



Dental Care Utilization by Adults in a Socially Diverse Metropolitan Area

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Article Info	ABSTRACT
Article type: Original Article	Objectives: This study assessed the association of dental care utilization with individual and contextual characteristics, and measured disparities based on age and contextual deprivation. Materials and Methods: This cross-sectional study recruited 1,510 randomly selected adults residing in Tehran by phone-based interviews between January 2023 and June 2023. A questionnaire that consisted of questions about predisposing (sociodemographic), enabling (economic status, insurance coverage, neighborhood deprivation, and dental knowledge), and needs characteristics (oral health-related problems, and time loss) influencing dental care utilization was used for data collection. Dental care utilization was assessed using a dichotomized variable. The hierarchical logistic regression model and concentration indices were applied for data analysis using STATA 16 (alpha=0.05). Results: The participants' mean age was 46.21±18.43 years. Approximately 48.0% of the participants reported no dental care utilization. Enabling sources [dental insurance (P<0.001) and neighborhood deprivation (P<0.001)], and need factors [time loss due to oral conditions (P<0.001) and not wearing dentures (P<0.001)] were significantly associated with dental care utilization. Age as a predisposing factor had a significant association with dental care utilization with a concentration index of -0.27 (P<0.001). Conversely, the concentration index of socioeconomic status was 0.03 (P=0.005). Conclusion: Disparities in dental care utilization were evident in more affluent groups and among younger age groups. Dental care utilization was associated with psychosocial loss, productivity loss, and contextual deprivation barriers. Moreover, Andersen's model revealed that social structure, time loss, and enabling sources, rather than the other indicators, determined dental care utilization. Keywords: Dental Health Services; Utilization; Adults; Healthcare Disparities; Socioeconomic Factors
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INTRODUCTION

Utilization of dental care, as a behavior with societal and personal determinants, may be the primary consequence of self-perceived dental care needs. Dental care utilization is motivated by individual perception of

dental problems. Hereupon, psychosocial barriers, and facilities to access dental care have a crucial role in this behavior [1]. Additionally, the great influence of the economic aspect in dental care utilization should be correctly addressed.

Direct economic costs are the resources consumed to treat a pathological condition in the oral cavity. However, indirect economic costs are defined as time consumed (often working time) for dental examinations/therapy and are called "productivity loss". Time spent for dental examination/treatment combined with individual wage data can be used to identify the economic effects of oral and dental diseases on individuals' productivity loss [2]. This financial impact can affect dental care utilization and oral health status as well.

In order to determine indicators that influence individuals' utilization of dental care, several theories such as the Dutton model, Evans and Stoddart model, health belief model, and Grossman model of health demand have been employed. These theories describe the possible impact of socioeconomic status, communities' contextual characteristics, and individuals' health-related behaviors on dental care utilization [3,4].

The Andersen model is one of the widely used models for explaining contributing factors to subjects' utilization of dental care. This model consists of personal and contextual components that are employed in several healthcare areas, including dental care utilization. The Andersen model includes predisposing factors, enabling sources, and need factors as predictive domains [5].

Utilization of dental care demonstrates diversity and consequently poses disparity both in developed and developing societies. Chen et al. [5] showed that residency location, gender, insurance coverage, economic status, and health beliefs/values influenced dental care utilization according to the Andersen's model. Likewise, determinants such as gender, socioeconomic status, enrollment in a primary care team, living in rural areas, and living in crowded households were mentioned as indicators that induce disparity in dental care utilization in Brazil [6].

Some studies conducted in Iran, such as Najafi et al. [7] reported that economic and educational inequalities in dental spending among Iranian households benefited those with higher economic and educational status.

Likewise, a study by Rezaei et al. [8] confirmed a disparity favoring the wealthy in dental care utilization. Understanding the drivers of dental care use is key to reduce unmet needs and improve public oral health.

In addition, the contextual characteristics were highlighted as determinants that contributed to dental care utilized by subjects in previous studies, and living in deprived areas results in comparatively worse oral health status, in both children and adults, and is associated with dental care utilization [8–11]. The studies mentioned above [8–12] have detailed the impact of dental care utilization on improving oral health at both the individual and community levels.

Collecting data on individual and contextual characteristics that influence dental care utilization in the Tehran metropolitan area is critical for health policymakers. Tehran is the capital and the most populous and diverse area of the Tehran province. Such data can help policymakers design effective, evidence-based interventions. Accordingly, these interventions aimed to improve access to dental care services and ensure utilization based on actual need. Hence, this study aimed to identify the potential predisposing, enabling, and need factors, based on the Andersen model, that are linked to dental care utilization, and to quantify inequalities based on age and socioeconomic status in Tehran city.

MATERIALS AND METHODS

This study received ethical approval from the Health Sciences Ethics Committee at Tehran University of Medical Sciences (IR.TUMS.DENTISTRY.REC.1400.182). The research was conducted following the principles of the Declaration of Helsinki. Before starting the interview, all participants provided verbal informed consent, and were ensured about the confidentiality of their identity and information.

Participants and sampling:

This cross-sectional study evaluated dental care utilization in the past year by the adult population of Tehran. Randomly selected individuals aged over 18 years were surveyed over the phone between January 2023 and June 2023.

The sample size was calculated using the formula for prevalence studies, assuming a 56% utilization rate from prior research [13], a confidence interval (CI) of 95% ($Z=1.96$), and a margin of error of 0.0353. The initial calculation yielded a minimum sample of nearly 759. Accounting for an effect size of 2, the final required sample size was 1,510 participants. To ensure representation from all 22 municipal districts of Tehran, a proportionate stratified random sampling method was employed.

Trained and calibrated interviewers conducted the surveys. The phone-based survey was used in this study since it is a valuable and low-cost approach to obtain data from a broad geographical area such as Tehran. A random number generator was used to select phone numbers from prefixes assigned to different telecommunication providers in each district. Up to two call attempts were made per number—one in the morning and one during non-working hours if the first was unanswered. Respondents were screened for eligibility based on the study's inclusion and exclusion criteria. Individuals were included in the study if they met the following criteria: (1) aged 18 years or older, (2) residents of the Tehran metropolitan area for at least one year, (3) willingness to participate and provide oral informed consent, and (4) provide complete responses to the study questionnaires.

If the person answering was not eligible, they were asked if another eligible household member was available. Individuals unable or unwilling to participate due to disabilities, neurological/cognitive impairments, or being too ill/hard of hearing were excluded.

Data collection:

The study instrument was developed in three phases. First, the questionnaire domains were defined according to the Andersen's model. Items were drafted based on a review of relevant literature [1, 3-10]. The questions were presented to the community oral health experts to initiate the next step (face and content validity assessment). The prepared questionnaire consisted of three sections:

-Section 1 asked for sociodemographic data:

age (categorized as 18-64 or +65 years), gender (female/male), and educational level (illiterate, primary/high school, high school diploma, associate/bachelor's degree, postgraduate degree).

-Section 2 collected information on economic status and knowledge level:

2-1 Dental insurance coverage (yes/no)

2-2 Housing status (owner, renter/others)

2-3 Level of development of participant's residential district (as a proxy to neighborhood deprivation)

Unequal distribution of urban facilities and services in the neighborhoods, and the heterogeneous socioeconomic status of Tehran population cause substantive differences among the districts of the metropolitan in line with contextual and economic enablers. The present study, based on the Fuzzy Technique for Order Preference by Similarity to Ideal Solution used 53 indicators of quality of life and development of infrastructure in Tehran. All districts of Tehran metropolis were classified into four categories: the most developed districts, developed districts, less developed districts, and in need of intervention (very deprived) districts [14].

We ascertained the individuals' economic status according to the level of development of their residential district, housing status, and dental insurance coverage. The Principal Component Analysis was employed to create a continuous economic scale using the type of participants' house ownership status (owner/renter), residential district, private insurance status, and educational level [15]. These proxy measures were employed since the residents of Tehran metropolis often work more than one job and information on income alone is underestimated and unreliable [16].

Oral health-related knowledge was evaluated by seven questions, as shown in Table 1 [17,18]. Correct answers for knowledge questions were coded 1, and incorrect or "I don't know" answers were scored 0. The total score of the seven questions for oral health knowledge determinant ranged from 0 to 7. We categorized the score of oral health-related knowledge into four levels based on the variable distribution: the highest level, second level, third level, and the lowest level.

Table 1. Questions about oral health-related knowledge

Questions	
I	Sugary food and drinks are among the main causes of dental caries.
II	Tooth brushing twice a day with fluoride toothpaste is crucial for the maintenance of a healthy oral condition.
III	The oral cavity should not be rinsed immediately after tooth brushing and one should only spit out any excess toothpaste.
IV	It is necessary to use dental floss at least once a day to remove the food particles and plaque from the interdental regions.
V	Proper tooth brushing takes at least 2 minutes.
VI	Chewing sugar-free gums for 5–20 minutes after meals 2 to 3 times a day is effective in preventing dental caries.
VII	Periodic dental check-ups are essential to ensure optimal oral health status and prevent oral diseases.

The answer choices were true, false, and I don't know.

-Section 3 included five questions: three questions to evaluate oral health-related problems and one question for subjective health assessment. Oral health-related problems were assessed by questions: "have you ever had bleeding while tooth brushing within the past 12 months?" (Yes/No), "have you ever experienced tooth loss due to dental caries or gingival disease?" (Yes/No). The participants were also asked about removable denture use: (1) having a complete denture, (2) having a complete denture in one jaw (single denture), (3) having a partial denture, and (4) not having a denture. Those selecting answer choices 1-3 were considered as denture wearers.

Productivity loss (time loss) was evaluated by asking if participants had taken time off from work, school, or daily activities due to oral conditions in the past 12 months. Self-rated health was measured by asking "how would you assess your general health status?"

Outcome determinant:

Dental care utilization was measured by the question, "how long has it been since you last visited a dentist?" with four answer choices. Responses were dichotomized: those who visited a dentist within the past 12 months (options 1 and 2) were classified as 'utilizers', and others (options 3 and 4) as 'non-utilizers'. Table 2 shows how explanatory variables were categorized within the Andersen's model framework [19].

Content and face validity were assessed by five community oral health experts, who evaluated the questionnaire's accuracy, comprehensiveness, relevance, and wording. Moreover, a preliminary test with 20 randomly selected individuals from the target population was conducted to identify any missing relevant topics.

Finally, for quantitative content validity assessment, 20 professors from various dental

Table 2. Hierarchical logistic model predicting the odds ratio (OR) of dental care utilization including predisposing factors, enabling sources, and need factors

Explanatory variables	Equation	Description
Predisposing factors (age, gender, educational level)	$y = \beta_0 + \beta_i \text{ Predisposing factors}$	$i = 1 \dots 3$
Enabling sources (dental insurance, oral health-related knowledge, neighborhood deprivation, housing status)	$y = \beta_0 + \beta_i \text{ Predisposing factors} + \beta_j \text{ Enabling sources}$	$i = 1 \dots 3; j = 1 \dots 4$
Need factors (self-assessed general health, bleeding while brushing, experience of tooth loss, denture use, time loss)	$y = \beta_0 + \beta_i \text{ Predisposing factors} + \beta_j \text{ Enabling sources} + \beta_k \text{ Need factors}$	$i = 1 \dots 3; j = 1 \dots 4; k = 1 \dots 5$

β_0 : the intercept (log-odds when all predictors are zero); β_i : regression coefficients for predisposing factors; β_j : regression coefficients for enabling factors; β_k : regression coefficients for need factors; i : predisposing factors; j : enabling factors; k : need actors.

schools rated each item for necessity, relevance, simplicity, and clarity [20]. The content validity index and ratio met acceptable standards.

A pilot study with 30 subjects from two districts, interviewed 2 weeks apart, assessed reliability. Repeatability or test-retest reliability was evaluated by the Spearman's rank correlation coefficient [20]. Test-retest reliability, measured by the Spearman's correlation, was 0.65 ($P=0.01$). The questionnaire's internal consistency, indicated by Cronbach's alpha, was 0.81.

Perceived barriers to dental care utilization:

Perceived barriers to utilization of dental care were evaluated by asking the question "within the past 12 months, was there a time you perceived a need for dental care, but did not receive it?", and asking the subjects to select from six-option commonly described categories: cost, lack of enough time, spontaneous pain relief, make an appointment too late, unjustified previous dental procedure, and physical distance from dental care centers.

Statistical analysis:

Missing data accounted for less than 5% of values; thus expectation-maximization imputation was used for handling them [21]. The concentration index was also employed to measure disparities in dental care utilization based on age and socioeconomic status [22]. The outcome variable and predictor variable were depicted on a two-dimensional plot, identifying the outcome variable within different predictor statuses. When the outcome among all predictor statuses has an equal distribution, the equity line is positioned at a 45-degree angle. When the concentration curve is above the diagonal line of equality, it suggests that the outcome variable is concentrated among the disadvantaged (lower socioeconomic) groups. In contrast, when the curve falls below the equality line, the outcome is concentrated among the advantaged (higher socioeconomic) groups [23].

A logistic regression model was employed to determine which predisposing factors, enabling sources, and need factors were significantly associated with dental care utilization within the past 12 months. In the first step, the predisposing factors were

analyzed; in the second step, the enabling sources were added to the model; in the third step, predisposing factors, enabling sources, and need factors were included in the logistic analysis model. The Hosmer-Lemeshow goodness-of-fit test was performed to ascertain if the models show a good fit to the data.

Multicollinearity was assessed using the variance inflation factor, with a mean value of 2.09 indicating no issue. All analyses were performed in STATA SE (Stata-Corp., College Station, TX, USA), with a significance level of $P<0.05$.

RESULTS

Table 3 presents the participants' descriptive characteristics. The mean age was 46.21 ± 18.43 years and the mean socioeconomic status score was -0.01 ($SD = 1.00$). About 50% were female, and 40.0% had a university degree. Of all, 22% had experienced bleeding while tooth brushing, over 28.0% assessed their health status as fair, and 13.4% perceived their health condition as poor/very poor.

About 55.0% stayed in less developed districts in the metropolis, and 47.9% reported no dental care utilization within the past 12 months. Lastly, 74.1% of the subjects stated that they had not lost time away from work, school/university, or normal daily activities to utilize dental care services. The response rate was 52.4%. The telephone survey achieved a response rate of 52.4%, with 11,691 calls made and 2,582 refusals.

Table 4 shows subjects' self-perceived sources for not utilizing dental care services on regular dental checkups or when it was necessary. The high cost of dental procedures (86.2%) was reported as the most prevalent barrier.

Table 5 indicates the distribution of use of dental care based on neighborhood deprivation. In the most developed districts, individuals aged over 65 years utilized dental care much more than the same age group in the most deprived districts. Illiterate subjects living in the most developed districts utilized care much more than counterparts in the most deprived districts. However, the distribution of use of dental care among all the neighborhoods did not change considerably by different educational levels.

Table 3. Sociodemographic characteristics of subjects aged over 18 years in Tehran metropolis, in 2023 (N=1,510)

Explanatory variable		Weighted Frequency	
		n	%
Predisposing factors			
Gender	Female	757	50.1
	Male	753	49.9
Age group (yrs.)	18-34	1359	90.0
	+65	151	10.0
Educational level	Illiterate	90	5.9
	Primary and high school	340	22.5
	high school diploma	479	31.7
	Associate and Bachelor's degree	437	28.9
	Postgraduate	165	11.0
Enabling sources			
Dental Insurance	Yes	405	26.8
	No	1,105	73.2
Oral health-related knowledge*	Highest level	417	27.6
	Second level	621	41.1
	Third level	305	20.2
	Lowest level	167	11.1
Neighborhood deprivation	Most developed	256	17.0
	Developed	141	9.3
	Less developed	836	55.4
	Need to intervene	277	18.4
Housing status	Owner	919	60.9
	Renter/Others	591	39.1
Oral health needs			
Self-assessed general health	Excellent	177	11.7
	Very Good/Good	704	46.6
	Fair	427	28.3
	Poor/Very poor	202	13.4
Bleeding while brushing	Yes	332	22.0
	No	1177	78.0
Experience of tooth loss	Yes	233	15.4
	No	1277	84.6
Time loss	Yes	392	25.9
	No	1118	74.1
Denture use	Full dentures	74	4.9
	Single denture	68	4.5
	Partial dentures	153	10.1
	Don't use dentures	1216	80.5

SD: Standard Deviation.

*Oral health related knowledge levels were categorized based on quartiles of the total knowledge score (range: 0–7): Level 1 (highest)=upper quartile; Level 2=second quartile; Level 3=third quartile; Level 4 (lowest)=lowest quartile.

Table 4. Self-perceived barriers for not utilizing dental care services amongst individuals aged over 18 years in Tehran metropolis in 2023 (N=1,510)

Self-perceived barriers	Weighted Frequency	
	n	%
Lack of enough time	787	52.1
Spontaneous pain relief	633	41.9
Make an appointment too late with the dentist	674	44.6
Avoiding dental treatment due to high cost of dental procedures	1302	86.2
Unjustified previous dental procedure	599	39.7
Physical distance from dental care centers	561	37.1

Table 5. Distribution of dental care utilization according to neighborhood deprivation amongst individuals aged over 18 years in Tehran metropolis in 2023 (N=1,510)

Explanatory variable		Utilization of dental care							
		Need to intervene		Less developed		Developed		Most developed	
		n	%	n	%	n	%	n	%
Predisposing factors									
Gender	Female	39	45.5%	242	51.5%	40	46.9%	70	47.7%
	Male	47	54.5%	228	48.5%	46	53.1%	77	52.3%
Age group (yrs.)	18-64	82	96.3%	459	97.9%	84	97.3%	126	86.1%
	+65	3	3.7%	10	2.1%	2	2.7%	20	13.9%
Educational level†	Level1	1	0.9%	11	2.3%	4	5.1%	11	7.4%
	Level2	13	14.7%	79	16.8%	21	24.9%	45	30.6%
	Level3	24	28.0%	170	36.2%	31	35.6%	37	25.1%
	Level4	32	37.7%	152	32.4%	22	25.6%	41	27.8%
	Level5	16	18.6%	58	12.3%	8	8.8%	13	9.1%
Enabling sources									
Dental Insurance	Yes	30	35.1%	139	29.6%	31	36.2%	45	30.7%
	No	55	64.9%	330	70.4%	55	63.8%	102	69.3%
Oral health-related knowledge*	Highest level	27	31.1%	116	24.7%	23	27.2%	34	23.3%
	Level 2	31	35.9%	195	41.7%	41	47.9%	63	42.7%
	Level 3	25	29.4%	106	22.5%	15	17.1%	25	16.9%
	Lowest level	3	3.7%	52	11.1%	7	7.8%	25	17.2%
Housing status	Renter/Other	27	31.1%	116	24.7%	23	27.2%	34	23.3%
	Owner	45	52.9%	291	62.1%	50	58.1%	80	54.6%
Oral health needs									
Self-assessed general health	Excellent	16	18.1%	60	12.8%	11	12.2%	27	18.2%
	Very Good/Good	32	37.0%	247	52.7%	43	50.3%	89	60.6%
	Fair	28	32.5%	129	27.5%	28	32.7%	29	19.6%
	Poor/Very poor	11	12.4%	33	7.0%	4	4.8%	2	1.6%
Bleeding while brushing	No	24	27.5%	106	22.5%	9	10.4%	41	28.2%
	Yes	40	47.1%	178	37.9%	36	41.9%	67	45.4%
Experience of tooth loss	No	66	77.3%	405	86.4%	67	77.7%	110	75.2%
	Yes	19	22.7%	64	13.6%	19	22.3%	36	24.8%

Table 5 Cont'd

Denture use	Full dentures	2	2.2%	9	1.9%	6	7.4%	6	4.1%
	Single denture	1	0.6%	7	1.5%	3	3.4%	14	9.3%
	Partial dentures	1	1.5%	35	7.4%	14	16.1%	24	16.5%
	Don't use dentures	82	95.7%	418	89.2%	63	73.1%	103	70.1%
Time loss	No	33	38.6%	119	25.4%	30	35.3%	66	45.0%
	Yes	52	61.4%	350	74.6%	56	64.7%	81	55.0%

† Educational level, Level 1: Illiterate, Level 2: Primary and high school, Level 3: High school diploma, Level 4: Associate and bachelor's degree, and Level 5: Postgraduate degrees.

*Oral health-related knowledge levels were categorized based on quartiles of the total knowledge score (range: 0–7): Level 1 (highest) = upper quartile; Level 2 = second quartile; Level 3 = third quartile; Level 4 (lowest) = lowest quartile.

Individuals who perceived their general health status as very good/good utilized dental care more than other participants, and the subjects who perceived their general health status as poor/very poor showed the least utilization. Subjects who experienced missed work/school days due to oral conditions had more utilization of dental care. Table 6 depicts the concentration indices of dental care utilization based on age and socioeconomic status in Tehran metropolis. The concentration curves of dental care utilization are shown in Figures 1 and 2. In contrast to the concentration index of age, the concentration index of socioeconomic status was positive. It should be noted that concerning dental care utilization, the concentration indices of age and socioeconomic status were -0.27 ($P<0.001$), and 0.03 ($P=0.005$), respectively.

Table 7 displays the results of the hierarchical logistic regression analysis.

Predisposing factors:

-Age: Individuals aged over 65 years experienced an 80% ($OR=0.20$, 95% $CI=0.14$, 0.27) decrease in the odds of dental care utilization, compared to the rest of the subjects.

-Gender: No significant associations were observed between the utilization of dental

care and gender after adjusting for other determinants within the model.

-Education: The likelihood of utilizing dental care increased for individuals with a higher level of education. The odds of visiting a dentist increased by 1.12 times for individuals with an associate/bachelor's degree, and 1.15 times for those with a postgraduate degree, compared to illiterates. The association between dental care utilization and educational level was not statistically significant ($P>0.05$).

Enabling sources:

-Insurance coverage: The odds of dental care utilization increased by 1.77 times (95% $CI=1.37$, 2.28) among individuals with dental insurance coverage.

-Neighborhood deprivation: The likelihood of utilizing dental care decreased by 46% ($OR=0.54$, 95% $CI=0.39$, 0.75) for those living in less developed areas, compared to those living in most developed areas. Likewise, the likelihood of utilizing dental care decreased by 83% ($OR=0.17$, 95% $CI=0.11$, 0.26) for those living in the most deprived districts.

Need factors:

-Self-assessed health: The association between dental care utilization and self-assessed general health status was not statistically significant ($P>0.05$).

Table 6. Concentration index for utilization of dental care by age and socioeconomic characteristics amongst subjects over 18 years in Tehran metropolis in 2023 ($N=1,510$)

Utilization of dental care within the past 12 months	Concentration Index	95% CI	P value
Age	-0.27	(-0.37, -0.17)	<0.001*
Socioeconomic status	0.03	(0.01, 0.04)	0.005*

* $P<0.05$; CI: Confidence Interval.

Table 7. Hierarchical logistic model predicting the OR of dental care utilization amongst individuals aged over 18 years in Tehran metropolis in 2023 (N=1,510)

Explanatory variable		Model 1 Predisposing factors		Model 2 Predisposing and enabling factors		Model 3 Predisposing, enabling, and need factors	
		aOR (CI)	P value	aOR (CI)	P value	aOR (CI)	P value
Predisposing factors							
Gender	Female	Ref.		-		-	
	Male	1.15 (0.91,1.44)	0.247	1.04 (0.81, 1.32)	0.765	1.04 (0.81, 1.34)	0.764
Age group (yrs.)	18-64	Ref.		-		-	
	+65	0.19 (0.15,1.26)	<0.001*	0.18 (0.13, 0.24)	<0.001*	0.20 (0.14, 0.27)	<0.001*
Educational level†	Level 1	Ref.		-		-	
	Level 2	0.98 (0.58,1.64)	0.939	0.93 (0.54, 1.59)	0.787	0.90 (0.51, 1.55)	0.706
	Level 3	1.11 (0.67, 1.83)	0.680	1.07 (0.64, 1.80)	0.788	1.02 (0.60, 1.72)	0.947
	Level 4	1.18 (0.71, 1.96)	0.520	1.16 (0.69,1.97)	0.569	1.12 (0.66, 1.91)	0.675
	Level 5	1.08 (0.61, 1.92)	0.794	1.14 (0.63, 2.09)	0.661	1.15 (0.62, 2.12)	0.654
Enabling sources							
Dental Insurance	Yes			1.66 (1.29, 2.12)	<0.001*	1.77 (1.37, 2.28)	<0.001*
	No			Ref.		-	
Oral health-related knowledge**	highest level			1.07 (0.73-1.58)	0.723	1.19 (0.79, 1.77)	0.404
	Level 2			1.27 (0.91, 1.76)	0.157	1.34 (0.96, 1.88)	0.034
	Level 3			1.19 (0.91, 1.56)	0.202	1.21 (0.92, 1.59)	0.181
	Lowest level			Ref.		-	
Neighborhood deprivation	Most developed		Ref.		-		
	Developed		0.71 (0.45, 0.96)	0.032*	0.70 (0.45, 1.11)	0.131	0.131
	Less developed		0.61 (0.45, 0.83)	<0.001*	0.54 (0.39, 0.75)	<0.001*	<0.001*
	Need to intervene		0.22 (0.14, 0.32)	<0.001*	0.17 (0.11, 0.26)	<0.001*	<0.001*
Housing status	Renter/Other			Ref.		-	
	Owner			0.98 (0.78, 1.25)	0.918	1.21 (0.94, 1.55)	0.147
Oral health needs							
Self-assessed general health	Excellent					0.70 (0.41, 1.19)	0.187

Table 7 Cont'd

	Very Good/ Good	0.90 (0.59, 1.38)	0.625
	Fair	1.01 (0.66, 1.54)	0.985
	Poor/ Very poor	Ref.	
Bleeding while brushing	No	Ref.	
	Yes	0.99 (0.74, 1.33)	0.971
Experience of tooth loss	No	Ref.	
	Yes	1.13 (0.81, 1.58)	0.462
Denture use	Full dentures	Ref.	
	Single denture	0.81 (0.39, 1.69)	0.574
	Partial dentures	1.21 (0.65, 2.25)	0.543
	Don't use dentures	2.40 (1.45, 3.97)	<0.001*
Time loss	No	Ref.	
	Yes	1.60 (1.21, 2.11)	<0.001*

aOR: Adjusted odds ratio; *P<0.05; OR: Odds ratio; CI: Confidence interval; Ref: Reference group, Hosmer and Lemeshow goodness-of-fit: model 1, P= 0.061; model 2, P= 0.636; model 3, P=0.548.

†Educational level, Level 1: Illiterate, Level 2: Primary and high school, Level 3: High school diploma, Level 4: Associate and bachelor's degree, and Level 5: Postgraduate degrees.

**Oral health related knowledge levels were categorized based on quartiles of the total knowledge score (range: 0–7): Level 1 (highest)=upper quartile; Level 2=second quartile; Level 3=third quartile; Level 4 (lowest)=lowest quartile.

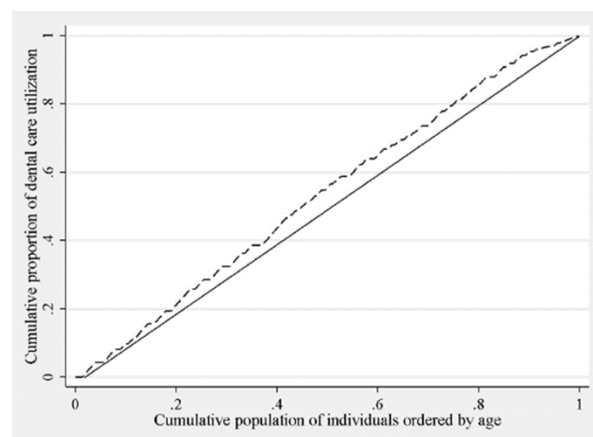


Figure 1. Concentration curve for dental care utilization within the past 12 months by age among adults (>18 years) in Tehran metropolis, 2023 (N=1,510).

-Time lost due to oral diseases: Time lost due to oral health conditions in daily normal activities was associated with dental care utilization. The odds of dental care utilization increased by 1.60 times per each increment in the number of days

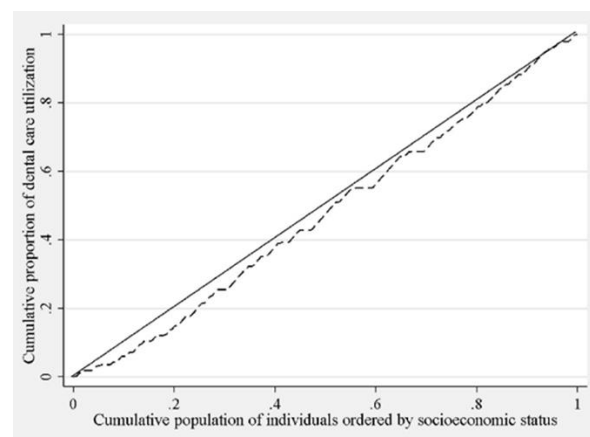


Figure 2. Concentration curve for dental care utilization within the past 12 months by socioeconomic status among adults (>18 years) in Tehran metropolis, 2023 (N=1,510).

lost due to oral diseases (95% CI=1.21, 2.11).

-Denture use: The results also indicated that adults without denture were more likely to utilize dental care services (OR=2.40, 95% CI=1.45, 3.97).

DISCUSSION

This study assessed individual and contextual characteristics as determinants of dental care utilization according to the Andersen's behavioral model among adults in a socially diverse metropolitan area. Andersen's healthcare utilization model was empirically examined in a randomly selected sample using a multilevel statistical approach. Additionally, we measured existing disparities in the utilization of dental care when individuals were ordered by age and socioeconomic status. Eldership as a predisposing factor demonstrated a significant association with non-utilization of dental care in Tehran metropolis. Furthermore, enabling sources (dental insurance and neighborhood deprivation) and need factors (time loss due to oral conditions and not wearing dentures) were associated with the utilization of dental care.

A significant inverse contribution of neighborhood deprivation was found in predicting utilization of dental care. Absence of neighborhood deprivation as an enabling source demonstrated a significant effect on dental care utilization. Individuals who lived in deprived neighborhoods were less likely to utilize dental care. This is in line with studies that investigated the impact of neighborhood deprivation on utilization of dental care in North America and Australia as well as in some regions of England [24–26]. However, local previous studies did not investigate the effect of neighborhood deprivation on utilization of dental care.

Individuals residing in deprived areas face more geographical, physical, and financial challenges that make dental care utilization difficult to access. Furthermore, individuals in deprived neighborhoods may be less aware of the oral health importance [27,28]. Less awareness shapes individuals' behaviors and may lead to norms in oral health-related behaviors of residents in deprived neighborhoods [29,30].

We found an inverse association and a significant disparity between dental care utilization and aging. In this study, working-age adults (18–64 years) were more likely to utilize dental care than the elders (≥ 65 years). This finding might be related to income

adequacy, and supports the hypothesis indicating that individuals of working age with higher income levels are more likely to utilize dental care. Furthermore, as revealed in the literature, as people age, the focus on chronic conditions they may experience increases. These conditions prevent people from seeking the dental care they need [30]. Thus, chronic conditions and restrictions in normal daily activities that are more prevalent among elders might influence the utilization of dental care.

Additionally, findings revealed that utilization of dental care was associated with insurance coverage. Although the population of Tehran has basic dental insurance coverage, this package covers limited dental services. In this way, as the ability to pay is associated with dental care utilization, the promotion of dental insurance coverage could be one of the key strategies in addressing disparities in dental care utilization such as decreasing the financial burden of dental care in dental insurance by providing governmental support, and defining flexible complementary dental insurance according to personal characteristics (age and socioeconomic status) to expand coverage [31].

This study demonstrated the great influence of time loss from normal activity due to oral problems on dental care utilization and showed that those who took away time from normal activities were almost two times more likely to utilize dental care services. This finding is consistent with a previous study conducted in a Canadian population, which investigated predictors of dental care needs. In that study, individuals who experienced time loss were reported to be 1.1 times more likely to have dental treatment needs [32,33].

Time loss from normal activities due to oral problems is a crucial component of an integral understanding of the influence of oral conditions at the societal level [34]. Hereupon, the enhancement of the financial eligibility level would allow the community without dental coverage greater access to dental care, further assuaging economic productivity time loss. However, there are very few studies investigating the indirect costs in the dental literature [2–35]. In an effort to understand the

burden of dental problems and their magnitude, the reduction in economic productivity due to oral conditions should be addressed as well.

This study indicated that individuals without denture were more likely to utilize dental care. Denture use is more common among older adults compared to younger ones. Hence, this may eventually mean that utilization of dental care becomes more difficult for older adults, probably as a result of restricted access to care due to disabilities. McGrath and Bedi [36] suggested that more tooth loss in older adults was likely due to insufficient basic oral hygiene practice as a consequence of aging.

The findings of this study indicated that almost all of the subjects stated the cost of dental procedures and financial constraints as the main barriers against utilization of dental care. Bahadori et al. [37] also mentioned this deterministic factor as a barrier to dental care usage. Particularly, individuals with low socioeconomic status are not likely to utilize dental care due to high cost. These subjects generally less benefit from social support systems like financing, and almost all advanced dental procedures are costly.

Ultimately, in this study, we investigated the impact of the neighborhood developmental level on utilization of dental care. A disparity was identified in utilization of dental care among adults living in Tehran metropolis. Moreover, Andersen's behavioral model demonstrated that neighborhood deprivation, previous experience of time loss due to oral problems, and enabling source predicted the utilization of these services rather than the need for dental care.

The cross-sectional design of this study limits its ability to infer causality. Absence of objective dental and periodontal measures should be mentioned as another limitation. In telephone interviews, interviewing severely-ill subjects and those with hearing impairments or neurological problems is challenging. Therefore, we did not include them in this study. Further investigations are required to collect more data on dental care utilization (i.e. preventive care, caries/periodontal treatment process, and prosthetic rehabilitation for individuals in need of restoring masticatory function), and subjects'

satisfaction with the care received.

The results of this study can assist policymakers in addressing local needs by promoting more equitable access to dental care. This is achievable by coverage of more dental services in the primary healthcare system and also by the establishment of centers that provide dental care with lower franchise fees in deprived areas. Dental care utilization is a complex behavior. A thorough understanding of both the direct and indirect economic impacts of oral health issues, including productivity loss, and dental need characteristics, is essential for accurately predicting and influencing this behavior.

CONCLUSION

This study revealed that dental care utilization among adults in Tehran was primarily determined by enabling sources (dental insurance and neighborhood deprivation) and need factors (time loss due to oral problems and denture use), rather than perceived need. Older adults (≥ 65 years) were 80% less likely to utilize dental care compared to younger adults. A significant socioeconomic disparity was observed, with higher utilization among more affluent groups (concentration index: 0.03). These findings confirm the applicability of Andersen's behavioral model and highlight persistent inequities in access to dental care.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interests.

GENERATIVE AI IN SCIENTIFIC WRITING

We confirm that no artificial intelligence tools were used in the preparation of this manuscript. This research was conducted prior to the widespread availability of generative AI tools. All stages of the work—from study design and data analysis to writing and final editing—were performed exclusively by the authors without any AI involvement.

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