural conditions and considerations of the participants, laziness, negligence and forgetfulness of the questioner or the individual in change of recording data, attrition of participants and errors during entering data into the software program.

Although it was explained above that one of the considerations in relation to the evaluation of the effect of missing data is the percentage of these data, it is less important than the mechanism and the pattern of missing of these data.[18] On the other hand, although some statisticians have suggested that 5-10% is the maximum acceptable level for such data, no accepted critical level has been defined for the percentage of missing data.[19]

In discussions on the pattern of missing data, it is possible to define three different patterns. Imagine a study in which the numerical values of variable K (V_1, V2,…, V_k) are measured: (1) If the values of one or more variables of some participants (e.g., V_2, V_1 or V_k) are lost, the missing data pattern is referred to as univariate. (2) Now suppose that values of V_5 are lost and as a result the data of V_6 to V_k are lost, too. This is due to the dependence of variables on one another or their time sequence. To understand this better, suppose that in a clinical trial with repeated measurements, V_5 is the fifth measurement, which is lost due to participant attribution. In that clinical study, it is highly probable that subsequent measurements will be lost due to the continuation of lack of cooperation. Therefore, in such situations, data will be lost from one point on. This pattern is referred to as homogeneous pattern. (3) In the third pattern, referred to as irregular pattern, values for each variable of some participants are lost in a random manner.

The best critical point to deal with missing data is during collection of data. In other words, prevention is always better than correction of this error. In addition, correction of such a serious deficiency in data is helpful and even necessary by replacing the missing data or values. Of course, before correcting such deficiencies, it is necessary to identify the details of the deficiency by analyzing the missing data.[3] There are various techniques to analyze missing data and replace them, which are beyond the scope of this article. A very important consideration is the fact that use of each technique and the validity of their results depend on various considerations and factors, such as mechanism, pattern, percentage of missing data, and sample size.

Management of missing data in statistical software programs, too, is of great significance, which can be useful in identification and proper management of such errors. Different statistical software programs use different signs to show missing data. One of the most important signs in this respect is point [.]. Use of a point with a numeric definition is better than the numeric symbols of 9 or 999 because if these numbers are not defined as codes for missing data, they might be considered real data during analyses and influence the results of the study.

In the majority of statistical software programs, special commands and menus have been designed for the analysis and replacement of missing data (due to the wide range of these items, they will not be discussed in detail here). In the early stages of reviewing data, it is possible to use the frequency command in different software programs (Analyze → Descriptive Statistics → Frequencies in SPSS). This command can determine the number of missing data for each variable.

Observations with various error types

In some cases, more than one error type mentioned above occurs in data in one observation (e.g., in data of one participant). In such cases, if the errors in the data still remain after referring to the registered documents of the observation in question (e.g., the paper version of the questionnaire of that participant), the best recommendation is to eliminate that observation. Therefore, if one or several variables of one observation are outlier data and some others are missing data, the best option is to refer to the paper documents of that observation. If the errors are not corrected, in the next stage, this observation will be eliminated and will not be included in the analyses of missing data.

Establishment of premises for the analysis of data

After the researcher evaluates the quality of data in the previous stages and corrects the deficiencies, it is necessary to select an appropriate statistical model for the analysis of data. In this context, there exist many important considerations. Here, it is necessary to note that the majority of statistical analyses have some premises and correct results will be obtained on the condition that they are established.[20] Another important consideration in the selection of an appropriate model for analysis of data is the fact that the researcher should select the simplest appropriate statistical model. Although discussions on the steps involved in selecting an appropriate statistical model is beyond the scope of this article, attempts have been made to review one of the most common steps in the following sections.[21]

Normality of distribution of data

As discussed previously, it is necessary to control the establishment of premises of the selected model for analysis of data. The premise of a relatively large group of simple and commonly used models for the analysis of quantitative data is normality of distribution of data.[20] Normality means that the histogram of data is similar to the normal distribution graph. There are different techniques to evaluate normality of data. A very important consideration is the fact that none of the techniques should be used as the only criterion for judgment. A correct decision for the normality of data is possible based on the results of several appropriate methods. In the following paragraphs, some of these methods will be explained.

Comparison of central parameters of data

In the normal distribution of data, the numerical mean, mode and median are equal and the same. Therefore, comparison of these three parameters can provide information about the normality of data distribution. For example, as the absolute value of the parameter D becomes smaller the distribution of data gets closer to normal distribution.

$$D = \frac{\text{Median} - \text{Mean}}{\text{Mean}} \times 100$$

Use of data distribution parameters and the properties of normal distribution

The range of changes of the variable can provide information about the normality of data distribution. To use the range of changes, one of the properties of normal distribution is used (in normal distribution, 95% of data lie within 2 SDs from the mean). To this end, the value "2 × mean ± SD" is calculated for the variable under question and compared with the range. If the difference is low (approximately 5%), the distribution is probably normal.[4]

The skewness and kurtosis parameters show the inclination of data to one-tail (a measure of horizontal symmetry of distribution). Skewness can be used in two-ways to make a decision about the normality of data distribution. One method is to make a decision about the severity and direction of skewness of "sample distribution" based on parameter value. There are different methods

to quantify skewness, but the aim of this article is not to explain these items. Therefore, suffice it to say that the amount of skewness of an ideal normal distribution is zero and for non-normal distributions it is a positive value (skew to the right) or a negative value (skew to the left). Therefore, skewness values from −1 to +1> mean severe skewness; values from −1 to −1.2 and from +1 to +1.2 mean moderate skewness and values from −1.2 to +1.2 indicate relative skewness.[22]

Another method is to calculate the skewness standard statistic values and carry out the statistical test to compare it with the critical value from −1.96 to +1.96 at a confidence interval (CI) of 95%. This technique will provide us with some information about the normality or non-normality of the "distribution of the variable in the population." It can be understood that the meaning of this awareness about what determines the amount of skewness is very different. To calculate the standard statistic of skewness, the parameter value is divided by the standard error. If the statistic is placed at a range from −1.96 to +1.96, the distribution of variable is not skewed; otherwise, the hypothesis of "not skewed" will be ruled out.[4]

If the hypothesis of "not skewed" is confirmed, it is necessary to assess the kurtosis of data distribution, too. Kurtosis shows the peakedness of the distribution summit in comparison to the summit of normal distribution. As discussed above in relation to skewness, in making decisions about the normality of distribution of data, it is possible to make two uses of the kurtosis parameter. If data are distributed normally, the numeric value of kurtosis will be 3. However, in some software programs (such as SPSS and SAS), the parameter value is not displayed and only the numeric value of the difference of distribution kurtosis from 3 is displayed, which might be a positive or a negative value. To use the kurtosis parameter, the "index value" is compared with 3 or the "numeric value of the difference of the parameter from 3" is compared with zero. If the parameter value is < 3, the distribution peak is shorter than the normal distribution peak (platykurtic), and vice versa (leptokurtic) and if it is equal to 3, the distribution peak height is equal to that of normal distribution (mesokurtic). The second use of the kurtosis parameter is the possibility of carrying out the statistical test with a premise that the kurtosis parameter is equal to 3. To achieve this aim, the procedures will be the same as those discussed above about skewness.

If the skewness and kurtosis of the distribution of the variable in question are similar to normal distribution, the premise of the normality of data distribution is confirmed; otherwise, the premise is ruled out. It should be noted that we have to consider other methods when we are going to decide on normality.[21]

To use any of the methods mentioned above, the descriptive statistics of each of the statistical software programs can be used to acquire the necessary information. For example, in the SPSS, it is possible to place the variable in questions on the dependent list in the following pathway:

Analyze → Descriptive Statistics → Explore

And calculate the parameter which is required.

Statistical tests

Although these tests alone cannot provide a definite response in relation to the normality of data distribution, if they are used correctly, they can provide more accurate responses compared to previous methods. Various statistical tests are available to evaluate normality of data distribution, the most commonly used of which are Shapiro-Wilk (S–W) and Kolmogorov–Smirnov (K–S) D test (Lilliefors test).

Each of these tests has specific characteristics, and they should be used based on the characteristics of data in question.

For example, S-W test will have a proper performance with a sample size of 7-2000. With larger sample sizes, other tests such as

Shapiro–Francia, Skewness–Kurtosis, and Jarque–Bera can be used. The K–S test has lower sensitivity to a lack of normal distribution of data compared to the S–W test.[22]

It is not possible to apply all the available tests for the evaluation of normality in any of the statistical software programs. However, it is possible to run the two commonly used tests of K–S and S–W with SPSS. The following pathway is available in SPSS for these two tests:

SPSS → Analyze → Descriptive Statistics → Explore →Plots → Normality plots with tests

To use the pathway above, it is necessary to select the lowest box of the explore window in one of the options of plots or both. The null hypothesis in both these tests is the normality of data distribution; therefore, statistical significance level of < 0.05 indicates the difference in the distribution of the variable in question relative to the normal distribution. If the results of both these tests show the normal distribution of one variable, the parametric statistical methods can comfortably be used for that variable. However, if the test results are significant and it appears that the distribution of data is not normal, it cannot reliably be claimed that non-parametric statistical methods should be used and this consideration should be kept in mind when the sample size is large. Another important consideration is the fact that these tests do not provide any information about the reason for non-normal distribution of data; therefore, attention should always be paid to other methods used to evaluate the normality of data, such as skewness and kurtosis variables and the graphs used to assess the normality of data, which will be discussed in the following section.

Graph-based methods

In one classification system, the methods used to assess normality of data are divided into two groups: numerical and graphical. Methods presented up to this point are all considered numerical methods. In the graphical methods, decisions are made based on comparison between different graphs with one definite and standard pattern. In this group, different types of graphs, including stem-and-leaf plot, detrended normal quantile-quantile (Q-Q) plot, Q-Q plot, histograms and (skeletal) box plots exist. In the following sections, each graph will be introduced. It should be pointed out that each graph contains different data and should be assessed differently.

Histogram

This graph provides visual data on the nature of distribution and its similarity to the bell-shaped graph in the normal distribution based on the frequency of drawn observations. If a gap exists in data in this graph or the distribution of data has more than one mode, it will be identified. In addition, outlier data and their distance from other data can somehow be identified by looking at the graph. Figure 3 (A and B) is examples of histograms with normal and non-normal distributions, respectively.

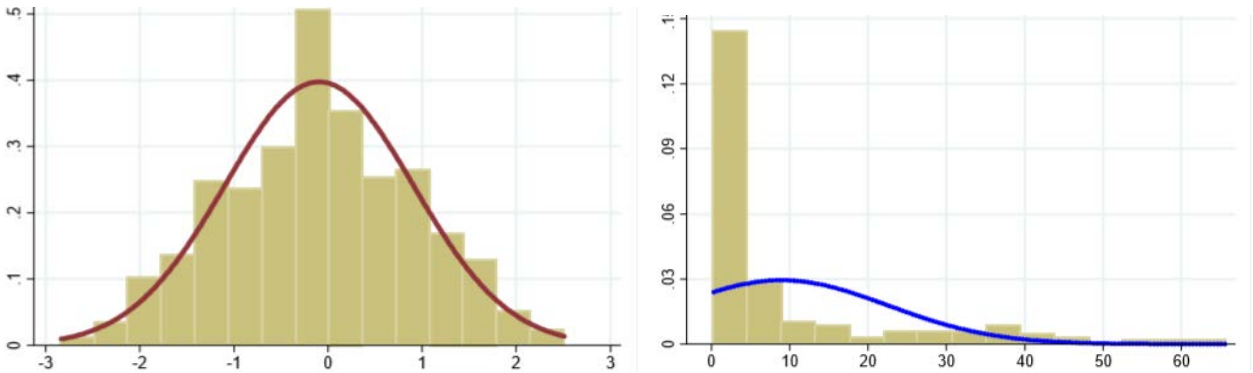

Figure 3. A histogram with normal distribution (A) and histogram with non-normal distribution (B)

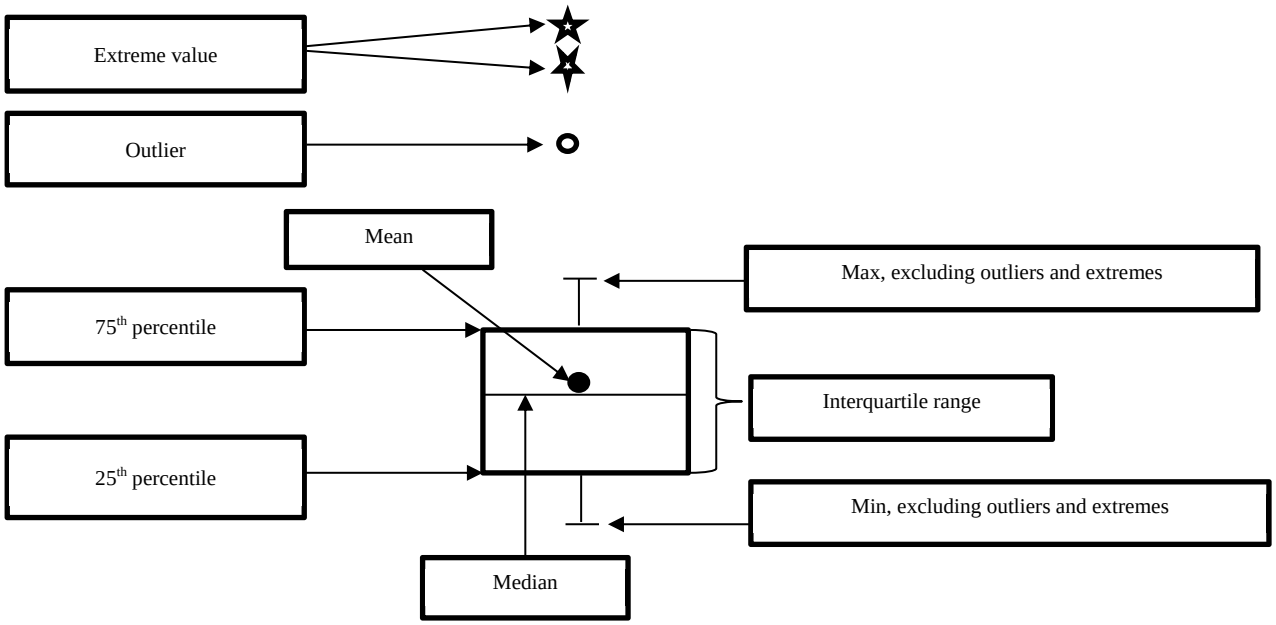

Figure 4. Schematic representation of a box plot (O = Outlier data; * = Extreme value)

Stem-and-leaf plot

In cases in which data can be shown using integers, this graph can replace a histogram to show distribution of data. There are many techniques and details for drawing graphs; however, in general, in such a graph there exists a vertical line. The stems and leaves are located on the right and left sides of the vertical line, respectively. With an increase in the resemblance of leaf section to a bell, there is an increase in closeness of distribution to normal distribution.

Box plot

This graph consists of a box and two whiskers around the box. The horizontal line drawn at the middle of the box indicates the median of data and its two parallel sides indicate the first and the third quarters; therefore, the height of the box equals the interquartile range. The point which has been determined within the box indicates the mean of data. The whiskers show the minimum and maximum of data at "1.5 × distance" from the interquartile range. In this graph, the distance of the first quarter from the third quarter minus "1.5 × interquartile range" is called the inner fence and the distance of "3 × interquartile range" from the first and third quarter is called the external fence. If each data is located between the outer fence and the inner bound, it will be referred to as the outlier data and if is located beyond the outer fence it will be referred to as an extreme value (Figure 4).

If there are multiple outlier data or extreme values or if the median line is not located in the middle of the box (corresponding with the mean), there are doubts that the distribution is non-normal. If the horizontal line approaches the upper or lower sides, the data are positively or negatively skewed, respectively.

Normal Q-Q plot

In normal Q-Q plot, the real position of each data is drawn relative to the position the data should have if the distribution is normal. To show this pattern, the plot has two sections: a sloped line which shows the ideal conditions of normality (when the observed value and the expected value are equal on the condition of normality) and hollow circles which indicate the real observed value compared to the expected value on the condition of normality. If the distribution of data is normal, the points will almost be located on the sloped

line. Any deviation from the sloped line means deviation from the normal distribution. As the total or collected distance of the points increases from the sloped line, there is more deviation from normal distribution.

It should be noted that this plot does not provide any information about outlier data. If distribution of points begins from somewhere above the sloped line, moves to the underneath of the line and then ends above the line, it indicates skewness to the left. If the crescent-shaped pattern above is reversed, ii indicates skewness to the right. If the distribution pattern resembles a long S, with data variance pattern of above-under-above-under, it indicates distribution with positive kurtosis and if the pattern is reversed, i.e., under-above-under-above, it indicates negative kurtosis. It is possible in this S-shaped pattern for only a part of the central segment of S to be placed on the other side of the sloped line, in which apart from the non-normal kurtosis, distribution of data is skewed, too (Figure 5).

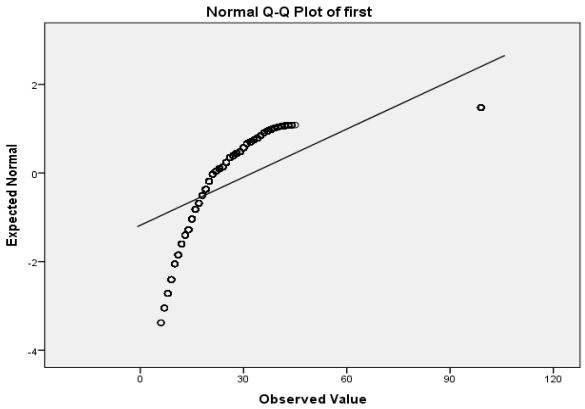

Figure 5. Normal quantile-quantile (Q-Q) plot of a non-normal distribution

Detrended normal Q-Q plot

In this plot, the amount of deviation of point observations from the direct and horizontal line is displayed as a sign of normal distribution. If the distribution is normal, the point observations will be distributed randomly and evenly above and under the horizontal line. However, if the distribution is not normal, the points will be placed in the form of reverse J or U letters and the line of normal distribution is not located in the middle of data (Figure 6).

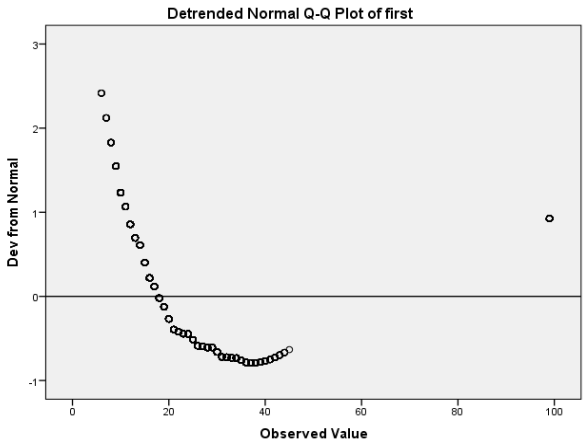

Figure 6. Detrended normal quantile-quantile (Q-Q) plot in the form of letter J, indicating non-normal distribution

As discussed at the beginning of this section, none of the methods above alone can make us sure that distribution of data is normal or non-normal. Now imagine, based on the results of all these methods, we reach the conclusion that distribution of data is a little different from normal distribution. Does any deviation mean that commonly used and accepted statistical tests (parametric tests) cannot be used? In the next section, this question is going to be reviewed.

Transformation

Although a lack of establishment of premises of a statistical method is very important and provides a definitive reason for not using that method, regarding the high rate of favorability and ease of interpretation of commonly used parametric methods and the limited diversity and low statistical power (almost 5% less compared to corresponding methods) of non-parametric methods, statisticians have suggested methods to compensate compromise of the premises of common and parametric tests. Therefore, it is possible to compensate minor deviations from normality hypothesis with transformation methods and if the

transformation proves useful, it is possible to analyze data with parametric statistical tests.[4]

To this end, if data distribution is skewed positively, transformations of the square root, logarithms at a base of 10 or Napier number (e) and reversing can be used. If data distribution is skewed negatively, the value should first be reflected and then again one of the techniques of transformations of the square root, logarithmic or reversing can be used. Sometimes it is necessary to apply several transformations to achieve normality of data.[4]

Of course, it should be noted that despite the more appropriate appearance of transformed data, it is more difficult to interpret the results and particular attention and expertise are required.[4] It is advisable to carry out all the analyses with the use of transformed data. However, finally, all the statistics should be converted to their initial form (the reverse of the transformation steps) to report the results.

Applying simple data cleaning and its effects: An oral health example

Finally, to review and practice the subjects discussed in this article on cleansing of data, the following data from a hypothetical research to evaluate the relationship between age and the decayed-missing-filled (DMF) index in a group of children under 15 years of age is evaluated here (Table 1).

To demine the relationship between the two variables of age and DMF in the samples mentioned above, the following path is used in SPSS:

Analyze → Correlate → Bivariate → Pearson

The calculated Pearson's correlation coefficient was -0.064 and non-significant (P = 0.788). The very small numeric value of 0.064 in relation to the correlation coefficient indicates a lack of relationship between age and DMF in the data available.

Based on what was discussed in this study, the prerequisite for the analysis of data is making sure that the data are clean. To this end, we return to the algorithm in the first section of the article and carry out the cleansing steps of data in the table 1.

Table 1. Row data from a hypothetical research to evaluate the relationship between age and the decayed-missing-fi (DMF) index

ID	Age (year)	DMF index
1	7	1
2	7	0
3	10	4
4	12	8
5	8	4
6	8	3
7	9	8
8	8	4
9	13	9
10	60	4
11	12	8
12	12	9
13	11	9
14	15	10
15	10	33
16	9	18
17	8	5
18	13	7
19	12	7
20	11	6

The first step is to evaluate data in relation to the presence of inconsistent data. In the column of age, the value 60 is seen! Since the study was carried out on children, the data on the age of the subject with an ID of 10 (ID = 10) has been entered incorrectly. Imagine that by re-evaluation of data, it becomes clear that the correct age of this individual is 10. Do you see any other inconsistent data in this table? By accurately evaluating the DMF column, it becomes evident that one of the data has been recorded as 33. Since the maximum of DMF in each individual is 28 or 32 (its maximum equals the number of teeth, i.e., 28, without taking wisdom teeth into account). Therefore, the value 33 cannot be correct. Imagine that by re-evaluation of the documents it becomes clear that the correct value is 7 and the correction is made.

The second stage of cleansing the data based on the algorithm is to evaluate outlier data, which can be accomplished through the following steps in SPSS:

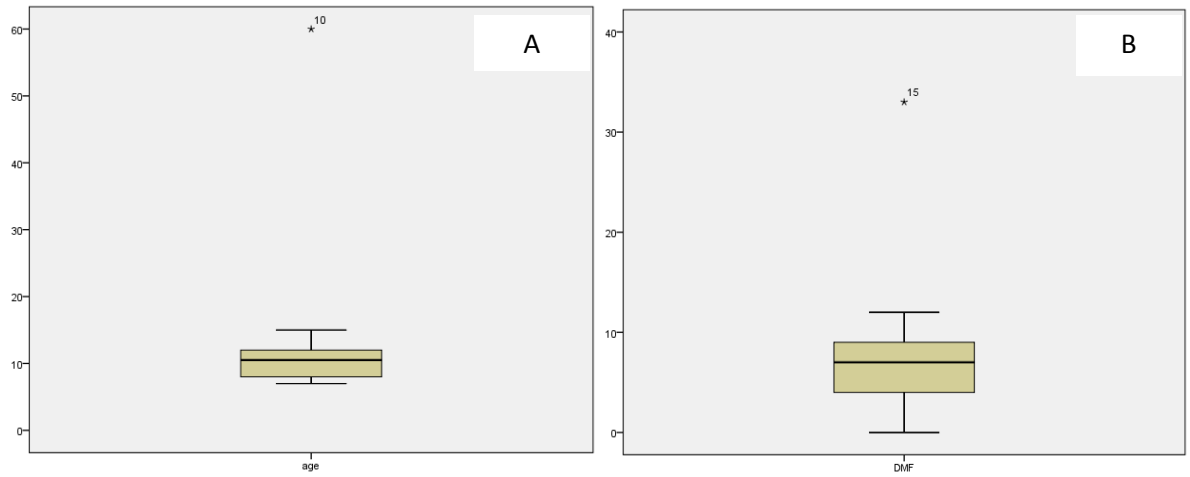

Figure 7. Outlier data showed in box plots [A for age and B for decayed-missing-filled (DMF)]

Analyze → Descriptive Statistics → Explore → Statistics → Outliers

In the following diagrams, outlier data are seen in the data on age and DMF (Figure 7):

As it is evident, in the data on age, the data of the ID = 10 is considered outlier, which was 60 as seen in the preceding paragraph and had been entered erroneously and was corrected. In the data on DMF, the data of ID = 15 is distant from other data. The DMF of ID = 15 is considered outlier and the value that had been erroneously entered was 33, which was corrected. The next stage in cleansing data is to evaluate missing data. In the data presented, in table 1, no data is missing. Of course, this is natural in this data series because missing data usually occur in studies with a very large sample size or in cases in which sensitive questions are asked during the course of the study or in situations in which the subjects are followed over a long period of time and the subjects may not show up in follow-up sessions; the data set here has none of the properties mentioned above.

After the data mentioned above were corrected due to inconsistency, the correlation coefficient of the two variables was calculated at 0.692, which is significant (P = 0.001). Note that changing only two variables in the table can significantly affect the results of the study.

Conclusion

Cleansing data before statistical analyses is necessary before drawing any conclusions from data. Researchers should make sure that no mistakes have been made in entering data in datasheets and after it in entering data into the statistical software. Evaluation of the presence of outlier data of one or several variables, missing data and normality of data distribution and if necessary, the transformation of data, are the principal steps in cleansing and preparation of data for analysis. It is suggested that the cleansing and preparation steps of data be explained in the final report of research studies.

Conflict of Interests

Authors have no conflict of interest.

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Oral health related quality of life in patients with diabetes mellitus type 2 in the year 2012

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Original Article

Abstract

BACKGROUND AND AIM: The aim of this study was investigation of oral and dental side effects of diabetes mellitus (DM) on oral health-related quality of life (OHQoL) in patients with DM type 2.

METHODS: In this descriptive, analytic study 121 patients were participated by consecutive method based on the type of diabetes and the age. After the subjects received adequate explanations about the necessity of carrying out such a study, a questionnaire was handed into each patient who gave their consent to take part in the study. Oral lesions consisted of ulcers, erythema, leukoplakia, erythroplakia, candidiasis, angular cheilitis, median rhomboid glossitis, and denture stomatitis based on oral examination. The OHQoL were surveyed by oral health impact profile (OHIP-14) questionnaire. Data were analyzed by Pearson's correlation test, T-test, and χ^2 by SPSS software.

RESULTS: A total of 121 patients with diabetes were evaluated in this study [31 males (25.6%) and 90 females (74.4%)]. In this study, there was no significant correlation between OHQoL and decayed, missing, and filled teeth (DMFT), periodontal disease index (PDI). OHQoL was associated with higher ages and higher levels of blood sugar (P = 0.002, P = 0.016). The average of OHIP score significantly was increased by xerostomia experience (P = 0.010).

CONCLUSION: In this survey, the influence of oral manifestation on OHQoL was low. Xerostomia was the most important symptom in diabetic patients that causes decreasing OHQoL. Age and blood sugar had more influence on this matter as well.

KEYWORDS: Diabetes Mellitus; Oral Manifestation; Oral Health Related Quality of Life

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Diabetes is one of the most common chronic diseases.[1] This disease is a metabolic disease, with heterogeneous clinical and genetic characteristics. It is characterized by an abnormal increase in blood glucose concentrations (hyperglycemia) and disturbances in the regulation of carbohydrates, proteins, and lipids.[2] Since diabetes mellitus (DM) is associated with various complications such as cardiovascular, neurologic, renal, ocular and oral conditions, it is one of the most important health problems worldwide.[1] It has been demonstrated that continuous hyperglycemia affects almost all the tissues of the body and is associated with major complications in different organs such as the eyes, nerves, kidneys, and blood vessels. These complications have a role in the higher rate of morbidity and mortality in diabetic patients.[3] Clinical manifestations of DM consist of a wide range of acute manifestations up to asymptomatic conditions that are only discovered during routine screening tests.[2] Health-related behaviors are necessary to

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prevent progression of disease and its complications.[4,5] Some of these care services include daily control of blood glucose levels, limited dietary regimens, use of oral medications, and injection of insulin and sports activities.[6]

At present more than 366 million people suffer from diabetes worldwide and it is estimated that it will increase to 552 million people by 2030.[1] The World Health Organization reported in the recent decade that 170 million people worldwide suffer from diabetes.[7] At present, more than 3 million people suffer from diabetes in Iran, which is considered one of the highest rates all over the world.[8]

The oral manifestations of diabetes consist of bacterial, viral and fungal infections, a delay in wound healing and an increase in the incidence and severity of dental caries, gingivitis, periodontal diseases, periapical abscesses and burning mouth syndrome.[9] Promotion of the quality of life of human beings is one of the aims of health systems at the beginning of the 21st century and evaluation of quality of life of patients with diabetes is an important component in the evaluation of the effect of health-care behaviors.[3]

Since oral problems are one of the consequences of inadequate control of diabetes, which can affect the oral function, facial appearance and social relationships of patients[10] and decrease the health-related quality of life and it can affect the overall quality of life of these patients and this issue has never been evaluated in Iran; the present study was undertaken to evaluate the effect of oral and dental complications of diabetes on oral health-related quality of life (OHQoL).

Methods

In the present descriptive, analytical, cross-sectional study, the OHQoL of diabetic patients was evaluated based on periodontal and oral disease parameters. A total of 121 patients with diabetes, who were 17-75 years of age, were consecutively selected from those referring to public hospitals in Kerman, Iran. The diagnostic criteria in diabetic group were as follows: Hemoglobin A1c of 6.5% or higher; fasting plasma glucose (FPG) of 126 mg/dl or higher in two occasions or 2-hour FPG of 200 mg/dl or higher in two occasions; patients with classic symptoms and signs of hyperglycemia, hyperglycemia crises and a random plasma glucose level of 200 mg/dl or higher.[11] In addition, the subjects reported minimum use of medications to control other systemic conditions and did not use any medications with oral manifestations. The exclusion criteria consisted of the following: patients taking any medications with oral manifestations, smokers, and patients with mental problems.

After the subjects received adequate explanations about the necessity of carrying out such a study, a questionnaire was handed into each patient who gave their consent to take part in the study. The questionnaire consisted of sections on oral lesions, the status of teeth including decayed, missing, and filled teeth (DMFT) index and supporting tissues, i.e., periodontal disease index (PDI) index. Oral lesions consisted of ulcers, erythema, leukoplakia, erythroplakia, and candidiasis (angular cheilitis, median rhomboid glossitis, and denture stomatitis).[9] Questionnaire was given after oral examination and in the case of the illiterate or less educated were completed by a family member.

The clinical examination was carried out under field conditions in the dentistry unit by resident of oral medicine, whereas the observations were recorded by a trained assistant. Using a set of equipment including a unit lamp as source of illumination, mirror dentistry and dental probes, patients were examined while seated on a unit. To evaluate the status of teeth in relation to the presence of caries, DMFT index was used based WHO instructions. Tooth-supporting tissues were examined using periodontal indexes and 6 teeth were assessed, which included maxillary left central and first

premolar, maxillary right first molar, mandibular left first molar and mandibular left central and first premolar teeth.[12] In this study, xerostomia was confirmed, if based on FOX questionnaire, the patient provided at least one positive response to three questions.[13]

To assess OHQoL, the Persian version of the valid questionnaire oral health impact profile (OHIP)-14 was used, which consists of 14 questions. The interviewees were asked to rate the questions on the questionnaire as follows: very often = 4, in fairly often = 3, occasionally = 2, hardly ever = 1, and never = 0. Therefore, the total score on the questionnaire would be 0-56. A higher score indicates compromised OHQoL.[14] Data were analyzed by Pearson's correlation test, T-test, and χ^2 by SPSS software (version 17, SPSS Inc., Chicago, IL, USA).

Results

A total of 121 patients with diabetes were evaluated with 31 males (25.6%) and 90 females (74.4%). The age range of the subjects was 18-78 years with a mean and standard deviation (SD) of 52.07 ± 11.35 years. In relation to educational status, 37 subjects (30.6%) were illiterate, 52 (43.0%) were literate with some school education, 24 (19.8%) were high school graduates, and 8 (6.6%) were university graduates. The mean and SD of blood glucose levels was 284 ± 106 with minimum and maximum levels of 126 and 700, respectively. 45 patients (37.2%) used both insulin and oral medications; 36 patients (29.8%) received only insulin and 40 (33.1%) took only medications. On the whole, 24 patients (19.8%) had no history of other conditions and the remainder had one or more other conditions.

53 patients (43.8%) were edentulous. The mean ± SD of DMFT index (excluding edentulous patients) was 10.66 ± 5.65, with a minimum and maximum of 2 and 30, respectively. Mean and SD of PDI (excluding edentulous patients) was 4.99 ± 0.95, with minimum and maximum of 1 and 6, respectively. 76 patients (62.8%) had no symptoms and signs of candidiasis and the remainder (31.0%) had one symptom or sign or more than one symptom or sign (14.0%) (Table 1). 22 patients (18.2%) had burning sensation in the oral cavity. Table 1 presents the locations of burning sensation in the oral cavity. The most sign was tongue blade sign (Table 1).

Table 2 shows the different oral condition according score of OHIP-14. Based on Fox questionnaire, 9.57% of the subjects had xerostomia. There were no significant relationships between scores of OHQoL and affliction with candidiasis and history of frequent abscess; however, the mean score of OHQoL had significant relationships with xerostomia, tongue blade sign, and burning sensation in the oral cavity. In this context, the life quality score was higher in patients with xerostomia, positive tongue blade sign and burning sensation, i.e., they had lower quality of life. The mean ± SD of the total score on OHIP-14 questionnaire was 6.50 ± 3.63, with a minimum and maximum of zero and 41, respectively.

Table 1. The frequency of oral candidiasis, oral sore location and selected oral lesions or signs in patients with DM

Candidiasis	n (%)	Oral sore location	n (%)	Selected oral lesions or signs	n (%)
Hyperplastic	0 (0)	Tongue	19 (15.7)	White plaque	1 (0.8)
Erythematosis	10 (8.3)	Floor of mouth	3 (2.5)	Erythematose plaque	0 (0)
Trush	3 (2.5)	Hard and soft palate	2 (1.7)	Lichenoid lesions	3 (2.5)
MRG	20 (16.5)	Buccal, lip and vestibule mucosa	3 (2.5)	Ulcer	0 (0)
Denture stomatitis	23 (19.0)	-		Frequent abscess	14 (11.6)
Angular cheilitis	8 (6.6)	-		Tongue blade sign	59 (48.8)

DM: Diabetes mellitus

A total of 56 subjects (46.3%) scored zero on the questionnaire. The mean score range of each question was 0.07-0.56. These two extremes belonged to questions 10 and 3, respectively. Table 3 shows the frequency, average, and SD of answers to OHIP-14 questionnaire.

Table 2. Comparison of oral health quality of life according to selected oral lesions and signs

Variations	Mean ± SD	P*
Candidiasis		
Yes	6.01 ± 3.25	0.350
No	7.23 ± 6.01	
Xerostomia (Fox Q)		
Yes	3.25 ± 1.45	0.005
No	7.75 ± 5.22	
Sore mouth		
Yes	6.50 ± 3.10	0.003
No	6.16 ± 6.02	
History of frequent abscess		
Yes	6.42 ± 3.51	0.780
No	7.40 ± 4.57	
Tongue blade sign		
Yes	4.29 ± 2.03	0.031
No	7.92 ± 5.32	

*Independent t-test, SD: Standard deviation

There was no significant relationship between the age, sex and educational status on one hand and blood glucose level. There was no significant relationship between the mean scores of OHQoL on one hand and gender and educational status of subjects on the other. There was a weak but significant relationship between the score of OHQoL and blood glucose level and age, i.e., with an increase in age and blood glucose level the score of OHQoL increased, indicating a decrease in OHQoL. In this context, the correlation coefficients of blood glucose level and age with the relevant score on OHIP-14 questionnaire were 0.28 (P = 0.002) and 0.22 (P = 0.016), respectively. There was no significant relationship between the score of OHQoL and the type of medications taken, a history of other conditions and edentulism. There were no significant relationships between scores of OHQoL and PDI and DMFT indexes; in this context, the correlation coefficients between DMFT and PDI on the one hand and OHIP-14 questionnaire scores on the other hand were −0.7 (P = 0.570) and 0.16 (P = 0.200).

Discussion

This study was carried out on 121 diabetic patients with a mean age of 52.07 years. In this study, the mean ± SD of the total score of OHQoL was 3.63 ± 6.50 with minimum and maximum of zero and 41, respectively. In a study by Allen et al.,[15] too, diabetes had not significantly affected the OHQoL of patients. Sandberg et al.[16] evaluated the effect of diabetes on the OHQoL and reported that patients' satisfaction with the oral and dental status was similar in diabetic and non-diabetic patients.

Table 3. Answers to the OHIP-14 questionnaire

Questions	Never	Hardly ever	Occasionally	Fairly often	Very often	Mean ± SD
1. Had trouble pronouncing some words	95	1.7	2.5	0.8	0	0.90 ± 0.43
2. Felt sense of taste had worsened	81	9.9	5.8	0.8	2.5	0.34 ± 0.83
3. Had painful aches	57.9	29.8	10.7	1.7	0	0.56 ± 0.75
4. Found it uncomfortable to eat food	57.9	29.8	10.7	1.7	0	0.36 ± 0.68
5. Been self-conscious	73.3	19.2	6.7	0	0.8	0.42 ± 0.68
6. Felt tensed	67.8	23.1	8.3	0.8	0	0.35 ± 0.76
7. Diet has been unsatisfactory	79.2	9.2	10.0	0.8	0.8	0.31 ± 0.73
8. Had to interrupt meals	80.2	11.6	5.8	1.7	0.8	0.23 ± 0.62
9. Found it difficult to relax	85.1	8.3	3.3	1.7	1.7	0.26 ± 0.75
10. Been a bit embarrassed	93.4	5.8	0.8	0	0	0.07 ± 0.29
11. Been a bit irritable	88.4	9.1	2.5	0	0	0.14 ± 0.41
12. Had difficulty doing usual jobs	86.8	9.1	3.3	0	0.8	0.19 ± 0.57
13. Felt life, less satisfying	85.1	10.7	3.3	0	0.8	0.21 ± 0.58
14. Been totally unable to function	95.9	0.8	1.7	1.7	0	0.09 ± 0.46

SD: Standard deviation; OHIP: Oral health impact profile

The subjects' OHQoL decreased with age. In a study by Allen et al.[15] on type II diabetic patients, the mean age of the subjects was 56 years, somewhat consistent with that in the present study. It appears aging results in more oral problem due to different reasons, including a decreased attention to oral hygiene status by patients.

In this study, the mean score of quality of life had no significant relationship with patients' gender and educational status, consistent with the results of a study by Bosic-zivanovic,[17] in which there was no relationship between gender and type II DM.

In this study, the mean ± SD of DMFI (after exclusion of edentulous patients) was 10.66 ± 5.65, with no significant relationship between DMFI and OHQoL. Stojanovic et al.[18] showed that the extent of caries and probing depth were higher in patients with weak diabetic control.

In the present study, the mean ± SD of PDI (after excluding edentulous patients) was 4.99 ± 0.95, with no significant relationship between PDI and OHQoL in diabetic patients. In studies by Drumond et al.,[19] Li et al.,[20] and Saini et al.[21] the OHQoL in diabetic patients with periodontitis was lower compared to those without periodontitis.

In the present study, the mean score of OHQoL exhibited a significant relationship with xerostomia based on FOX questionnaire and tongue blade sign; in this context, the score of OHQoL was higher in patients with xerostomia and positive tongue blade sign, i.e., they had lower quality of life. In a study by Busato et al.,[22] too, diabetic patients had a higher rate of xerostomia; in this context, xerostomia had exerted a significantly negative effect on the OHQoL. In a study by Bajaj et al.,[23] xerostomia was more severe in diabetic patients with higher blood glucose levels. In addition, Dorocka-Bobkowska et al.[24] sensation in the oral cavity were the most common complaints of patients with type II DM. An increase in blood glucose levels results in polyuria, which leads to the excretion of extracellular fluids and hyposalivation, in turn, giving rise to xerostomia. Xerostomia in diabetic patients leads to social and clinical problems, with negative effects on OHQoL.[9,24]

In the present study, 18.2% of subjects had burning sensation in the oral cavity and 37.2% had one or more than one type of oral candidiasis; however, there was no significant relationship between the mean score of OHQoL and burning sensation and candidiasis. No studies have evaluated the effect of burning sensation and candidiasis on OHQoL in diabetic patients.

In the present study, there were lichenoid reactions in 3 patients and leukoplakia in one patient; however, there was no significant relationship between the mean score of OHQoL and the presence of leukoplakia and lichenoid lesions. No similar study was found but in a study by Saini, two patients of 420 diabetic patients had lichen planus, with no significant relationship between diabetes and these lesions.[21]

Conclusion

This study showed the low influence of different oral manifestation on quality of life in diabetic patients. Xerostomia, age and blood sugar have more effect on OHQoL.

Conflict of Interests

Authors have no conflict of interest.

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Evaluation of application of fix and removable habit breakers among a group of preschool children with thumb sucking habit in Kerman, Iran

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Original Article

Abstract

BACKGROUND AND AIM: Thumb sucking has been reported as one of the etiologic factors for malocclusion. The aim of this study was to determine the prevalence of thumb sucking and use of different kinds of habit breaker (HB) appliances in children attending private kindergartens in Kerman, Iran.

METHODS: The census method was used in the present cross-sectional study, and the study population consisted of all the children attending private kindergartens. A checklist was completed for each subject, and clinical examinations were done. Fisher's exact test was used to evaluate the relationship between thumb sucking and the variables under study. Stata 13 was used for the analysis of data.

RESULTS: Of 503 4 to 6-year-old children, 14 (2.8%) had thumb sucking habits at the time of the study. Among these 14 children, only 6 children used HBs fixed (4 persons) or removable (2 persons).

CONCLUSION: The prevalence of finger sucking, its side effects, as well as using the HBs of this habit in children of Kerman kindergartens were not high. Furthermore, it has same rate like other cities. In this situation, it's necessary for the personnel of kindergartens to notify their parents about the hygiene of the problems.

KEYWORDS: Finger Sucking; Malocclusion; Pacifier

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Considering a high prevalence rate of malocclusion in different communities and the problems resulted from it, it appears absolutely necessary to elucidate the relevant etiologic factors as well as, treatment methods. Thumb sucking has been reported as one of the etiologic factors for malocclusion. It is one of the most common habits of children and is usually broken during normal growth up to age 3 spontaneously. Thumb sucking after 3 years of age might give rise to speech deficiencies, masticatory problems, lisping and open bite in children, exerting a negative effect on their self-confidence.[1]

Changes resulting from thumb sucking are diverse and depend on the severity, duration, and the frequency of the habit. Long duration of this period leads to greater tooth movements. The most important malocclusion emanating from thumb sucking

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is anterior open bite. Breaking this habit will not result in the correction of malocclusion due to the incorrect growth pattern resulting from it. The most probable success is achieved when children themselves are interested in breaking this habit. Three different approaches to the treatment have been advocated: (1) Psychoanalytic method, (2) behavioral modification technique, and (3) use of habit breaker (HB) appliances.[2,3]

The aim of this study was to determine the prevalence of thumb sucking and use of different kinds of HB appliances in children attending private kindergartens in Kerman, Iran in 2014-2015 educational year.

The prevalence of thumb sucking in children in Kerman was evaluated in 2001; however, since the social and cultural behaviors of families have undergone changes during the last 10 year, furthermore in that study was not evaluated the treatment methods, so it is necessary to re-evaluate the problem in Kerman. In that study which done by Poureslami et al.,[4] among the 3-6-year-old kindergarten children, the results showed that 3.4% of the subjects were in the habit of thumb sucking with equal prevalence in boys and girls. Almost 50% of children had normal dental relationship and 50% had anterior open bit only, the prevalence of posterior cross-bite and posterior open bit along with anterior open bite was 0%.

Methods

The census method was used in the present cross-sectional study and the study population consisted of all the children attending 17 private kindergartens in Kerman, which added up to 503 children 4 to 6-year-old (259 girls and 244 boys), who underwent examinations. The researchers attended the kindergartens and recorded the number of children in each case. The parents signed letter of satisfaction. Then, the kindergarten authorities and the parents were questioned about each subject's thumb sucking habit and using the HBs. A checklist was completed for each subject. Finally, detrimental effects of thumb sucking on the dentoalveolar system were explained, and instructions were provided to prevent thumb sucking for those who had this habit and did not follow any treatment method.

The checklist consisted of two sections. The first section included the personal data of each subject, and the second section consisted of questions for parents to answer in relation to the thumb sucking habit of their children. These questions covered areas such as age, gender, the child's nutritional status during infancy, use of a pacifier and the duration of the use of a pacifier. The results of clinical examinations, too, were recorded in the checklist. The examination included the status of teeth and the dental arches, which were categorized in three groups, including normal anterior and posterior teeth, anterior open bite, and anterior open bite along with posterior open bite or posterior cross-bite.

To determine the prevalence of thumb sucking, descriptive statistics for qualitative data and calculating 95% confidence intervals (CI) was used. Fisher's exact test was used to estimate the association between gender and kind of nutrition and also gender and occlusion. Stata 13 (Stata Corporation, College Station, TX, USA) was used for the analysis of data. The study did not have important ethical considerations because no therapeutic intervention was carried out and no medications were prescribed; however, the demographic data of the subjects were kept confidential. The protocol of the study was approved by the Ethics Committee under the code IR.KMU.REC.1394.14.

Results

Of 503 4 to 6-year-old children attending private kindergartens in Kerman 14 (2.8%; 95% CI: 1.5-4.6) had thumb sucking habits at the time of the study. Among these 14 children, only 6 children used HBs fixed or removable (4 persons fixed and 2 persons

Table 1. Prevalence of thumb sucking and using of HBs among a group of preschool children in Kerman

Number of children [n (%)]	Children with thumb sucking [n(%)]		Using fixed HB [n(%)]	Using removable HB [n (%)]	No using HB by the suckers [n (%)]
	Female	Male			
503 (100)	9 (1.8)	5 (1.0)	4 (0.8)	2 (0.4)	8 (1.6)

HB: Habit breaker

removable appliances). Five mothers stated his/her child have had finger sucking but was broken the habit by using HB in last year and at the time of the study; these 5 children were free of the habit. Tables 1 and 2 show the gender distribution of thumb sucking and the effect of thumb sucking on teeth relationships and occlusion.

The role of the type of nutrition during their infancy in their thumb sucking habit has been shown in table 3. As well as table 3 presents the status of the use of pacifier during their infancy.

Discussion

At the time of study, 14 children 2.8% exhibited a thumb sucking habit and 1.2% used HBs (0.8% fixed appliance and 0.4% removable appliance). Different prevalence rates have been reported for this habit in the studies, but no study reported the rate of using HBs. The differences on prevalence rates might be attributed to differences in study methodologies and also cultural and social factors that are involved in forming such a habit and each set of statistical data on this habit is specific for that community only. The study that is the closet to this study in relation to its location is a study by Poureslami et al.,[4] in which of 1000 children studied 34 (3.40%) exhibited thumb sucking and of these children 55.88% (19 subjects) were female and 44.12% (15 subjects) were male, indicating no significant relationship between the thumb sucking habit and gender. In this study, 2.7% of the subjects (14 children) had the habit, 64.28% (9 subjects) of which were female and 35.72% (5 subjects) were male, revealing no significant relationship between thumb sucking and gender.

In the study by Poureslami et al.,[4] the statuses of teeth and the dental arches were evaluated in children with a thumb sucking habit. The results showed a significant relationship between the thumb sucking habit and the statuses of teeth and the dental arches. In this context, the minimum relative frequency belonged to children who had anterior open bite in association with posterior open bite or posterior cross-bite (0%). Children with normal relationship of anterior and posterior teeth comprised 50% of the children (17 subjects) and those with anterior open bite only, too, comprised 50% of the children (17 subjects). In this study, too, the statuses of the teeth and dental arches were evaluated in children with a thumb sucking habit. The results showed a significant relationship between the thumb sucking habit and the statuses of teeth and dental arches. In this context, the minimum relative frequency belonged to children with anterior open bite along with posterior open bite or posterior crossbite (21.43%, 3 children), and 35.71% (3 children) of the subjects exhibited a normal relationship between anterior and posterior teeth. Anterior open bite was recorded in 35.71% (5 children) of the subjects.

Table 2. Prevalence of different types of occlusion among the preschool children with thumb sucking habit according to gender (%)

Occlusion	Female [n (%)]	Male [n (%)]	Total [n (%)]	P
Normal	4 (28.58)	2 (14.28)	6 (42.86)	0.96
Anterior open bite	3 (21.42)	2 (14.28)	5 (35.71)	
Anterior and posterior open bite	2 (14.28)	1 (7.15)	3 (21.43)	
Total	9 (64.27)	5 (35.73)	14 (100)	

Table 3. Prevalence of different kinds of the feeding and frequency of using of pacifier (in infancy period of life) among the preschool children with thumb sucking habit according to gender (%)

Kind of nutrition	Female	Male	Total	P
Breast feed	5 (35.72)	3 (21.43)	8 (57.15)	0.99
Formula	0 (0)	0 (0)	0 (0)	
The both	4 (28.57)	2 (14.28)	6 (42.85)	
Total	9 (64.28)	5 (35.72)	14 (100)	
Using of pacifier				
Yes	4 (28.58)	3 (21.43)	7 (50.00)	0.99
No	5 (35.72)	2 (14.29)	7 (50.00)	
Total	9 (64.29)	5 (35.72)	14 (100)	

The results of the present study were consistent with those of Poureslami et al.,[4] and the differences were attributed to changes in cultural and social variables from 2001 to 2014, which have taken place in the municipal community of Kerman. The differences in the results might be attributed to the number of samples. In addition, in this study, the relationship between the use of a pacifier and thumb sucking habit was evaluated: 50% of the subjects (7 children) used a pacifier and 50% did not, indicating no significant relationship between the use of a pacifier and the thumb sucking habit, consistent with the results of the study by Poureslami et al.[4]

In relation to the status of nutrition during infancy and its relationship with thumb sucking, there was no significant relationship between the two. In this context, of 14 children with the habit, 57.15% (8 children) had been breastfed and 0% had received milk formulations only; 42.85% (6 children) had been breastfed and had received milk formulations. In the study by Poureslami et al.,[4] of 34 children with the habit, 47.06% of the subjects (16 children) had either been breastfed completely or had been predominantly breastfed; 35.30% (12 children) had been breastfed and had also received milk formulations and 17.64% (6 children) had received milk formulations only or had been predominantly fed on milk formulations, consistent with the results of the present study. Furthermore, there was no significant relationship between birth order of children who had the habit and did not have the habit.

In a study on 1031 children aged 2-5 to evaluate the presence of anterior open bite and its relationship with oral habits, thumb sucking was reported to be the important etiologic agent for anterior open bite in children, with a prevalence rate of 2.8%,[5] consistent with the results of this study. In addition, it was demonstrated that the incidence of malocclusion was affected by the thumb sucking habit. It was concluded in this study, too, that the incidence of malocclusion is directly under the influence of thumb sucking habit and it is the principal cause of open bite and cress-bite.

Furthermore, Jahanbin et al. study[6] on 436 female children aged 7 the highest prevalence rat of thumb sucking habit was observed in children who had been breastfed only; in addition, the highest rate of the use of a pacifier was observed in children who had been breast- or bottle-fed. This finding is contrary to the results of this study. The discrepancies in the results of these two studies can be attributed to differences in the factors involved in the incidence of oral habits. In addition, in that study, the relationship between the rates of pacifier use and sucking of mother's breast was evaluated, and the thumb sucking habit was noted in children who had exclusively been breastfed, while in the present study, there was no relationship between the incidence of thumb sucking habit and being exclusively breastfed.

In another study by Vasconcelos et al.[7] among 1308 children, the prevalence rate of non-nutritional sucking habits was 40%, which was related to gender, age and type of nutrition, contrary to the results of the present study.

In a study by Romero et al.,[8] the infants' nutrition and non-nutritional sucking habits of children were evaluated in a group of children aged 3-6. The subjects were classified based on periods fed on mother's milk. The relationship between breast-feeding and non-nutritional sucking habits and the incidence of anterior open bite in the initial dental structure was evaluated. The children who were not breastfed had a higher chance to develop anterior open bite compared to children who were breastfed for more than 12 months, indicating the position effect of breast-feeding on dentoalveolar structure. In our study, the thumb sucking habit had no significant relationship with age and the type of nutrition and the discrepancy between the results might be attributed to differences in the study protocols.

In addition, de Albuquerque et al.[9] evaluated the relationship between non-nutritional sucking habits and nutritional methods among children aged 12-36 months. The subjects consisted of 292 children of both genders. There was a significant relationship between nutritional methods and non-nutritional sucking habits. The prevalence of the thumb sucking habit decreased with an increase in the duration of breast-feeding. The results of that study were contrary to the results of the present study. In this study, the duration of breast-feeding had no significant relationship with the thumb sucking habit.

In another study by Fukumoto et al.[3] on 555 children aged 36-47 months, questionnaires were used to collect data. Termination of breast-feeding before 12 months of age or use of a pacifier before 14 months of age was related with the thumb sucking habit, which is contrary to the results of the present study. Such discrepancy might be attributed to the age range of the subjects: 12-36 moths in that study versus 3-6 years in the present study.

In Noori et al. study,[10] 400 boys and girls aged 24-72 months of age were selected and the thumb sucking habit, bottle-feeding and use of a pacifier were evaluated. Of the subjects, 68 subjects of both genders had oral habits: 52.9% had thumb sucking, 38.2% were bottle-fed, 7.3% had thumb sucking along with bottle-feeding, and 1.4% used pacifiers. There was a direct and significant relationship between thumb sucking on one hand, and tooth crowding and the shape of the hard palate on the other hand. The results of that study are consistent with those of the present study which showed a direct and significant relationship between thumb sucking and tooth crowding, resulting in malocclusion. A study which carried out by Ghasempour and Nasrolahi[11] the prevalence of thumb sucking and its effect on dentoalveolar anomalies were evaluated. The subjects consisted of 374 children aged 5-6 years, who attended kindergarteners; 20.1% of the subjects exhibited thumb sucking habit, with no significant differences between boys and girls. The results showed a higher rate of malocclusion in children with a thumb sucking habit, consistent with the results of the present study.

Conclusion

The prevalence of finger sucking, its side effects as well as using the HBs of this habit in children of Kerman kindergartens was not high. Furthermore, it has the same rate like other cities.[5-11] In this situation, it is necessary for the personnel of kindergartens to notify their parents about the hygiene of the problems.

Conflict of Interests

Authors have no conflict of interest.

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Preventive methods of dental caries is a problem of most general practitioners yet: A survey of knowledge, attitude and practice

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Original Article

Abstract

BACKGROUND AND AIM: It is clear that education of parents and physicians regarding the importance of caries prevention will improve children's dental health. Most of the times pediatric and general dentists are dependent on the knowledge base and attitude of pediatricians and family practice physicians for referral of infants and young children in need of preventive and restorative care. This study was conducted to assess the knowledge, attitudes and practice of general dental practitioners and pediatricians in relation to techniques used to prevent dental caries, including use of fissure sealants and fluoride therapy, in the south-east of Iran.

METHODS: A cross-sectional survey was conducted between 399 general practitioners and pediatricians in the south-east of Iran. Data collected through a self-administered questionnaire consisted of demographic characteristics, questions that evaluating, knowledge, attitude and practice level regarding preventive methods of dental caries. Then, scores were given to each question and sum of the scores was categorized to weak, moderate and good. These scores were evaluated as follows: < 50%: weak, 50-75%: moderate, and > 75%: good. Data analyzed by SPSS using independent-sample t-test and linear regression models.

RESULTS: In this study, 399 questionnaires were completed including 352 (88.2%) general practitioners and 47 (11.8%) pediatricians. The findings indicated that general practitioners and pediatricians had moderate knowledge (52.6%), good attitude (76.9%), and moderate practice (38.6%) regarding preventive methods of dental caries.

CONCLUSION: Although general practitioners and pediatricians have more communication and closer relationship with target group of caries unfortunately, they had not desirable knowledge and practice regarding fluoride and fissure sealant therapy.

KEYWORDS: Dental Caries; Prevention; General Practitioner; Pediatrician; Knowledge

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Maintaining oral health helps achieve good general health. Many children have inadequate oral and general health because of active and uncontrolled dental caries, yet dental caries is the most common chronic childhood disease and this situation effects on general health.[1] Decline in caries prevalence in developed countries has been related with improved oral hygiene methods and several preventive programs unlike developed countries where the focus is often on curative care. Undoubtedly, both children and adults will benefit from the frequent use of fluorides in that dental caries can be prevented and managed by fluorides. Several controlled clinical trials have shown that the fluorides can prevent cariogenic activities in several

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different ways.[2] Furthermore, many clinical studies have reported on the success of pit and fissure sealants with respect to caries reduction.[2] Since infants and children are frequently visited by their primary care (medical) providers, there is an opportunity for these practitioners to promote oral health and refer children for dental care.[3] In general, pediatricians visit children as the first health-care personnel. As a result, they have an important role in detecting and managing orodental conditions and should gain knowledge in dealing with these conditions due to their high prevalence rate, differences in the prevalence rates in different races and socioeconomic groups and inadequate access of a large number of children to professional dental preventive and therapeutic services. Although there has been a decrease in the prevalence rate and severity of cariogenic activity in recent years, the number of children aged 5-17 years with dental caries has increased 5 folds compared to those with asthma.[4,5] It's obvious that education of parents and physicians regarding the importance of caries prevention will improve children's dental health.[6] Most of the times pediatrics and general dentists are dependent on the knowledge base and attitude of pediatricians and family practice physicians for referral of infants and young children in need of dental care.[7] In recent years, there has been a decrease in continuous education programs in the medical field on oral health, but pediatricians have the opportunity to increase their knowledge oral health matters so that they can provide oral health-care services as depicted in AAP policies for oral health risks.[5] Unfortunately, little attention has been directed toward this role of pediatricians in Iran and in many other countries.

According to our search, there are few studies regarding knowledge, attitude and practices of general practitioners and pediatricians about dental preventive programs (fluoride and fissure sealant therapy) in our society. In addition, little published literature has focused on the extent to which pediatricians participate in preventive oral health programs.[8]

The purpose of this study was to determine the knowledge, attitude and practices of general practitioners and pediatricians regarding preventive methods of dental caries (fissure sealant and fluoride therapy) in the south-east of Iran.

Methods

A cross-sectional survey was conducted between general practitioners and pediatricians in Province of Kerman. Kerman Province is the largest Province in Iran and is located in the south-east of the country with a population of over 2 million. The racial structure of the population in this Province is heterogeneous.

This study was approved by ethics committee of Kerman University of Medical Sciences (k/91/111). The name list of general practitioners and pediatricians was obtained from Kerman Medical Council. The list included 790 general practitioners and 50 pediatricians. Out of this, 352 General Practitioners and 47 pediatricians were selected through systematic random sampling. After explanation of the survey objectives, the participants were asked to complete informed consent. The subjects were asked to fill the questionnaire anonymously and were reassured that the responses they provided would be kept confidential. A researcher-designed self-administered questionnaire was given to the participants. This questionnaire consists of 6 parts:

1. Demographic data such as age, gender, scientific degree, number of years after graduation, number of patients visited per day, working hours per week and years of activity.

2. Knowledge level regarding caries preventive methods (fissure sealant and fluoride therapy) was determined by 6 questions. Each correct answer was given 1 score and wrong or no idea answers received 0 score). Sum of the knowledge scores was varied between 0 to 6 and

categorized to weak (0-2.99), moderate (3-4.5), and good (> 4.5). These scores were evaluated as follows: < 50%: weak, 50-75%: moderate and > 75%: good. Similar scores were given to attitude and practice.

3. Attitude level was evaluated based on 5 questions. Their attitude toward caries preventive methods was assessed using 5-point Likert scale (rating from completely agree to completely disagree) and answers are coded 0-4. Therefore, the range of attitude scores was varied from 0 to 20.

4. Practice level was assessed based on 9 yes/no questions and the answers are coded 0 to 1. Finally, range of practice scores was differed from 0 to 9.

5. Participants were asked about sources that they used for getting information regarding preventive caries methods.

6. Self-assessment evaluation consists of 2 questions which have been received fissure sealant and fluoride therapy for their children.

For assessment of questionnaire validity, it was revised by 8 specialists (pedodontist, orthodontist, oral pathologist, oral radiologist, and oral disease specialist). After discussions with the experts, two questions were added and five questions were revised, which was the modified version of the primary questionnaire, and no irrelevant question was detected. Content validity index (CVI) for each question was calculated. In each question which CVI was lower than 0.78, it had been modified. After modification, index of each question and questionnaire was obtained. Questionnaire index was 0.8. Regarding reliability evaluation, the questionnaire was completed by 43 physicians and pediatricians. Cronbach's alpha confirmed the questionnaire's reliability and an acceptable reliability was shown (α = 0.66). Data analysis was performed by the SPSS18 software, using independent -sample t-test and linear regression models. Values of P < 0.0500 were considered statistically significant.

Results

In this cross-sectional survey, 399 questionnaires were analyzed, including 352 (88.2%) General practitioners and 47 (11.8%) pediatricians. The mean age of participants was 40.16 ± 20.85. More than half of participants were females (52% general practitioners and 57.4% pediatricians). Demographic characteristics of participants according to scientific degree were shown in table 1.

Mean score of knowledge questions was 4.03 ± 0.97 (67.13 ± 16.33).

Knowledge level of general practitioners and pediatricians was shown in figure 1. Years number after graduation (P = 0.0230), gender (P = 0.0001), and scientific degree (P = 0.0150) had significant relationship with knowledge mean of persons. In the other hand, mean score of knowledge in females was higher than males. Mean score of knowledge in pediatricians was higher than General Practitioners, but in participants with low clinical experience, this score was more. Multivariate analysis has been shown in table 2.

Mean score of attitude questions was 16.5 ± 3.1 (82.65 ± 15.54). Level of participants' attitude toward prevention of dental caries was described in figure 1. A significant relationship was seen in years' number after graduation (P = 0.0060) and years of activity (P = 0.0150) with the mean score of attitude.

Table 1. Demographic characteristics of general practitioners and pediatricians

Variable	General practitioner	Pediatrician
Male [n (%)]	169 (48)	20 (42.6)
Female [n (%)]	183 (52)	27 (57.4)
Years of medical practice (mean ± SD)	11.4 ± 8.2	19.7 ± 16.3
Working hours per week (mean ± SD)	39.85 ± 16.70	35.75 ± 9.62
Number of patients visited per day (mean ± SD)	33.84 ± 39.60	39.6 ± 16.50

SD: Standard deviation

Table 2. Multivariate analysis between mean knowledge score and demographic variables in participants

Variable	Demographic characteristics	P	B
Knowledge	Gender	0.0001	+0.723
	Graduated year	0.0230	-0.030
	Scientific degree	0.0150	+0.825
Attitude	Years of medical practice	0.0150	+0.041
	Graduated year	0.0060	+0.047
Practice	Number of patients visited per day	0.0950	-0.004
	Scientific degree	0.0001	+1.794

Mean score of practice questions was 6.2 ± 2.4 (68.65 ± 26.67).

Participants' practice concerning dental caries prevention was shown in figure 1.

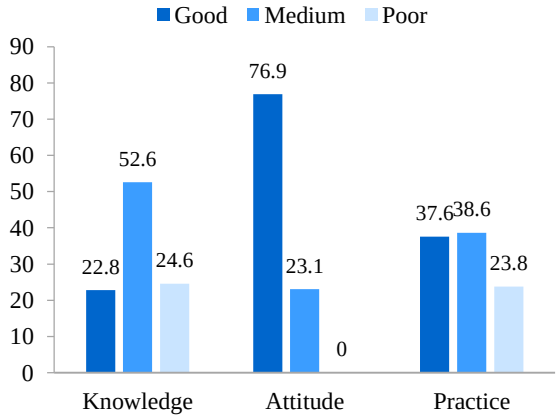

Figure 1. Knowledge, attitude and practice level of general practitioners and pediatricians

Significant relationship was shown in number of patients visited per day (P = 0.0950) and scientific degree (P < 0.001) with practice mean of participants.

Comparison of knowledge, attitude and practice of pediatricians and practitioners was demonstrated in table 3.

We found a significant relation between knowledge and attitude (P < 0.001), knowledge and practice (P = 0.004) also attitude and practice (P = 0.002) of all participants.

In the last section, 40.8% of participants stated that they had no specific resources about caries preventive methods and only 16.4% of them reported that they get preventive information from college courses and continuing education programs (Table 4).

Considering different types of preventive cares, children of practitioners and pediatricians have been received fissure sealant and fluoride therapy 4% and 6%, respectively.

Results revealed that 376 (94.2%) of participants need more information about caries preventive methods.

Discussion

This study tried to investigate knowledge, attitude and practices of General Practitioners and pediatricians toward preventive methods. All the study population had good level of attitude and moderate level of knowledge and practice, which confirms the findings of Yahya and Solmaz's study[9] regarding knowledge but it didn't confirm to attitude and practice. It indicated that the universities have paid more attention to preventive care in educational curriculum in recent years.

Table 3. Comparison of knowledge, attitude and practice numbers of general practitioners and pediatricians regarding preventive methods of dental caries

Variable	General practitioner (mean ± SD)	Pediatricians (mean ± SD)	P
Knowledge	65.0 ± 16.6	85.0 ± 14.0	< 0.0010
Attitude	80.0 ± 20.3	84.0 ± 11.2	0.7570
Practice	62.4 ± 20.5	79.6 ± 32.7	< 0.0010

SD: Standard deviation

Table 4. Sources of participants' information about caries preventive methods

Resources for caries prevention information	n (%)
Not specific resource	162 (40.8)
Colleagues	84 (21.2)
Scientific journals	77 (19.4)
College courses	35 (8.8)
Continuing education programs	30 (7.6)
Others	9 (2.2)

Similar to the previous study,[10] we found that higher educational degree leads to higher knowledge and practice level. It may be related to longer educational studies and more responsibility of pediatricians to preventive care.

Clinical experience had positive effect on attitude of general practitioners and pediatricians. Recently, graduated physicians had more knowledge level regarding caries preventive methods. Moreover, their knowledge number significantly increased 0.03 for each year. This fact is matched with Di Giuseppe et al.[10] and Eslamipour et al.[11] study. This finding may reflect that newer graduated persons have more information and they also spend more time for learning novel preventive methods.

Similar to other studies (Lewis et al.[12] and dela Cruz et al.[13] studies) patients' number per day had a significant relation to physician's practice. Physicians with crowded offices had poor practice regarding preventive interactions. A large number of barriers might have resulted in such a situation. One of the problems is short appointments which force the physicians to exclude preventive measures such as oral health. In addition, inadequate partnership between health professionals and oral health professionals to solve existing problems is another issue. It is strongly recommended to resolve these problems through an evidence-based and collaborative approach.

In this research, male's knowledge about preventive methods was significantly lower than females. It's indicated that females had more precise view and sensitivity to preventive measures and perhaps they feel more responsibility in comparison with males.

A survey of physicians' attitudes regarding pediatric dental health concluded that, although they are the first health professionals in contact with the parents, they are not well informed about dental health.[14] Sanchez et al. assessed the knowledge and attitudes of pediatricians and family practice physicians toward pediatric preventive dental care. Both groups recognized that they received inadequate information regarding pediatric preventive dental care during training and almost unanimously advocated increasing their knowledge through medical and specialty training or continuing education.[15] Clearly, family practitioners and other primary healthcare providers must receive additional education before they can assume a larger role in the early detection of oral and dental diseases.[16-18]

More than 90% of participants gain their information from colleagues or scientific journals and education programs, but only 9% of individuals get their information from college courses which confirms finding of studies by Sanchez et al.[15] and Eslamipour et al.[11] This finding showed that education of physicians is not enough desirable as it could be. Therefore, increasing preventive dentistry topics in the medical college courses can be useful in this respect. More than 94% of the participants need more information about preventive dentistry, which is in line with Bozorgmehr's et al. findings.[8] Fortunately, it's indicated that physicians know their weakness in this field. Hence, we strongly suggested to program for improving the knowledge of physicians. It is necessary to investigate the role of problem-oriented technique in continuous education programs. Educational programs have undergone revisions to improve them to impart knowledge to physicians to help them provide guidance on oral health practices for families and also prevent and offer therapeutic services for them. These efforts

entail major revisions in all the levels of medical education and in the policies and strategies involved to bring about improvements in the services provided by the physicians. In this context, commitment and proper attitudes are of utmost importance. A process of change such as this will require cooperation among many organizations and a pure dedication to ameliorate oral and dental preventive care for children. Social desirability may cause over –or under report attitudes and practices in self-report questionnaire. To avoid this weakness, we assured the respondents' anonymity.

We suggest that following measures may be taken to solve this problem.

1. Preventive dentistry topics and journals included in medical curriculum.
2. More communication between medical and dental students.
3. Encourage practitioners and pediatricians to refer the target group of caries (ages 3-12) to the dentists regularly.
4. Conferences should be held regarding caries preventive methods in medical schools.

Upgrade the knowledge about preventive dentistry can be done by sending the pamphlets, posters, and brochures to the practitioners and pediatricians.

Conclusion

Our research showed, although practitioners and pediatricians have more communication and closer relationship with target group of caries, unfortunately, they had not desirable knowledge and practice regarding caries preventive methods.

Conflict of Interests

Authors have no conflict of interest.

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Evaluation of salivary immunoglobulin A level in thalassemic patients with periodontitis in comparison with thalassemic patients with healthy periodontium

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Original Article

Abstract

BACKGROUND AND AIM: This study was conducted to evaluate salivary immunoglobulin A (IgA) level in thalassemic patients with periodontitis in comparison to thalassemic patients with healthy periodontium.

METHODS: Seventy-five patients were included in this study and were divided into three groups, group A: 25 major thalassemic patients with mild to moderate periodontitis, group B: 25 thalassemic patients with healthy periodontium, and group C: 25 systemically healthy people with normal periodontium. To measure salivary IgA levels, stimulated saliva was collected and analyzed by enzyme-linked immunosorbent assay (ELISA). The data were analyzed by t-test, ANOVA, and chi-square.

RESULTS: Salivary IgA was significantly different in major thalassemia patients with periodontitis (69 µm/ml) in comparison to major thalassemia patients with healthy periodontium (81 µm/ml) ($P < 0.05$). The highest level of salivary IgA was observed in the systemically healthy people with normal periodontium (88 µm/ml).

CONCLUSION: The levels of salivary IgA were decreased in major thalassemia patients with periodontitis and healthy periodontium in comparison to systemically healthy people with normal periodontium.

KEYWORDS: Major Thalassemia; Periodontitis; Immunoglobulin A

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Thalassemia is a congenital disorder in which protruded maxilla, severe malocclusion, open bite, flattened bridge of the nose, upper lip protrusion and glossitis have been observed in these patients.[1,2] In thalassemic patients, T cell response is diminished and cellular immunity impairment is seen.[3] So immune system of these patients cannot control infection well and preventive dentistry is necessary because of anemia, iron overload, and splenectomy.

Although the prevalence and severity of periodontal diseases have been demonstrated in association with a number of systemic diseases,[4,5] but little information exists on the relationship between periodontal disease and thalassemia and there are contradictory results in this area.[6]

In addition to the effect of thalassemia on systemic immunity, local defence system is also affected. Therefore, no changes in salivary immunoglobulin levels in thalassemia patients with gingivitis is due to lack of response of B-lymphocytes to gingival inflammation. It was shown that burning sensation and dry mouth are the most frequent oral manifestation in thalassemia patients. One of the causes of local immune deficiency is dry mouth that reduces salivary

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immune function. So, local salivary immunity of thalassemia patients is not responsive well against the gingivitis.[7]

To date, few studies evaluated the level of salivary immunoglobulin A (IgA) in thalassemia patients, and the most studies have focused on serum immunoglobulin levels,[8-10] that are inconsistent with salivary immunoglobulins titer results.[7] Since there is little information about the relationship between periodontal disease and thalassemia, and the results of studies are contradictory, we compared salivary IgA titer in thalassemic patients with mild to moderate periodontitis and thalassemic patients with normal periodontium.

Methods

In this descriptive study, a total of 75 patients aged 10-25 years old were enrolled in three groups, group A: 25 major thalassemia patients with mild to moderate periodontitis, group B: 25 thalassemic patients with healthy periodontium, and group C: 25 systemically healthy people with normal periodontium. The groups were matched in terms of gender and age. This study was approved by Ethics Committee of Kerman University of Medical Sciences, Iran, and the ethical code was k/92/479. Exclusion criteria was any antibiotic use during the last 2 weeks. Before examination, the information of patients such as age, gender, and splenectomy was recorded. Diagnosis of periodontitis was based on clinical attachment level. To measure the clinical attachment level, a Williams probe was used to determine the distance between the cemento enamel junction (CEJ) and the base of pocket. In group A, amount of loss of attachment was between 1-4 mm while there was not any loss of attachment in groups B and C. Selection of patients was performed by an experienced periodontist. The patients were selected by convenience sampling.

Collection of saliva sample

Sampling of saliva was performed at the same time between 11 to 12 am in all patients. A few drops of 1% solution of citric acid was poured on the back of patient's tongue to stimulate salivary secretion and after 1 minute, saliva was collected in sterilized tube and was sent to the laboratory in ice pack.

Enzyme-linked immunosorbent assay (ELISA) protocol

In this experiment, specific kit to measure salivary IgA (SigA, Salimertics, UK) has been used. When performing the test, the saliva samples which were frozen at -70 ºC were first melted and after vortex they were centrifuged at 1500 g for 15 minutes in order to remove any mucins and other insoluble particles. Simultaneously, along with preparing the saliva samples, serial dilution (with the concentrations of 600, 200, 66.7, 22.2, 7.4 , and 2.5 mg/ml) of the standard solution was made by using standard solution available in the kit. Next, by use of the diluent of the kit, the saliva samples were diluted to a ratio of 1:5 and then 50 ul of anti-SIgA antibody which been conjugated with horseradish peroxidase (HRP) enzyme were added to the tubes containing the standard solutions and aslo the saliva. Accordingly, in such condition, the amount of extra antibody which was not attached to SIgA was conversely proportional to the amount of SIgA that was available in the samples. After 90 minutes incubation in room temberature and mixing, 50 µl of the material inside the tubes were duplicated within the ELISA well plates whose surfaces were coated with human SIgA. All of the free conjugated anti-SIgA antibodies were connected to the SIgA on the surface of ELISA wells. After 90 minutes of incubation and six times washing with washing buffer, conjugated antibody attached to the SIgA on the surface was measured after adding 50 µl substrate 3,3′,5,5′-Tetramethylbenzidine (TMB), 45 min incubation in darkness and adding Stop solution (1 normal sulfuric acid). The absorbance rate in each of the wells was measured by ELISA reader machine (Biotech, USA) at a wavelength of 450 nm. Using the obtained standard curve, the concentration of

IgA dissolved in saliva in each of the samples was determined. Chi-square, t-test, analysis of variance and post-hoc Tukey test were used for statistical analysis.

Results

The age of all patients entered in this study was in the range of 10-25 years. Forty-six percent of patients were male and 54% were female. There was no significant relationship between age and gender and level of salivary IgA. IgA titer in group A was 69 µm/ml and it was 81 µm/ml and 88 µm/ml in groups B and C, respectively.

Salivary IgA level is demonstrated in table 1 which expressed as mean ± standard deviation (SD) in these three groups. The maximum level of salivary IgA was reported in group C, and the least titer was seen in group A. The difference between these three groups was statistically significant ($P < 0.05$). Prevalence of splenectomy was 12.5% in group A and 16.0% in group B. There was no statistically difference between splenectomy and level of IgA in these patients ($P > 0.05$).

Table 1. Comparison of salivary immunoglobulin A (IgA) levels in groups A, B, and C

Groups	Mean ± SD (µm/ml)		P
Group A	69	8.5	0.003
Group B	81	6.8	
Group B	81	6.8	0.001
Group C	88	5.9	
Group A	69	8.5	0.001
Group C	88	5.9	

SD: Standard deviation

Discussion

In thalassemic patients both local and systemic immunity systems are affected. Until now, a few studies evaluated the level of salivary IgA in thalassemic patients and most of them focused on serum immunoglobulins.[8-10]

In our study, there was significant difference between thalassemic patients with periodontitis in comparison with thalassemic ones with healthy periodontium. The level of IgA in group A was lower than the group B. Furthermore, IgA level was lower in thalassemic groups in comparison with systemically healthy patients.

In Siamopoulou-Mavridou et al.[7] study, the levels of stimulated salivary IgA in thalassemic patients with gingivitis was lower than healthy people. This result is simillar to our study that was performed on periodontitis patients. In Motaleb Nejad et al. study,[11] the levels of salivary antibodies in thalassemic patients with gingivitis was evaluated and although mean antibody level in gingivitis group was higher than control group but this difference was not significant. They justified this slight increase of antibody by immune system dysfunction.[11] Their results were inconsistent with the results of our study.

Apart from the two above-mentioned study,[7-11] other studies have focused on the level of serum immunoglobulin and their results have been contradictory, so that some of them showed decrease while in other studies increase or no change was reported.

In Macdougall et al. study,[12] humoral immune system of children with iron deficiency was evaluated and the results demonstrated that the average concentration of serum IgA was normal and comparable with healthy adults. In another study that humoral immune system of thalassemic patients was investigated by Ghaffari et al.,[13] none of humoral immunity markers such as IgG, IgM, IgE was significantly different compared to healthy controls but there was a modest rise in antibody levels of IgA. They concluded that there was no need to evaluate humoral immune system in routine immune tests in thalassemic patients. In another study, serum levels of IgM and IgG were significantly higher in these patients and with increasing age, the amount of these antibodies increased.[14]

In our study, IgA level was lower in thalassemic patients with periodontitis in comparison with thalassemic patients with healthy periodontium and both had lower values than systemically healthy people with normal periodontium. These differences between studies may be due to various

factors that affect the level of antibodies in saliva such as methodological problems and standardization of preparation, collection and storage of saliva, loss of protein during sample preparation and technical methods such as particle-enhanced nephelometric immunoassay and ELISA, flow rate of saliva, acute or chronic stress factors, age, gender, and geographic variables.[15]

In the studies that collected the unstimulated saliva, amounts of IgA were at least 3 times more than studies in which the stimulated saliva was used. Stimulated saliva sampling is preferred, because the method is easier and not affected by saliva storage in salivary glands. Salivary IgA is a part of adoptive immune system. Therefore, daily and seasonal variations, type of food, smoking, level and type of male and female hormones can influence on IgA levels in different times.[15-18] In thalassemic patients that undergo splenectomy surgery, systemic as well as local immune response is reduced, so that in studies on these patients gingival inflammation was higher than thalassemic patients with no history of this surgery.[19] Tovo et al.[8] demonstrated that in the splenectomized patients in comparison to the non-splenectomized ones, a significant increase was observed in IgG and IgA in the elder ones while a significant reduction was observed in IgM. Because of the low sample size of our study for patients underwent splenectomy, the data did not show any association between splenectomy and IgA level.

Our results showed that saliva of thalassemic patients cannot response well against infection because in these patients, function of T-cells is impaired and B-cells activity is influenced consequently and cannot defend well.

Conclusion

The results showed that salivary IgA in thalassemic patients with periodontist was lower than patients with normal periodontium. Because of impaired local immune systems in thalassemic patients, dental preventive and therapeutic consideration would be necessary.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

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The level of evidence of published articles on orthodontics in PubMed journals from Iran during 2000-2015

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Original Article

Abstract

BACKGROUND AND AIM: Evidence-based dentistry (EBD), including orthodontics, needs the availability and use of the high-quality studies. The aim of this study was to identify the level of evidence (LOE) of Iranian articles on orthodontics published in PubMed.

METHODS: All the articles on orthodontics published from 2000 to 2015 in PubMed with Iran affiliations were extracted by typing orthodontics medical subject heading vocabulary in the PubMed search. Then, the study design of each article was determined followed by assigning LOE according to Oxford scale whereby systematic review and randomized clinical trial possess highest-LOE and expert opinion has lowest-LOE. Descriptive statistic indices were applied to summarize the results.

RESULTS: Of all the articles, 34.6% were in-vitro, 24.3% were cross-sectional and 8% were randomized controlled trials (RCT). In terms of LOE, just 5% were level 1, whereas 45.9% were non-evidence. The number of articles with high-LOE increased from 2009 to 2015.

CONCLUSION: The number of orthodontic articles published in PubMed from Iran has increased in recent years. Nonetheless, there are still deficiencies in high-LOE studies.

KEYWORDS: Evidence-Based Dentistry; Level of Evidence; Orthodontics

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Evidence-based dentistry (EBD) is "an approach to oral health care that requires the judicious integration of systematic assessment of clinically relevant scientific evidence, relating to the patient's treatment needs and preference" as defined by American Dental Association (ADA).[1] Evidence-based clinical decision-making needs the availability, access and use of large and high-quality studies.[2] According to the hierarchy in EBD, meta-analyses (MA), systematic reviews (SR), and randomized controlled trials (RCT) are rated as the highest-quality studies.[3] Some bibliometric studies that are the quantitative analysis of publications have been conducted in the field of orthodontics. Sun et al.[2] assayed the clinical orthodontic evidence on Medline from the year 1966 to 1999 and concluded the less number of articles were related to therapy, Hui et al.[4] analyzed the characteristics of 100 top-cited articles from 1975 to 2011, and Primo et al.[5] quantified the published orthodontic literatures in Brazilian and international publications from 1999 to 2009. Both reported that the majority of studies rarely possess high-quality scientific evidence.

The data resulting from bibliometric studies can reflect the scientific progress in a given field or country, but a few publications can provide clinically applicable information. Further assessment is needed to identify the level of evidence (LOE) of studies.[2,6] LOE was evaluated by Sackett for the first time and

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updated by the "Oxford Center for Evidence-based Medicine" in 2009 whereby the highest-LOE includes RCT, and the lowest LOE includes studies that detail expert opinion.[4]

In recent years, Iran has demonstrated notable growth in medical sciences, including dentistry.[7,8] Badri et al.[6] surveyed orthodontic research output from Iran in international and national journals and concluded that orthodontic research production in Iran has made significant progress during the recent years until 2012. Although some studies have been performed to quantify the availability of orthodontic literature,[2,4-6] there is not any study to show LOE in orthodontic articles.

The aim of this study was to assess the LOE in orthodontic articles published in PubMed-indexed journals from Iran during 2000 to 2015.

Methods

A PubMed search was conducted for all the published orthodontic articles in PubMed-indexed journals from Iran. We (M.Sh and A.Sh) typed "((orthodont*) OR (malocclusion*) OR (functional orthopedic*) OR (crossbite*) OR (open bite*) OR (deep bite*) OR (overbite*) OR (prognath*) OR (orthognath*) OR (retrognath*) OR (mandibular deficiency*) OR (Mandibular excess) OR (maxillary deficiency*) OR (maxillary excess) OR (growth modification) OR (dentofacial orthopedics) OR (maxillary growth) OR (mandibular growth) OR (molar relationship*) OR (occlusal problem*) OR (occlusal anomal*) OR (occlusal discrepancy*) OR (tooth problem*) OR (tooth anomal*) OR (tooth discrepancy*) OR (vertical excess) OR (vertical deficiency*) OR (tooth movement*) OR (tooth correction*) OR (teeth correction*) OR (tooth alignment*) OR (teeth alignment*) OR (distal movement*) OR (mesial movement*) OR (distalization) OR (mesialization) OR (functional appliance*) OR (removable appliance*) OR (fixed applianc*))"[9] in the "all fields" search box and the word "Iran" in the "affiliation" search box. We activated the "publication dates" from 1 January 2000 to 31 December 2015. First, we scanned all the titles and divided the articles into "related," "unrelated" and "uncertain," and then we reviewed the abstracts of all uncertain articles and excluded all "unrelated" articles. Data extraction included "year of publication," "study design," and "LOE." Identifying study design and LOE, we surveyed the abstracts (not relying on the title alone) as well as full-texts if they were indistinct.

Level categorization was conducted by the authors according to table 1 which is a modification of levels in accordance to "Center for Evidence-Based Medicine"[10] and "American Society of Plastic Surgeons"[11] and "Australian National Health and Medical Research Council."[12] LOE ranks studies according to the probability of bias and quality of studies, therefore, RCTs have the highest level because they are designed to be unbiased. On the other hand, a poorly designed RCT has the same level as a cohort study. An expert opinion is often biased by author and has lowest-LOE.[13] Articles including in-vitro study, animal study, review, letter, news, and tutorial were classified as non-evidence (LOE 0).

All the extracted data were entered in SPSS (version 18, SPSS Inc., Chicago, IL, USA) spreadsheet. Descriptive statistical indices were used to summarize the results.

Table 1. Level of evidence (LOE)

Level	Type of evidence
1	High-quality RCT, or SR of this studies
2	Non-randomized clinical trial, or prospective cohort, or SR of these studies
3	Retrospective cohort, or case-control study, or SR of these studies
4	Case-series, or cross-sectional study
5	Case report, or expert opinion

RCT: Randomized controlled trials; SR: Systemic review

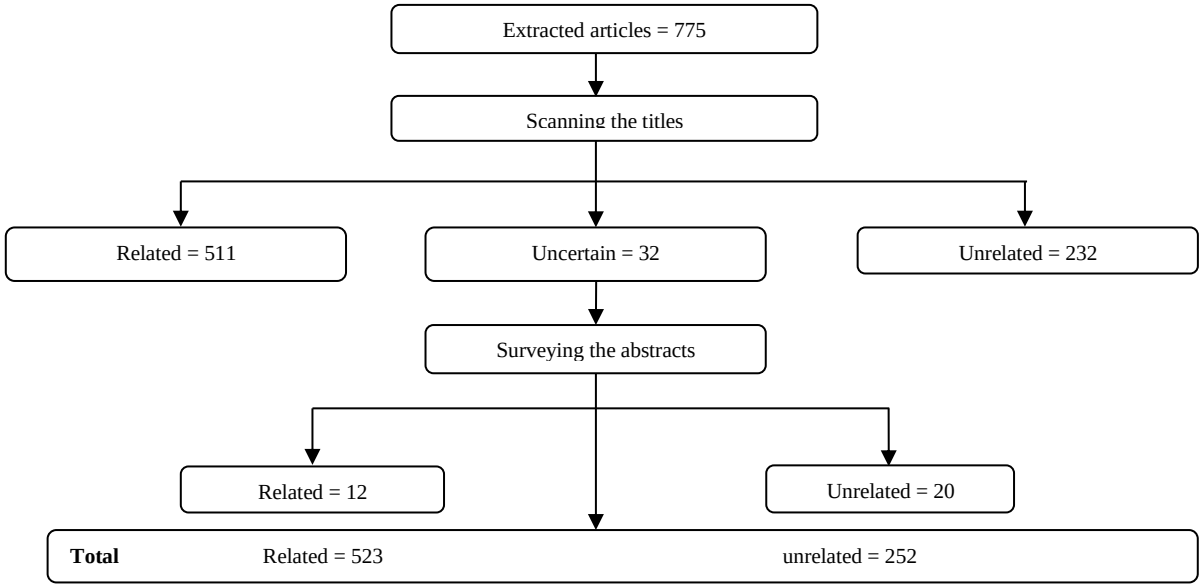

Figure 1. Flowchart of selected articles

Results

A total of 523 related articles were evaluated in this study (Figure 1). The number of published orthodontics articles from Iran and cited in PubMed per year from 2000 to 2015 is shown in figure 2.

Study designs of the articles are shown in figure 3. Most articles were in-vitro, followed by cross-sectional studies. Of all the articles, 42 were RCTs.

The distribution of articles based on their LOE is shown in figure 4. Of 523 articles, 240 (45.9%) were deemed non-evidence and just 26 (5.0%) were level 1.

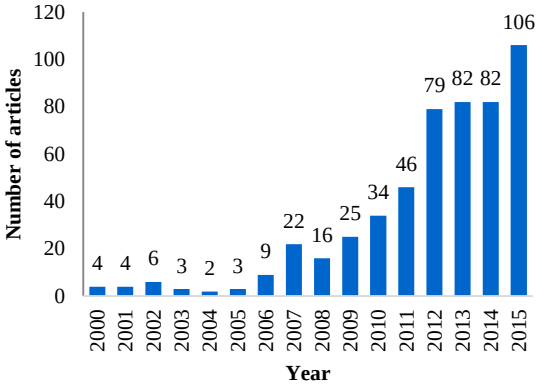

Figure 2. Number of articles per year

In terms of studies with LOE, there was not any level 1 evidence from 2000 to 2008. The number of articles with high LOE increased from 2009 to 2015, especially in 2015 (Figure 5).

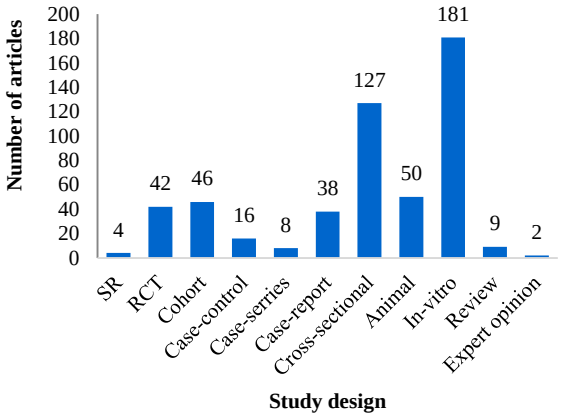

Figure 3. Frequencies of articles based on study design

RCT: Randomized controlled trials; SR: Systemic review

Discussion

Recently, there has been a tendency toward EBD,[14] including orthodontics. Orthodontics, as a biological science, uses many forms of evidence but evidence-based orthodontics is based on using the best information available; so it is critical to know what information is available.[15] In this regard MA, SR, and RCT possess the highest LOE.[3]

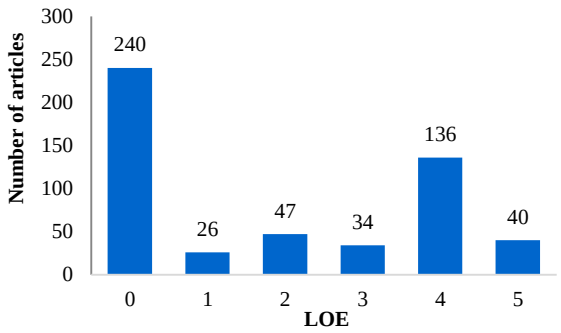

Figure 4. Number of articles in each level of evidence (LOE)

In this study, we found that just 5% of articles ranked as level 1 of evidence, whereas most of the articles (45.9%) were labeled as non-evidence, consistent with other studies.

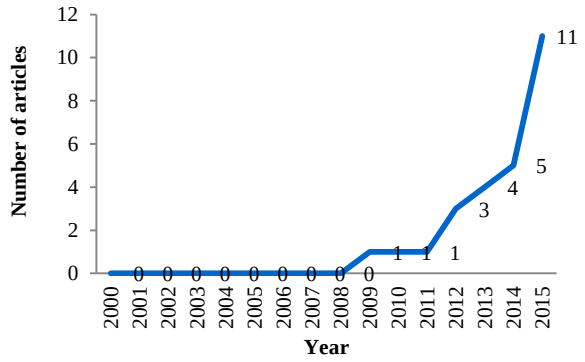

Figure 5. Trend of level 1 evidence per year

Paik et al.[16] and Torabinejad et al.[14] conducted studies to assign LOE for the outcome of endodontic retreatment and nonsurgical endodontic treatment, respectively, and both found that the majority of articles were low-LOE.

Shafiei and Shahravan[17] rated the LOE in two leading endodontic journals in 2012. They concluded that there is an increasing trend in the number of articles with high-LOE, but lack of articles that answer clinical questions can be felt.

Lau and Samman[18] assessed the LOE of four major journals in oral and maxillofacial surgery. None of the articles were level 1 whereas the majority of them were non-evidence.

Sadeghi et al.[8] evaluated the trend in dental research in Iranian publications from 1990 to 2009. The results showed that most Iranian dental articles have low potential to provide scientific evidence.

Lack of level 1 evidence is not surprising because there are difficulties in performing a standard RCT specially in orthodontics including: loss of follow-up because of trial length, difficulty to matching sample and control groups even in split-mouth design, variation in study designs, cost and many others,[19,20] but the main difficulties are related to randomization and random allocation.[14,18]

In-vitro studies constituted nearly one-third and animal studies formed almost one-tenth of studies which is consistent with Badri et al.[6] Both studies are categorized as non-evidence. Although most orthodontists look for evidence to use now, they have great regard for basic research (that can be defined as fundamental investigation) to advance scientific knowledge, without a specific application. Animal studies are sometimes prerequisites for clinical trials.[15,17]

The second most numerous articles were cross-sectional, comprising nearly a quarter of the articles which is consistent with Hui et al.[4] Cross-sectional studies take a short time to conduct; there is no loss in follow-ups. Although these studies cannot determine causal relationships, they can provide useful information for further research.[10,21]

Although RCTs comprised a small percentage, most of them were performed during 2013-2015. This finding shows that there has been a tendency among researchers to publish clinical trials recently. Other studies similarly showed this gradual increase in the number of high-LOE articles.[8,17,22]

We were aware that many papers from Iran are not indexed in PubMed; however, we used this source because of its open access and international visibility.[8]

Conclusion

Although the number of Iranian level 1

orthodontic articles indexed in PubMed has increased in recent years, it is not sufficient to answer the clinical questions in this field and it seems there is a long way to provide high-LOE research.

In addition to the number of articles, the quality of publication is also important; therefore, we suggest that further studies should be performed to critically appraise the articles.

Conflict of Interests

Authors have no conflict of interest.

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Assessment of stylohyoid ligament in patients with Eagle's syndrome and patients with asymptomatic elongated styloid process: A cone-beam computed tomography study

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Original Article

Abstract

BACKGROUND AND AIM: This study was performed to evaluate and compare the calcification patterns of the stylohyoid ligament in Eagle's syndrome (ES) patients, and asymptomatic patients with elongated styloid process (SP) via cone-beam computed tomography (CBCT).

METHODS: A total of 52 CBCT images in two symptomatic (ES) and asymptomatic groups (n = 26 per group) were assessed. The mean length and thickness of the SP, morphology, and pattern of calcification between the two sides in each group and between ES and asymptomatic groups were compared. The t-test was used for comparison. Fisher exact and chi-square tests were used to determine the relationship between different types of calcification pattern and morphology. The level of significance was considered at $P < 0.050$.

RESULTS: The SP was thicker in the ES group than the asymptomatic group. However, the styloid length showed no significant difference among the ES and asymptomatic groups. The most common pattern of calcification in both groups was partially calcified with no significant difference between the two study groups. The most common morphology in the asymptomatic and ES groups was "segmented" and "elongated," respectively.

CONCLUSION: The morphology and thickness of the SP showed a significant difference between the ES and asymptomatic groups. This can be helpful in differential diagnosis of facial, pharyngeal, and tonsillar pain.

KEYWORDS: Eagle Syndrome; Elongated Styloid Process Syndrome; Cone Beam Computed Tomography

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Eagle's syndrome (ES) is characterized by recurrent pain in the oropharynx and face caused by elongation of styloid process (SP) and calcification of stylohyoid ligament.[1] ES may be unilateral or bilateral and can be diagnosed based on the clinical and radiological investigations. Palpation of the SP in the tonsillar fossa is suggestive of the elongation process.[2]

Keur et al.[3] stated that if SP or mineralized stylohyoid ligament length is more than

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30 mm in radiography, it should be considered as an elongated SP. In the vicinity of stylohyoid complex (SC), there are critical structures such as cranial nerves and arteries that, in cases of elongation, create symptoms such as sore throat, difficulty in swallowing, foreign-body sensation, and limited head rotation. The pressure that is placed on the critical structures causes these symptoms.[4] The diagnosis is confirmed by radiological examination.[5,6]

Panoramic X-ray is the most common imaging method used for the detection of an elongated SP.[7,8] However, numerous factors such as magnification in different panoramic machines and the angle between the styloid and skull base can affect the measurements.[9,10] Therefore, three-dimensional techniques such as computed tomography (CT) or cone-beam CT (CBCT) are suggested. These methods can eliminate the errors caused by magnification or superimposition.[11,12] CBCT can be utilized to assess the anatomical structures in the craniofacial region accurately. The length and morphology of SP can be clearly shown on CBCT scans.[13,14]

There are different variants of elongated stylohyoid process regarding its length, thickness, angle, ossification degree, and pattern of calcification. Radiographic classification of the condition helps in diagnosis and treatment approaches.[15] Although the clinical assessment of ES has been described extensively in the articles, the radiographic findings have not been adequately described in the radiological literature.[16]

Patients with ES are often referred to a family physician, neurologist, psychiatrist, neurosurgeon or maxillofacial surgeon, but the successful treatment rate is usually low. One possible reason is that the term "ES" is not well known among physicians and thus often misdiagnosed.[17] Therefore, in patients with unexplained refractory head and facial pain, ES should be considered in the differential diagnosis.

Although a number of radiological studies have examined ES and the elongation of the SP, thus far, no research has been performed comparing ES patients and asymptomatic patients with long SP via CBCT. This study was performed with the aim of evaluating and comparing the calcification patterns of the stylohyoid ligament in patients with ES and patients with asymptomatic elongated SP as detected via CBCT images.

Methods

This retrospective study was performed on the patients referred to a private radiology center in Mashhad for CBCT imaging from 2008 to 2014. The patients had no background systemic disorder. The method of sampling was non-probability sampling based on the purpose. Informed consent was acquired. The Ethics Committee of Mashhad University of Medical Sciences approved this study (Code: 920428). CBCT scans were obtained with the ProMax 3D (Planmeca, Helsinki, Finland) (kVp = 64-68 mA = 8-12).

All CBCT images in which SP was completely imaged and its length was longer than 30 mm on both sides were evaluated. 52 CBCT images in two groups of symptomatic cases with ES and asymptomatic (26 in each group) were enrolled.

Two oral and maxillofacial radiologists who were blind to the patients' status evaluated CBCT scans. Divergent interpretations were discussed with a third radiologist, and final agreement was obtained in all cases.

The measurements were made by Romexis® digital imaging software, version 2.9.2 (Planmeca, Helsinki, Finland) on the central sagittal slice (slice thickness = 0.2 mm).[18]

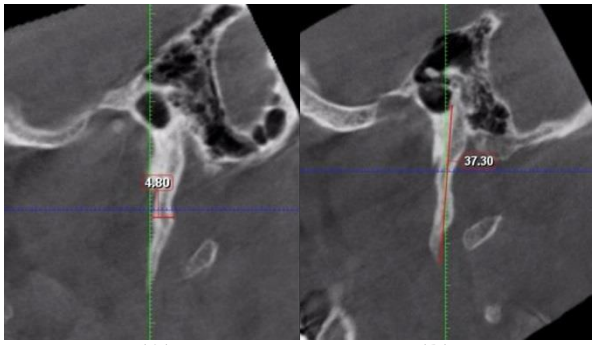
From 52 patients eligible for the study, 26 patients had bilateral long SPs alongside bilateral symptoms such as sore throat, referred otalgia, temporal headache, infraorbital neuralgia, limited head movement/rotation, difficulty in swallowing, and foreign-body sensation in the throat; titled as the ES group (carotid artery syndrome

type). None of these patients had a history of neck trauma or surgery (classic Eagle).

The other 26 cases (asymptomatic group) had CBCT scans for different reasons such as maxillofacial fractures or orthognathic preoperative evaluation. They had bilateral long SP with no symptoms similar to ES.

For each SP, maximum thickness and length, morphology type, and pattern of calcification were recorded based on Langlais et al. radiographic classification.[19] Measurements were repeated at an interval of 2 weeks, and the mean values were registered.

According to Langlais classification, elongated SP has three types. In Type I, elongated process appears as a completely calcified non segmented structure. Type II is a pseudoarticulated type that mineralized stylohyoid ligament is attached to the SP by single-pseudo articulate. In Type III (segmented), the ligament appears as a structure with interrupted mineralized parts. The calcification pattern has also four types including marginal (outline), partial, nodular, and complete calcification. The length of SP was measured from the point that the process is separated from temporal bone up to its tip regardless to its segmentation in sagittal view.[20] SC thickness was measured in the region with the greatest thickness (Figures 1-4).



(A) (B)

Figure 1. Measurement of the maximum thickness (A) and height (B) of styloid process (SP)

Finally, the mean length and thickness of the SP, the morphology, and the pattern of calcification were compared between the two groups.

Figure 2. A segmented long styloid process

Good interobserver agreement was obtained between the radiologists (kappa = 0.83). The t-test was used to compare the two groups for variables with normal distribution. Furthermore, the Fisher exact test and chi-square test were used to determine the relationship between different types of calcification pattern and morphology. The level of significance was considered at $P < 0.050$. Statistical calculations were performed with Microsoft Excel 2011 and SPSS (version 16, SPSS Inc., Chicago, IL, USA).

Figure 3. A completely calcified long styloid process (SP)

Results

In our study, the mean age of the patients was 46.11 ± 8.97. It was slightly higher in the symptomatic group than in the asymptomatic

Table 1. Comparison of the length and thickness of the styloid process (SP) according to the side

SP characteristic	Group	N	Mean ± SD	Test result
Length (left)	Asymptomatic	26	38.1700 ± 6.42528	P = 0.314
	ES	26	40.7400 ± 7.61719	
Length (right)	Asymptomatic	26	41.6215 ± 9.16026	P = 0.238
	ES	26	44.62190 ± 11.11813	
Thickness (left)	Asymptomatic	26	3.38080 ± 1.04452	P = 0.001*
	ES	26	4.75420 ± 1.90776	
Thickness (right)	Asymptomatic	26	3.19850 ± 1.12578	P = 0.001*
	ES	26	4.51880 ± 1.64157	
Length (both sides)	Asymptomatic	26	39.89580 ± 7.45124	P = 0.094
	ES	26	42.68100 ± 7.66693	
Thickness (both sides)	Asymptomatic	26	3.28960 ± 0.95292	P = 0.001*
	ES	26	4.63650 ± 1.60358	

*Significant. ES: Eagle's syndrome; SP: styloid process; SD: Standard deviation

group, but the difference between the two groups was not significant (P = 0.760).

Figure 4. A partially calcified long styloid process

The majority of patients in both groups were women. The number of women in the asymptomatic group was 21 (80.8%), and in the symptomatic group, it was 17 (65.4%). The chi-square test showed the same statistical sex distribution in both groups (P = 0.210).

The SP was thicker in the ES group than the asymptomatic group (P = 0.001) (Table 1). The mean length of SP was higher on the right side than the left in the asymptomatic group (P = 0.002) (Table 2). However, the styloid length showed no significant difference among the ES and asymptomatic groups.

The calcification pattern was mostly "partially calcified." A comparison of the two groups in terms of calcification patterns showed no significant difference (P = 0.140). The most common morphology in the asymptomatic and ES groups was "segmented" and "elongated," respectively.

Table 2. Comparison of the length and thickness of the SP according to the study group

Group	N	Mean ± SD	Test result
Asymptomatic			
Length (left)	26	38.17000 ± 6.42528	P = 0.002*
Length (right)	26	41.62150 ± 9.16026	
Thickness (left)	26	3.38080 ± 1.04452	P = 0.381
Thickness (right)	26	3.19850 ± 1.12578	
ES			
Length (left)	26	40.74000 ± 7.61719	P = 0.060
Length (right)	26	44.62190 ± 11.11813	
Thickness (left)	26	4.75420 ± 1.90776	P = 0.282
Thickness (right)	26	4.51880 ± 1.64157	

*Significant. ES: Eagle's syndrome; SD: Standard deviation

Discussion

In this study, the CBCT scans of 52 patients with a mean age of 46 years in two groups-symptomatic (ES) and asymptomatic-were studied. The results of our study revealed that the mean thickness, whether bilaterally or unilaterally, was significantly higher in the ES group than the asymptomatic group.

Oztunc et al.[21] retrospectively studied CBCT scans of 208 patients with neurological symptoms in the maxillofacial region. The structure, length, and medial angulations of SP were measured. Elongated SP was observed at the left side (13%), right side (8%), and bilaterally (33%). Increased prevalence of symptoms was noticed in patients with elongated SP.

In a study of 22 patients with ES, using axial CT, the mean SP length was 41 mm, with no significant difference between the left side and the right side.[22] Similarly, in this study, the mean SP length in the ES group was 42.7 mm with no significant difference at each side.

The most common pattern of calcification was partial with no significant difference between the two groups. In the ES group, the most common morphology pattern on both sides was Type I (elongated or continuous) (50%); whereas, in the asymptomatic group, the segmented type was dominated.

The results of studies performed in this field indicate that the most common type of SP calcification is a matter of debate. A study by Shaik et al.,[23] involved 1162 patients and looked at the prevalence of the elongated SP using panoramic radiography. An elongated SP was observed in 1085 cases, mostly in men and older patients. Type I morphology with outline calcification was reported to be the most common pattern.

In another study,[24] the SP was examined in 20 patients via panoramic and CBCT scans. SP calcification was more prevalent in elderly patients and tended to have an outline calcification pattern, whereas in our study, the most common type of calcification was partial. Another investigation on 207 patients, revealed that that the most common SP morphology observed in panoramic radiography was the continuous type.[9]

A study by More and Asrani,[25] which assessed 500 digital panoramic radiographs, found that Type I morphology and partial calcification were the more common patterns. The results were similar to ours in terms of both morphology and calcification pattern.

A study on 860 panoramic radiographs demonstrated that most of elongated SPs were bilateral and partially or completely calcified.[15]

Interestingly in our study, in patients with ES, a significant difference was observed between the left and the right sides in terms of the morphology and pattern of calcification. One limitation to the present study was that only patients with bilateral long SPs were enrolled; more research is needed to be conducted on other cases.

Conclusions

This study is unique due to a narrow range of the inclusion criteria used such as having the same age and sex distribution in the two groups. It seems that selecting a larger and more comprehensive sample size would help, statistically offering a more valid set of results. The results obtained in this study, which showed a significant difference between the two study groups in terms of morphology type and the thickness of SP, could be useful in differential diagnosis of pain in the face, neck, throat, and tonsils.

Conflict of Interests

Authors have no conflict of interest.

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Short-term effect of two education methods on oral health among hearing impairment children

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Original Article

Abstract

BACKGROUND AND AIM: Poor oral health among children with impaired hearing has been reported frequently due to lack of communication skills and effective health educations. In this study, we assessed the effect of two training methods on short-term oral health outcomes among children with impaired hearing.

METHODS: In this experimental study, 80 hearing impairment (HI) student aged 7-19 years old were randomized into two groups, one group watched a guided training video and the other group was educated by a dental model. The training sessions were weekly and continued for 1 month. A trained dentist examined all participants using O'Leary plaque index (PI) at baseline, 1-month, and 3-month visits.

RESULTS: At baseline, the difference between the mean O'Leary PI in the video training and dental model training groups was not significant (34.3% vs. 35.6%). In the video training group, sharp decrease was seen at the 1-month visit (reinforcement periods), i.e., 18.7% (P = 0.001), followed by a slight increase at the 3-month visit (non-reinforcement periods), i.e., 19.1% (P = 0.100), respectively. On the other hand, in the dental model, a decreasing trend was seen 24.7% at 1-month (reinforcement periods) and 19.9% (P = 0.001) at 3-month visits (non-reinforcement periods). Overall, there were no significant differences between the two methods of training (P = 0.300).

CONCLUSION: Both video and dental model effectively improve the oral health of children with HI in short term. Continuous school-based oral health education programs, particularly for HI children, need to be considered.

KEYWORDS: Hearing Impairment; Plaque Index; Oral Health; Education

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Oral health is a critical component of the overall health and quality of life worldwide.[1,2] Oral health effects on nutrition, growth, learning, communication, and quality of life of partially children.[3] Dental procedures and treatments for poor oral health conditions are so expensive and roughly cost 5-10% of all public health budgets in industrialized countries.[4]

Dental caries is one of the preventable diseases in childhood and caused by dental plaque.[5,6] Several studies showed that children with disabilities have higher levels of caries and

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untreated periodontal disease.[1,7-10] Children with impaired hearing have difficulties in speaking and communication and so learning process would be longer and even more challenging than the other children without such disabilities.[9] Schools are potentially perfect places for training and development of healthy habits and behaviors for children at young ages.[3] Previous studies have shown that education through posters or instructional videos in sign language was useful to raise awareness about oral cancer, prostate, and breast cancer among deaf people.[11-13]

Previous studies showed that training through video and dental model has been shown to be effective in improving the oral health of students with hearing impairment (HI) in Andhra Pradesh and Karnataka, India, respectively.[1,14] However, they did not measure the effect of oral health education after the period without any training, and they using one method of education in each research, also they using different indexes to recorded plaque score. As regards we not found the similar study in Iran, in this study, we assessed the effect of two training methods on short-term oral health outcomes among children with impaired hearing in reinforcement and non-reinforcement period.

Methods

Sampling and random allocation

Using the list of graduate students (N = 100) from the three primary schools that provide education services for children with HI in Kerman, we recruited 80 eligible participants into the study according to inclusion criteria. Then, children divided into two groups (Group A and Group B) by random allocation. That is, students in each class were random divided into two groups (A and B) by lottery. Students were given training oral health through videos on Group A and through the dental model in Group B.

Ethics review and consenting process

All protocol and study procedures were reviewed and approved by Ethics Committee Institution of Kerman University of Medical Sciences, Kerman, Iran (Ka/93/658-12 February 2015). A trained staff explained the study objectives and procedures to children's parents in group sessions and after debriefing answer to questions. Then, a written informed consent was obtained from all those provided consent.

Inclusion and exclusion criteria

Children aged between 7 to 19 years that present in the day of study and impaired hearing (70 dB or greater)[15] whom their parents provided written informed consent were eligible and recruited into the study. Disoriented children those with other oral diseases including dental fluorosis, severe caries, and severe periodontal disease.[16] Mental and physical disabilities at baseline visit were excluded from the study.

Measurements and procedures

A trained dentist used O'Leary plaque index (PI) to assess the oral health status of children with dental mirror and a probe in broad daylight. This index evaluated the presence of bacterial plaque on the four dental surfaces (mesial, buccal, distal, and lingual) by adding the total surfaces with plaque and dividing this by the total number of dental surfaces examined and then multiplying it by one hundred. The value of 10% or less considered as optimum oral health.[17]

After the baseline oral examination, all children received a package containing toothbrush, toothpaste, and dental floss and were asked to brush all tooth surfaces, three times a day after breakfast, lunch, and dinner. Parents were asked to avoid helping the children to brush their teeth during the study.

Training video clip

A 5-minute muted video clip (source: Colgate site: http://www.colgatebsbf.com.au/Kids) on how to brush and floss tooth correctly was demonstrated on screen for students in Group A. This session was guided by a trained dentist and a teacher who explained the content of the video by sign language. To ensure the training was sufficient, at the end

of the session, a child was asked to do the brushing and flossing, and further tuning and guidance was given.

Dental training model

First, a trained dentist explained the correct flossing and tooth brushing techniques using a toothbrush, flossing, and dental model for about five minutes to students in Group B assigned to this intervention. Simultaneously, a trained teacher explained the procedures in sign language. To ensure the training was sufficient, at the end of the session, a child was asked to do the brushing and flossing, and further tuning and guidance was given.

In both groups, the training sessions were repeated weekly for a period of 1 month. At 1-month visit, all children were reexamined by the same dentist, and O'Leary PI was calculated for all. Next, all children were asked to continue toothbrushing and flossing for 2 months. No training was given during this period, and after 2 months, they were reexamined by the same dentist and again the O'Leary PI was calculated for all (Figure 1).

Dentist does not know about type of training when recorded the plaque score in three times of study. In addition, data were encoding, and analyzer does not know about type of training.

Data analysis

We used the SPSS software (version 18.0, SPSS Inc., Chicago, IL, USA) for data analysis. The result of Shapiro–Wilk test showed that data had normality distribution. The change in the average of O'Leary PI over time and between the two groups was assessed by repeated measure test. Impact of follow-up time, HI severity, sex, education level, and age on outcome was assessed by linear mixed model; $P < 0.050$ was considered as significant.

Results

Study participants' characteristics

Our sample comprised 73 students. Seven cases were excluded from the study as they have dental fluorosis, severe caries, and mental and physical disabilities. Overall, 40 (54.8%) were male and the age ranged from 7 to 19 years old. While 36 (49.3%) of children had severe HI, the remaining suffered from moderate HI. Overall, 91.8% of students' mothers and 95.9% of students' fathers had diploma or less. No dropouts occurred during the study follow-up. Oral health education was given to 39 students

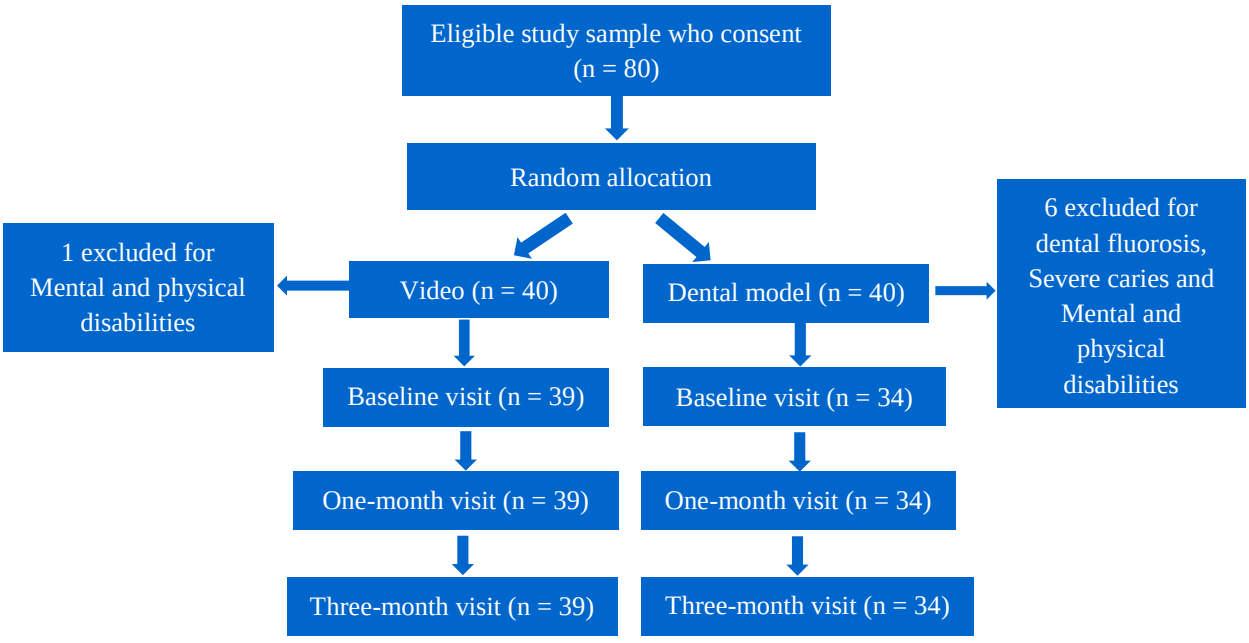

Figure 1. Flowchart of the study

Table 1. Demographic characteristics variable of children in two methods of training

Variable	Type of train			
	Categories	Video [n (%)]	Model [n (%)]	P
Gender	Female	17 (43.6)	16 (47.1)	0.760
	Male	22 (56.4)	18 (52.9)	
Hearing impairment	Severe	21 (53.8)	15 (44.1)	0.400
	Moderate	18 (46.2)	19 (55.9)	
Education level	First to third	18 (46.2)	17 (50.0)	0.740
	Fourth to sixth	21 (53.8)	17 (50)	
Age	7-12	22 (51.2)	21 (48.8)	0.640
	12-19	17 (56.7)	13 (43.3)	

through videos and 34 students through the dental model. The distribution of sex, age, HI severity, and education level was similar between the two intervention groups (Table 1).

PI

At baseline, the difference between the mean O'Leary PI in the video training and dental model groups was not significant (34.3% ± 16.4% vs. 35.6% ± 11.4%). In the video training group, sharp decrease was seen at the 1-month visit, i.e., 18.7% ± 8.1% (P = 0.001), followed by a slight increase at the 3-month visit, i.e., 19.1% ± 5.5% (P = 0.100) at the end of reinforcement and non-reinforcement periods, respectively. On the other hand, in the dental model, a decreasing trend was seen 24.7% ± 11.0% at 1-month and 19.9% ± 6.0% (P = 0.001) at 3-month visits at the end of reinforcement and non-reinforcement periods, respectively (Figure 2). Overall, there were no significant differences between the two methods of training (P = 0.300).

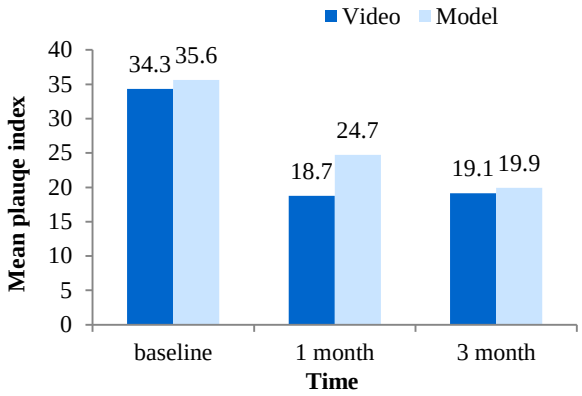

Figure 2. Mean plaque score at each time point of the study in two methods

After adjusting for covariates such as follow-up time, HI severity, sex, education level, and age, the average change of PI was similar in the two groups (difference -1.42, P = 0.300) (Table 2).

Table 2. Estimates of fixed effects of independent variables on plaque score

Variable	Parameter	Estimate	Standard error	P
Time	T (0) T (1) T (3)	-5.90	0.69	0.001*
Method	Video Model	-1.42	1.36	0.300
Hearing	Full loss Half loss	-2.50	1.72	0.150
Sex	Female Male	0.10	1.38	0.940
Education level	First to third Fourth to sixth	-0.67	1.68	0.690
Age (year)	7-12 12-19	0.42	0.39	0.280

*Significant (P < 0.050)

Discussion

The purpose of this study was to evaluate the impact of two methods of education on oral health status in HI student. The score of dental PI was considerably higher than the desirable score[17] at the baseline of this study. This represented a high percentage of dental plaque and poor oral health status. Previous studies, which done in different places, confirm the same result.[1,7,8,10,14,18,19] However, in one study, acceptable oral health was revealed among HI students. The reason of difference could be explained through differences in study design: As this study was conducted in a private school where the children had a high socioeconomic status, beside arranged dental checkup.[20] It can be said that impaired hearing is not the only reason for poor oral health and as regards, more than 90% of students in our study belonged to poor socioeconomic class; socioeconomic status plays an important role in oral health status of HI children, too.[18]

After education in both methods, PI decreased significantly after 1-month training. These results are in agreement with other studies that showed education improved oral health status in reinforcement period.[9,14,21] Further, PI was reassessing after 2 months without education. In both methods, oral health status was significantly improved compared to baseline; these results are in agreement with another study even though the study method was slightly different. In a study conducted by Shetty et al.,[9] students were trained oral health through video followed by daily education for a month, and in Livny et al.[22] study, training program was conducted in eight times per year, and immediately, after each training, oral health status was assessed. Furthermore, in Seema study, children were trained one time, and after 3 weeks, oral health status was assessed.[1] Similarity, the results of our study to other studies represented this fact that despite differences in cultural and socioeconomic conditions in nations and ethnic groups, proper education about oral health can eliminated these differences and change the health behavior that leads to improving oral health. However, education might not be the only reason to improve the oral health status because these HI students belong to poor socioeconomic class and given toothpaste and toothbrush can play motivational and encouraged role for them.

However, at baseline, the difference between the mean O'Leary PI in the video training and dental model groups was not significant. In the video training group, sharp decrease was seen after reinforcement periods, followed by a slight increase after non-reinforcement periods. On the other hand, in the dental model, a slight decrease trend was seen after reinforcement periods and non-reinforcement periods. This result may indicate that students are more interesting to watch video, and they tried to repeat tooth brushing according to educational video, so PI decreased faster than dental model method in reinforcement period. However, at the end of study, two methods have similar effect to improve the oral health status and students performed as well as trainings after stop education. Since similar study not found, this result is not comparable with other study. Although in Arunakul study, all methods used for education oral health (video and book) had positive effect on oral health status of HI Children.[23] Furthermore, result of Lees study showed that visual instructions were more effective than written instructions in patients with fixed appliances.[24]

Finally, this study can begin for assessing the impact of different methods of education to change the oral health status in HI students; it is hope that results of this study could provide a more effective way to improve oral health and change health behavior in these HI students in Kerman.

Limitations and recommendations

- Lack of a control group (a group without education) because of the low population but

due to this fact that PI was measured in baseline and before any intervention, each student can be itself controlled.

- Due to significant reduction of dental plaque in HI students after training, preparation proper educational program targeted on oral health to overcome the communication barriers is recommended.
- Suggest that other methods used to assess the impact of oral health education of HI children, including training through posters, lecture and also in groups of children with other disability.

Conclusion

Both video and dental model methods for oral health education effectively improve the oral health status of children with HI in short term. Continuous school-based oral health education programs, particularly for disable children, need to be considered and depending on the condition must use the best method.

Conflict of Interests

Authors have no conflict of interest.

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