Households' Willingness to Pay for Receiving Preventive and Therapeutic Dental Services: The Double- Bounded Dichotomous Choice Approach

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Abstract

Background: Understanding the value and willingness to pay (WTP) for services is crucial for decision- making.
Objectives: This study aimed to measure the level and factors affecting households' WTP for dental services using the double-bounded dichotomous choice approach.
Methods: This cross- sectional study collected data through a questionnaire- based interview with 300 households in the city of Tabriz, Iran, in 2019. The double- bounded dichotomous choice approach was used to estimate WTP, and factors related to WTP were calculated using an internal regression model, and data were analyzed using Stata 14.
Results: The households' mean WTP for fissure sealant, fluoride therapy, scaling, and removable orthodontics were $8.96, $4.36, $16.00, and $47.38, respectively. Household income, education level, age, regular dental visits, and having elderly people in the family were found to be factors affecting WTP for dental services.
Conclusions: The study found that household income was a significant factor affecting WTP for dental services. Not using dental services is often due to low household income and high service prices. Therefore, policymakers should consider setting dental service prices based on income levels to ensure access to services for all income groups.

Keywords: Willingness to Pay, Dental Health Services, Household Survey, Dental Care

1. Background

Tooth decay is an infectious disease that can spread to many teeth quickly and does not heal spontaneously. Its examination, diagnosis, and treatment require prolonged and consecutive actions; also, it requires high costs and specialists' presence, leading to loss of teeth if left untreated (1). Prevention of oral and dental diseases is one of the goals of creating any dental healthcare system worldwide (2). There should be a balance between preventive and therapeutic care in dental care. Preventive care includes oral health education, cleaning, fluoride therapy, and sealant placement, and it aims to avoid dental problems. Therapeutic care consists of repairing the problems caused by caries and gum disease (3).

Different factors may determine what type of treatment patients should receive by attending the oral health center. Factors related to the provider include the availability of materials and equipment, the expertise and preferences of the healthcare provider, and patients' perceptions, preferences, and financial considerations, which determine what type of treatment patients should receive by attending dental clinics (4, 5). Understanding patients' value of prevention and influencing factors allows us to develop strategies to change patients' behavior (6).

Economics has unique methods for measuring values; one of the ways that are often used in economic studies to determine people's willingness to pay (WTP) is the contingent valuation (CV) method (7). As one of the standard and flexible tools, this method continually evaluates people's preferences about a particular service or commodity to determine the product's actual price or service from the consumer's point of view (8).

2. Objectives

Considering the importance of understanding patients' value and WTP for services, which is one of the influential elements in decision- making, this study aimed to measure the factors affecting household heads' WTP to receive fissure sealant, fluoride therapy, scaling, and removable orthodontic services using the double bounded dichotomous choice approach. The mean WTP calculated can help policymakers determine the actual tariffs people can pay.

3. Methods

The present cross- sectional study was conducted during the summer and autumn of 2019 among household heads in Tabriz, East Azerbaijan province, Iran. Data were collected through questionnaire- based interviews conducted by one author (F.S.). Each interview lasted approximately 15 to 20 minutes, and participation was voluntary. Privacy was assured, and verbal informed consent was obtained from each household.

3.1. Sample Selection

A proportional sample size was determined based on the number of households registered in three health complexes. Simple random sampling was used to select households from each health center in this way: Based on the list of visitors to the health centers, one out of every five people was selected, and if there were no inclusion criteria, the next person was selected. The household head or their spouse provided the required information.

3.2. Sample Size

To determine the appropriate sample size for WTP studies, Michel and Carson ([9]) presented a table used in this study. Table V as the relative error, A as the confidence level, and D as the difference between the actual and the estimated WTP were expressed as a percentage of the actual WTP. A sample size of 286 was determined with a relative error of 1.5 and a confidence level of 0.1 using this table. To ensure confidence, the sample size was rounded up to 300.

3.3. Questionnaire

The structured questionnaire for this study was designed based on the CV framework guideline ([10]). The questionnaire had three parts: The first part consisted of introducing a questionnaire and scenarios for estimating the monetary value of four types of dental services, namely fissure sealant, fluoride therapy, scaling, and removable orthodontics. Each dental care service had two scenarios. The second part assessed oral health status through eight questions, and the third part examined households' demographic characteristics through 22 questions. After designing the questionnaire, its validity was evaluated by health economics experts. A pilot study was conducted to edit and revise any misconceptions and misinterpretations of the questions.

The interviewer started his price offer with an initial price. However, if the respondent was unaware of its appropriateness, they might consider it a vital factor in determining the correct price, leading to starting point bias, which might affect the individual's final WTP ([11]). Four starting point bids were estimated to prevent starting point bias, and one of them was randomly selected in each interview.

3.4. Inclusion and Exclusion Criteria

The study inclusion criteria included being the household head or their spouse, consenting to participate in the study, and having a household registered in a health center. If the selected household did not meet any of these criteria, it was excluded from the study.

3.5. Statistical Analysis

The double- bounded dichotomous choice approach was used to estimate the households' WTP for four dental care services. In this method, each respondent faced two bids, and the amount of the second bid depended on responding to the first bid. If the first bid's response was positive, the second bid would be more than the first amount; otherwise, the second bid would be less than the first offer ([10]), so there would be four conditions: (A) Yes- no, (B) yes- yes, (C) no- yes, (D) no- no. Considering this:

$$WTP_I \left(Z_i . U_i \right) = Z'_i \beta + U_i \; and \; U_i \sim N \left(0 . \sigma^2 \right) \tag{1}$$

Z_i, vector of explanatory variables; β, vector of parameters; U_i, u_i is an error term; t, suggested amount.

Then, each of the four states' probability is calculated as follows:

$$Pr \left(t^1 \leq WTP < t^2 \right) \tag{2}$$

$$= Pr \left(\frac{t^1 - Z'_i \beta}{\sigma} \leq \frac{U_i}{\sigma} < \frac{t^2 - Z'_i \beta}{\sigma} \right)$$

$$= \Phi \left(Z'_i \frac{\beta}{\sigma} - \frac{t^1}{\sigma} \right) - \Phi \left(Z'_i \frac{\beta}{\sigma} - \frac{t^2}{\sigma} \right)$$

$$Pr \left(WTP > t^1 . WTP > t^2 \right) = \Phi \left(Z'_i \frac{\beta}{\sigma} - \frac{t^2}{\sigma} \right) \tag{3}$$

$$Pr\left(t^2 \leq WTP < t^1\right) = \Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) - \Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right) \quad (4)$$

$$Pr\left(WTP < t^1.WTP < t^2\right) = 1 - \Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) \quad (5)$$

The maximum likelihood method was used to estimate the β and σ. To maximize the function, we need to find the model's parameters (12).

$$\sum\left[i = 1Nd_i^{YN}ln\left(\Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^1}{\sigma}\right)\right.\right.$$
$$\left.- \Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right) + d_i^{YY}ln\left(\Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right)$$
$$+ d_i^{NY}ln\left(\Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right) - \Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right) \quad (6)$$
$$\left.+ d_i^{NN}ln\left(1 - \Phi\left(Z'_i\frac{\beta}{\sigma} - \frac{t^2}{\sigma}\right)\right)\right]$$

The interval regression was used to determine the factors affecting the WTP in the double- bounded dichotomous choice approach. Data were analyzed using Stata version 14.

3.6. Ethical Approval

The study was approved by the Ethics Committee of Tabriz University of Medical Sciences (code: IR.TBZMED.REC.1396.1122). All methods were performed in accordance with the relevant guidelines and regulations.

4. Results

The households' main characteristics are presented in Table 1.

The mean age of household heads was 37 years, 35% of whom were employed, only 1% were illiterate, 136 (frequency) households had children under five, and 35% of the households had supplementary insurance. In the past month, 29% of household heads experienced toothache (Table 1).

In the assessment of WTP for dental services, 71.3% of household heads responded positively to the first bid for fissure sealant, 28.7% responded negatively, 33.3% of household heads responded positively to the first bid for fluoride therapy, and 66.7% responded negatively. Also, 34.3% of household heads responded positively to the first bid to receive scaling, and 65.7% responded negatively. To receive removable orthodontics service, 58.7% of household heads responded positively to the first bid.

Table 2 shows the mean WTP for each dental service (Table 2).

The interval regression analysis revealed that education level and household income positively and significantly affected WTP for fissure sealant. According to the interval regression results, household income variables and having an older adult in the family positively and significantly affected WTP for fluoride therapy.

According to Table 3, none of the studied variables is significantly related to WTP for scaling service. For removable orthodontics, income, education level, and regular dental visits had a positive effect, while the age variable negatively and significantly impacted WTP (Table 3).

5. Discussion

The present study aimed to determine the mean WTP and the factors influencing household heads' WTP for fissure sealant, fluoride therapy, scaling, and removable orthodontic services. The study found that the household heads' mean WTP for the four services were $ 8.96, $ 4.36, $ 16.00, and $ 47.38, respectively. The mean WTP for all four services was significant.

The study revealed that the lowest WTP belonged to two preventive services, i.e., fissure sealants and fluoride therapy, which is in contrast to the World Health Organization's recommendation that preventive services should account for 50% of dental care in 2010 and 80% in 2021 (13). Another study has shown that Iran's share of preventive services is much lower. Dentists emphasize two basic points regarding increasing the share of preventive services. One of these basic points is increasing people's awareness and interest in preventive services, such as health education, fluoride therapy, and sealant therapy (14). Also, oral health education in a direct model has caused more changes in pregnant women's knowledge, attitude, and behavior regarding oral health care (15).

Patients' awareness and demand are among the many factors that can contribute to enhancing dental health (16). Therefore, one effective approach to increasing the share of preventive services and promoting better oral and dental health in society is raising public awareness, followed by reducing prices to increase the demand for these services.

A study has shown that higher- income individuals have a higher WTP for fluoride varnish (17). This finding is consistent with the results of our study, which found a significant correlation between the household head's education level and income and their WTP for fissure service. As the household head's income and education levels increase, so does their WTP for preventive dental services.

Table 1. The Households' Characteristics in the Sample

Variables and Description	Frequency	Percentage	Mean ± SD
Age			
Indicated the age of each household head			37 ± 8.89
Employment			
Employed	105	35	
Housewife	193	64	
Unemployed	1	0.5	
Retired	1	0.5	
Education level			
Illiterate	2	1	
Elementary school	33	11	
Middle school	38	13	
High school	110	36	
University	117	39	
Insurance			
Insured	290	97	
Not insured	10	3	
Regular dental visits			
Number of dental visits is once or more per year	138	46	
No visits annually	162	54	
Elderly people (over 65 years)			
The household has an elderly person	24	8	
Otherwise	276	92	
Children under 5 years			
The household has children under 5 years of age	136	45	
Otherwise	164	55	
Monthly Income			
20000000 R and above	1	0.5	
10000000 - 20000000 R	41	13.5	
5000000 - 10000000 R	136	45	
< 5000000 R	122	41	

Table 2. The Household Heads' Mean Willingness to Pay for Fissure Sealant, Fluoride Therapy, Scaling, and Orthodontic Services

Services	Mean ($) ± Standard. Error	P- Value	Confidence Interval
Preventive			
Fissure sealant	8.96 ± 0.96	0.000	7.07 - 10.85
Fluoride therapy	4.36 ± 0.96	0.000	3.03 - 5.69
Therapeutic			
Scaling	16.00 ± 3.31	0.000	9.49 - 22.52
Removable orthodontics	47.38 ± 0.47	0.000	23.92 - 70.85

Table 3. The Effect of Explanatory Variables on Household Heads' Willingness to Pay for Fissure Sealant, Fluoride Therapy, Scaling, and Orthodontic Services [a]

	Fissure Sealant	Fluoride Therapy	Scaling	Orthodontics
Internal regression				
Number of observations	299	299	299	299
Log- likelihood	- 343.89	- 377.04	- 367.08	- 342.96
Wald chi 2(9)	55.55	20.58	15.87	53.74
P-value	0.0000	0.0000	0.0000	0.0000
Coefficient				
Age	- 0.18	-10	- 0.34	-16.37*
Education level	25.78*	5.73	35.99	428.12*
Income	18.63*	7.16*	24.498	226.87*
Insurance	12.04	0.79	- 11.33	361.22
Regular dental visits	8.91	4.57	26.36	306.06*
Children under 5	7.95	2.87	6.91	82.72
Elderly over 65	19.15	14.26*	26.22	142.74
Constant	-14.57	18.26	43.53	- 122.96
Sigma constant	40.44**	29.25**	137.38	805.07

[a] **, * significant at 1% and 5%, respectively.

Tooth decay can be significantly reduced through the use of preventive dental services. Raising parents' awareness and attitude about preventive dental services can be very important in encouraging them to demand and use these services and subsequently reduce tooth decay in children [18]. Household income has been identified as a key factor in using preventive dental services, such as sealant therapy [19].

The study findings revealed that parents with higher incomes had higher WTP for fissure sealant services than those with lower incomes, and income was identified as a factor affecting WTP [20]; these findings are consistent with the results of our study.

While the previous study found that individuals who had recently experienced toothache had a significantly higher WTP [17], our study found a positive relationship between toothache history and WTP, but it was not significant. Additionally, our study found that age was significantly correlated with WTP for orthodontic services, which is consistent with the findings of Moeeni et al.'s study [21].

Our study highlights that regular dental visits, education level, household income, and age are influential factors in the level of WTP for orthodontic services. Another study found that individuals with higher education levels and higher- income households had higher WTP for orthodontic treatment [22]; also, education level, household head's employment status,

and household income significantly affected the median healthcare expenses [23], which is consistent with our findings. Additionally, another study found that education levels were associated with the level of WTP for mammography [24].

The findings of this study were consistent with those of another study, showing that individuals who had regular dental visits and check- ups had higher WTP than those who did not [25].

The weaknesses and limitations of WTP studies are as follows: Starting point bias, the potential discrepancy between individuals' apparent preferences and decision-making in the real world, and overestimating the final WTP.

In order to mitigate these weaknesses and improve the accuracy of results, it has been attempted to use a single questionnaire and four initial bid amounts to prevent starting point bias. Additionally, they interviewed the household head, who is aware of the household income and expenses, to ensure that reported WTP levels are more realistic.

5.1. Conclusions

The findings of this study suggest that household income is a significant factor in determining WTP for dental services, and policymakers should take this point into account when setting prices for dental services, particularly preventive services such as fissure sealant

and fluoride therapy, which should be fully covered by insurance. By increasing access to these services, the likelihood of tooth decay in children can be reduced, ultimately decreasing the financial burden on families in the future.

In addition to the WTP, the ability to pay also plays a role in receiving services. Therefore, it is suggested that in the future, the ability of households to pay for dental services should be examined.

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Footnotes

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