

FACTORS AFFECTING COGNITION IN INDIVIDUALS WITH TOOTH LOSS

Fahad Ismail¹, Muhammad Usman Muneer¹, Abdul Razzaq Ahmed², Muhammad Waqar Hussain³, Muhammad Farhan Khan⁴, Muhammad Umer Quddos⁵, Muhammad Kashif⁸

¹ Avicenna Dental College, Lahore, Pakistan
² College of Dentistry, King Khalid University, Abha, KSA
³ Bakhtawar Amin Dental College, Multan, Pakistan
⁴ Baqai Dental College, Karachi, Pakistan
⁵ Demontmorency College of Dentistry, Lahore, Pakistan.

ABSTRACT

Loss of teeth and chewing ability has been associated with cognitive decline in individuals at an older age, which is attributed to either the loss of the chewing reflex and its subsequent stimulation of brain centers or due to the absence of nutrition because of poor chewing ability. This can be aggravated by the lack of education, poor socioeconomic status, age, and female gender. We administered a questionnaire for our sample that consisted of individuals with more than 10 missing teeth, over the age of 45 to notice the associations between these aforementioned factors and cognitive ability, which was assessed using the Mini-Mental State Examination on these respondents. It was observed that gender, education levels, and socioeconomic status played a crucial role in cognitive decline whereas age and a further loss of tooth did not play any role in further loss of cognition, in our cross-sectional study. Given these results, it was concluded that our sample size demonstrated very clear trends of cognitive loss in individuals of the female gender, who were not educated or had primary level of education and came lower-class economic backgrounds. Furthermore, due to the nature of the study, it was noted that age and tooth loss did not have a major effect on the cognitive abilities of these individuals at the time, which is subject to change as their life progresses.

Key words: Tooth loss, Cognitive impairment, socioeconomic status.

Introduction

Mastication is a reflex, an involuntary action when food is introduced in the mouth. It helps us breakdown our food and gets the nutrients one needs not only to live a healthy physical life but a mentally healthy one as well. Chewing helps us obtain necessary nutrition from it, such as Vitamin B complex including folate and cobalamin, which boosts cognition, memory, and recall^{1,2}.

Chewing centers are close to the hippocampus and the prefrontal cortex in the brain. Stimulation of these centers, in turn, causes stimulation of neurons near the hippocampus, which creates adult hippocampal neurogenesis^{3,4}. The loss of proper chewing ability will have a direct regressive effect on adult hippocampal neurogenesis and the stimulation of these cognition centers in the brain, which would result in a decline in cognitive ability, thought to form processes and good memory functions⁵. Chewing also promotes cerebral blood flow, which would, in turn, promote higher cognitive abilities and it was seen that chewing with a compromised dentition compromised this cerebral blood flow, as well.⁶

The biggest cause of decreased chewing ability is tooth loss and poor oral hygiene, e.g. periodontal disease, tooth mobility, and caries, which renders the individual incapable of chewing properly due to pain or discomfort.⁷

⁸. Patients with 5-7 missing teeth for a longer period of time; which has been deemed a disability on its own, would have compromised chewing ability and hence are at a risk of being cognitively impaired as opposed to patients getting restorative and prosthodontic rehabilitation done by a dental professional^{6,9,10}.

In a developing country like Pakistan, there are misconceptions in place about receiving dental treatment, which causes a loss of dentition at a very early stage in life. A lot of people opt for extracting teeth over retaining them in the oral cavity¹¹. Furthermore, it is observed the oral inflammatory mediators can be carried to centers in the brain and create inflammation, which is a precursor to dementia and Alzheimer's disease^{12,13} so prompt the treatment of dental infections becomes significant. This neglect towards oral care and hygiene comes down to a lack of education and awareness in the society, which is stemmed from poor socioeconomic status. Increased levels of education and awareness would help patients understand several treatment modalities and seek out proper dental treatment^{14,15}.

Readily available medical treatment and a vast variety of foods have prolonged age in most societies. Aging is also associated with dementia and degeneration of mental abilities in individuals¹³. This is further aggravated by

changes in chewing capacity as well due to age-related atrophy of muscles of mastication⁹.

Different studies indicate that women who are post-menopause are at high risk of developing dementia and Alzheimer's more frequently than their male counterparts^{14, 16, 17}. In addition, due to the higher levels of education amongst males than females in the society would make them less aware of oral health care, which would consequence in tooth loss amongst females, more than men¹⁸.

This research aims to observe the relationship of age, gender, education levels, and socioeconomic status of people with reduced masticatory capacity and tooth loss with cognition and memory.

Methodology

This cross-sectional descriptive study was conducted from March 2018 to December 2018 in the Prosthodontics Department of Avicenna Dental College, Lahore. Permission to conduct the research was acquired from the research committee of Avicenna Dental College. Consent was taken from the respondents after informing them of the scope of the research.

30 respondents were selected through convenience sampling technique. Respondents over the age of 45, having more than 10 missing teeth, and controlled diabetes were selected. Respondents with uncontrolled diabetes, previously existing mental disabilities and less than 10 missing teeth were excluded from the research.

Age, gender, and marital status were recorded as socio-demographic information along with medical health history, Kuppuswamy socioeconomic status scale, the number of missing teeth, and the Mini-Mental State Examination. The survey was administered by the same trained examiner for the entire sample size.

Kuppuswamy socioeconomic status Scale:

Kuppuswamy socioeconomic status scale is the most commonly used scale to measure the socioeconomic status of an urban family. It considers three parameters namely education, occupation, and income of the individual.

Total Score	Socioeconomic Status
26-29	Upper Class
16-25	Upper Middle
11-15	Lower Middle
5-10	Upper Lower
<5	Lower Class

Mini-Mental State Examination:

Mini-Mental state examination is a thirty-point questionnaire used in research and clinics to measure cognitive impairment and dementia in respondents. There are two separate score ranges that are different on the basis of the education level of the individual.

The first is for respondents with below primary level education or no education at all.

<u>Score</u>	<u>Interpretation</u>
22-30	No Cognitive Impairment
16-21	Mild Cognitive Impairment
<15	Severe Cognitive Impairment

The second scale is for respondents with middle school and higher-level education.

<u>Score</u>	<u>Interpretation</u>
24-30	No Cognitive Impairment
18-23	Mild Cognitive Impairment
0-17	Severe Cognitive Impairment

Evaluation of Data

Results were analyzed using SPSS (V. 23 IBM Corp. USA, 2016). The data was evaluated by calculating frequencies and means of age, gender, education, Kuppuswamy socioeconomic status, and the number of missing teeth.

Results

There were 30 respondents in the sample size, 63.3% (n=19) of which were males and 36.7% (n=11) were females.

Participants were divided into three age groups, out of which, the majority of the patient were in the 55-64 age group (n= 13) (Figure 1).

Figure 1: Age Groups %

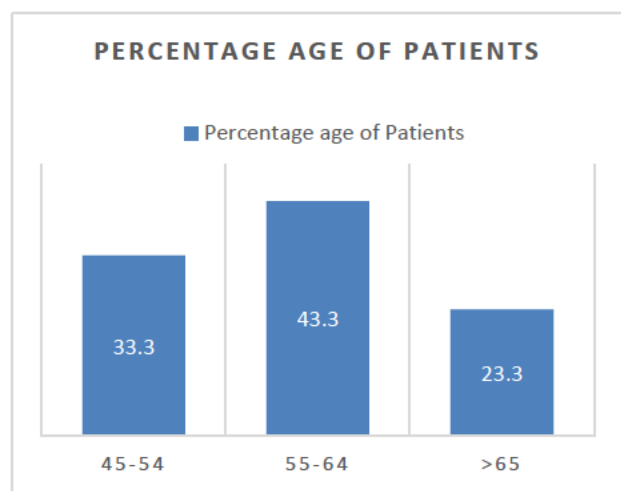


Figure 1: Age Groups of Respondents

When age and the results of the Mini-Mental state examination were compared it was observed that a total of 16 respondents showed no cognitive impairment, 50% (n=8) of which were categorized in the age group of 55-65 years. Out of the 14 respondents that were cognitively impaired, 57% (n=8) were grouped in the age group of 45-54 years as seen in Table 1.

Age	Mini-Mental State Examination		Total
	No Cognitive Impairment	Cognitive Impairment	
45-54	2	8	10
55-65	8	5	13
>65	6	1	7
Total	16	14	30

Table 1: Correlation between the patients' age and Mini-Mental Status Examination

Out of 30 respondents, 19 (63.3%) were male and 11 (36.7%) were female. Out of the 19 male respondents, 73.6% (n=14) were cognitively unimpaired whereas 26.3% (n=5) had cognitive impairment. Out of the 11 female respondents, 18.1% (n=2) were cognitively unimpaired and 81.9% (n=9) had cognitive impairment (Table 2).

Age	Mini-Mental State Examination		Total
	No Cognitive Impairment	Cognitive Impairment	
Male	14	5	19
Female	2	9	11
Total	16	14	30

Table 2: Correlation between the Respondents' Gender and Mini-Mental Status Examination

Out of the 30 respondents, 33.3% (n=10) were illiterate and 23.3% (n=7) had primary school education. Only 13.3% (n=3) of the respondents were graduates (Figure 3).

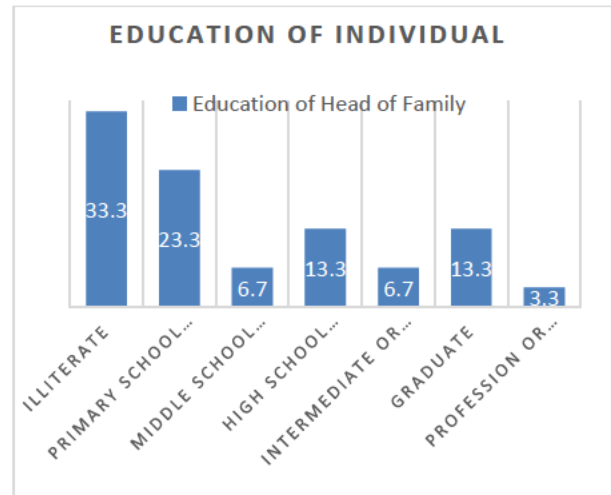


Figure 3: Education of the Respondents

When the education of the respondents and the results of the Mini-Mental state examination were compared, it was observed that out of the 16 respondents who were not cognitively impaired, a majority had at least a primary school education 31.5% (n=5). For the ones who were cognitively impaired, 42.8% (n=6) were illiterate and 18.7% (n=3) of the cognitively impaired patients were categorized as graduates (Table 3).

Education of family head	Mini-Mental State Examination		Total
	No Cognitive Impairment	Cognitive Impairment	
Illiterate	4	6	10
Primary School Certificate	5	2	7
Middle School Certificate	0	2	2
High School Certificate	3	1	4
Intermediate or Diploma	2	0	2
Graduate	1	3	4
Professional or Honors	1	0	1
Total	16	14	30

Table 3: Correlation between the Patients' Education and Mini-Mental Status Examination

Similarly, a majority of respondents were of the lower middle class (n=14, 46%) and middle class (n=12, 40%), respectively (Figure 4).

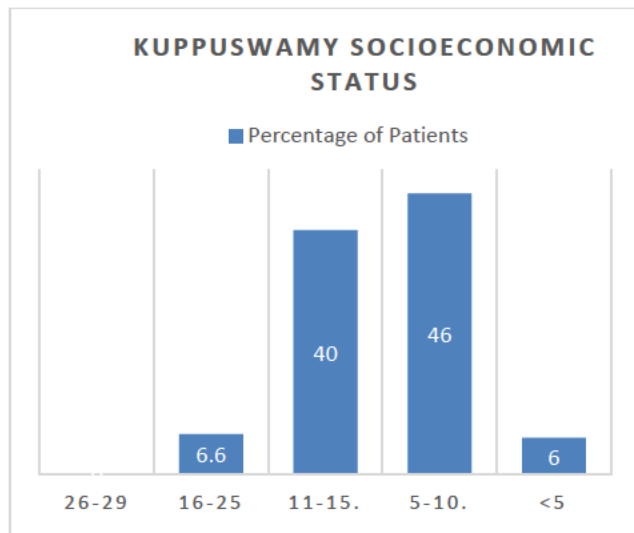


Figure 4: Kuppaswamy Socioeconomic Status

Comparing the results of the Kuppaswamy Socioeconomic status scale and the results of the Mini-Mental state examination, it was demonstrated that out of 16 respondents with no cognitive impairment were considered to be a part of the upper lower class; 50% (n=8), followed by 50% (n=8) in the lower middle class. Similarly, out of the 14 respondents with cognitive impairment, 42.8% (n=6) were categorized as being the part of the upper lower class and 28.5% (n=4) were a part of the lower middle class (Table 4).

Kuppaswamy Socioeconomic Scale	Mini-Mental State Examination		Total
	No Cognitive Impairment	Cognitive Impairment	
Upper Class (26-29)	0	0	0
Upper Middle Class (16-25)	0	2	2
Lower Middle Class (11-15)	8	4	12
Upper Lower Class (5-10)	8	6	14
Lower Class (<5)	0	2	2
Total	16	14	30

Table 4: Correlation between Kuppaswamy Socioeconomic Status and Mini-Mental Status Examination

All respondents had over 10 teeth missing from their oral cavity with only one patient with over 26 teeth missing. (Figure 4)

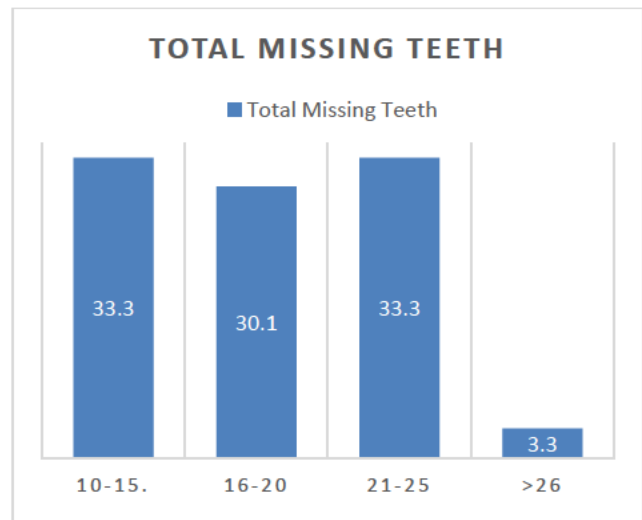


Figure 5: Total Missing teeth ranges

Similarly as seen in table 5, When the results of the number of missing teeth and the results of the Mini-Mental state examination were compared it was seen 71.4% (n=10) respondents that had 10 to 20 teeth missing were cognitively impaired out of the 14. Whereas out of 16 respondents with no cognitive impairment, 52.6% (n=9) of them had 10-20 teeth missing and 48.4% (n=7) had 21-30 missing teeth. (Table 4).

Total Missing Teeth	Mini-Mental State Examination		Total
	No Cognitive Impairment	Cognitive Impairment	
10-20	9	10	19
21 - 30	7	4	11
Total	16	14	30

Table 5: Correlation between the Total missing teeth and Mini-Mental Status Examination

Discussion

Cognition is a multifactorial phenomenon that helps individuals in making daily life decisions, remember important life, and think creatively and analytically. If any of these factors are compromised, it would affect the individual's ability to perceive and think the most profound way⁸. Aging causes a natural degeneration of neurons, which inhibits cognition. It has been observed that females are more prone to develop dementia or Alzheimer's post menopause¹⁶. Education and socioeconomic status of an individual plays a vital role in the development of proper cognition as well, especially in males¹⁹. However, tooth loss and compromised chewing ability can aggravate the

situation in patients exhibiting any of these preexisting risk factors¹², which makes the salvation of teeth and chewing reflex of paramount importance.

In this study out of the 14 cognitively impaired respondents, the majority were categorized in the age range of 45-54 years and only 1 patient was older than 65 who showed signs of cognitive decline as seen in Table 1. Based on the studies done by Taraghi *et al.* (2017) and Avlund *et al.* (2004) it was deduced that age and cognition work independently and have very little to no effect in a cross-sectional study, which supports these results^{10, 20}. However, this was not consistent with the research done by Kaye *et al.* (2010), which concluded that increased age plays a role in a deteriorated cognitive ability in individuals with tooth loss¹.

In our samples, female respondents were more prone to cognitive impairment than men, as seen in Table 2, which is corroborated by Tang *et al.* (1996) who claimed that women after menopause are at risk of developing dementia and Alzheimer's disease¹⁶. There was a clear pattern of cognitive impairment in women as opposed to men. It was also observed that women were less likely to be as educated as men in our society, which could have a huge role in the development of cognition in this gender¹⁸.

It was observed in the sample that the respondents who were more educated had less cognitive impairment and the opposite was seen of respondents who were illiterate (Table 3). Individuals who have received a higher level of education will have a much more developed cognition and vice versa^{14, 19-21}. This is due to the development of the brain's cognitive and critical thinking centers because it has been taught to learn, memorize, and recall. Moreover, the application of this education requires an analytical approach; all of these, cause an increased AHN, hence fewer chances of cognitive decline in the future⁵.

Respondents who came from a lower class or lower-middle-class backgrounds were more prone to be cognitively impaired (Table 4), which could be due to lack of dental facilities, prioritizing medical checkups to dental problems and their solutions, poor education, and improper or deficient nutrition. This is corroborated by the trends seen in already existing literature as well as our own¹².

All the selected individuals had more than ten teeth missed from their oral cavity. Loss of teeth plays a very significant role in cognitive decline in patients^{1, 12, 17} but in our sample, it was observed that further tooth loss does not necessarily mean decreasing cognitive ability with it, which is not consistent with the literature (Table 5). It could be because a few people in Pakistan, have callously opted to chew even without the presence of teeth, which has serious detrimental effects to the residual ridges but

allows them to consume food without a compromise, not only that but the diet, which is full of fiber helps retain chewing ability to some extent as well, in the early stages of tooth loss.

Our sample size was small and presented limitations due to the low number of the patient presenting to the Prosthodontics clinic, who fit into the inclusion criteria. Moreover, this is a cross-sectional study that does not include a follow up of the respondents present in the sample size, so, if there is any further loss of cognitive ability in these respondents it has not been observed. Despite these limitations, very distinct trends were seen regarding age, gender, socioeconomic status, and education of the individual.

Conclusion

Our sample showed that the loss of 10 or more teeth does indeed play a role in a diminished cognitive state. While increasing age did not play a huge role in a deterioration of cognition, it was seen that the lack of education, poor socioeconomic status, and the female gender had marked effects on the cognition of respondents with lost teeth. However, this study can be developed, particularly in the current area. A cohort study can be done using the same sample size over a period of a few years to see if there are any new changes in the cognition of the respondents. Furthermore, an increased number of respondents can give us significant data on this process and gives a better perspective for the readers and the researchers.

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Corresponding Author

Muhammad Kashif

Bakhtawar Amin Dental College, Multan, Pakistan.
Email Id: drkashifazam@gmail.com