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Willingness to pay for a quality-adjusted life year (QALY) in Pakistan: implications for health policy

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ABSTRACT

Objectives: Allocating healthcare resources in developing countries like Pakistan is constrained by economic limitations and uneven distribution. Therefore, in this study, we aimed to investigate the Willingness to Pay (WTP) for one additional Quality-Adjusted Life Year (QALY) among the general population in Pakistan to establish contextually relevant thresholds for health technology assessment (HTA).

Methods: We conducted a cross-sectional survey using the convenient sampling technique to estimate the WTP for one additional QALY among the general population of Pakistan. The contingent valuation method (CVM) using the payment card technique was used to assess its monetary value.

Results: A total of 600 participants participated in the survey and resulted in 1200 WTP responses for further analysis. The mean WTP/QALY was 114,006.4 Pakistani rupee (PKR) (United States Dollar 410.11), equivalent to 0.29 times Pakistan's GDP per capita. The WTP/QALY for the quality-of-life improvement scenario was lower than the life-extension scenario. The two-part regression model showed that higher education and income were positively associated with WTP value.

Conclusion: This study provides empirical evidence of the monetary value of one additional QALY from a sample of the Pakistani population. These findings highlight country-specific cost-effectiveness benchmarks, and incorporating WTP insights into the healthcare policy for better resource allocation, affordability, and long-term sustainability of the interventions

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1. Introduction

Healthcare resource allocation in developing countries is somehow complex and faces significant challenges due to the increased medical needs of the population, advances in treatment, and constrained budgets [1,2]. With limited health resources, healthcare systems tend to make choices that lead to optimal health outcomes at the lowest possible cost. In health economic valuation, Cost-effectiveness Analysis (CEA) is commonly used to compare the cost and health gain of two interventions. Because of the numeric value of CEA, the Incremental Cost-effectiveness Ratio (ICER) threshold is used which presents the cost in terms of monetary value and effectiveness expressed as one Quality-adjusted Life Year (QALY) [3–5]. QALY is a two-dimensional measure, that includes both quality and quantity of life. Quality of life (QoL), also known as health utility, is generally expressed on a numerical scale ranging from 0 (representing death) to 1 (representing perfect health) [6]. The general rule of economic valuation suggests that if ICER falls below a certain threshold, treatment is considered cost-effective [7].

The recommendation by the World Health Organization (WHO), which is based on Gross Domestic Product (GDP) per capita, is one of the methods for cost-effectiveness (CE) valuation. It stipulates that if a certain cost falls below one to three times GDP per capita, it is considered cost-effective [1]. Despite the increased use of the WHO CE threshold values, the recommendation might lack empirical evidence, and it may lead to inappropriate decisions regarding resource allocation in the healthcare system as Willingness to Pay for a Quality Adjusted Life Year (WTP/Q) seldom crosses 1 × GDP per capita. Similarly, applying 2–3× GDP per QALY might exhaust the national budget [8,9].

Keeping in view these recommendations, two perspectives have been proposed to derive such threshold values: the demand-side WTP perspective and the supply-side opportunity cost perspective [10,11]. The supply-side perspective means identifying opportunity costs as the result of the disinvestment needed to adopt new technology. The demand-side perspective is the WTP for small health gain and then aggregates the WTP needed for QALY [10,12]. The supply-side viewpoint is less common in practice than the demand-side WTP since it necessitates thorough and comparable data on the cost per QALY of all interventions [13].

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However, the demand-side approach is consistent with the approach taken in other public sectors in the context of conventional welfare economics [14].

It is particularly important to measure the WTP effectively in low-and middle-income countries (LMICs) although there is a lack of Universal Health Care (UHC) in countries like Pakistan [15–17]. The WTP estimates can provide valuable insights for the understanding of the preferences of the population and how individuals value health improvement. The WHO emphasizes that understanding societal preferences is essential for health interventions despite lacking the UHC [18]. This aligns with the International Society of Pharmacoeconomics and Outcome Research (ISPOR) advocacy for incorporating WTP assessment in the economic evaluation. This guides healthcare policymakers to prioritize the health interventions that maximize public health outcomes [19] in countries like Pakistan, where a limited healthcare budget demands careful consideration of healthcare expenditure. Pakistan's economic challenges, economic instability, GDP fluctuation, and scarcity of resources in Pakistan have caused a tremendous burden on the healthcare system and resources [20]. In addition, no previous study has been conducted in the country to estimate the monetary value of one additional QALY by eliciting the WTP of the general population [17]. Therefore, setting a cost-effective threshold that reflects the local economic condition and health priority is crucial, prompting policymakers to reallocate healthcare resources efficiently in times of financial turmoil.

2. Participants and methods

2.1. Study design and setting

A cross-sectional study was carried out from March to October 2024 to estimate WTP for a QALY among the general population of Pakistan. The Contingent Valuation Technique (CVM) was used to estimate the monetary value of one additional QALY [21]. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was followed to conduct this study and can be found in the S1 File.

2.2. Sample size

A minimum sample size of 545 was required for multiple regression, using the rule of thumb for a small effect size (30 participants per variable) expected for fifteen variables plus 50 additional samples, and a dropout of 10% [22]. We collected additional data to enhance the statistical power of our study, resulting in a total sample size of 600 participants.

2.3. Sampling technique

The convenient sampling technique was used to collect the data from the participants in the resource-limiting setting [23]. The inclusion criteria were 18 years old or above, Pakistani nationality, mentally stable, can understand or speak Urdu or English.

2.4. Questionnaire design

The sample questionnaire can be found in the S2 File. Due to the robust design, validation, and standardized health state measurement, the questionnaire for the survey was adopted from a study [24]. After carefully reviewing the questionnaire and discussing it with other team members and the principal investigator, we made some modifications. Initially, the reference study included 18 hypothetical scenarios, but after further discussion, we decided to reduce this number to 6. This change was made to simplify the questionnaire and make it easier to understand. Three questionnaires were used to collect data with different probabilities such as 50%, 75%, and 100%. Each questionnaire was comprised of five sections, including the introduction, demographics, health utility measures, and two hypothetical scenarios. First, a brief explanation of the survey was given with consent, 'Are you willing to participate in the survey' was asked and followed by the demographics of the participants.

Health-related quality of life (HRQoL) was assessed using the EuroQoL Five Dimensions, Five Levels (EQ-5D-5 L) tool, and the Visual Analog Scale (VAS), which is widely used for HRQoL assessment. Since Urdu is the national language of Pakistan, we requested the EuroQoL (ID 62,366) for the Urdu version of the EQ-5D-5 L [25]. After receiving approval and the Urdu version of the EQ-5D-5 L from EuroQoL, we included both the EQ-5D-5 L and the Visual Analog Scale (VAS) in the questionnaires. Since the Urdu version of EQ-5D-5 L was provided by EuroQoL, there was no need for cultural validation of the questionnaire. The last section consists of two hypothetical health conditions and asks participants to state the maximum amount they are willing to pay for the treatment of each hypothetical scenario. In total, there are three questionnaires, each comprised of two hypothetical scenarios based on the EQ-5D-5 L description. This survey demonstrates two ways of health improvement, improving QoL and extending life years.

For QoL improvement, mild, moderate, and severe scenarios were used, and one of them was explained to the participants. Without treatment, they would live for a certain period in a state of health and would regain their well-being after specified months. However, there is a new treatment that might offer an immediate recovery with a probability of 50%, 75 %, and 100%. Would you like to purchase this treatment? The terminal illness scenario reflects the assumption that the participant has a terminal illness and has a lifespan of certain months with a described health state (EQ-5D-5 L description: 44332). A newly developed treatment could have a 100%, 75%, or 50% chance of extending life years by XX months. The concept of probability was explained by a simple analogy: 'You have a 75% chance of getting immediately well if you receive this treatment, which means out of four, three will get perfectly well immediately.' The WTP payment was described as an out-of-pocket method, which means, 'the government or insurance company would not pay for this treatment, you have to pay for it yourself.' Those who said 'no' were then asked to state their reason. Those who said 'yes' were asked to state their maximum WTP amount using the payment card (PC) method. The PC method is one of the state preference techniques that use surveys to observe individual

respondents' preferences and reveal their WTP for non-market goods. It presents a set of predefined monetary values on a card, from which the respondents state the highest amount they are willing to pay. The true WTP of the respondents is assumed to be located above the stated value, and below the next highest value if such existed. The PC method was chosen because it avoids starting bias, respondents are confident about the stated amount, WTP can be directly measured from the original data, and WTP estimated by PC methods is more robust than relying dichotomous choice approach [26]. The WTP amount on the PC was estimated using the exponential rate scale by Weber's law [27], which means monetary value incremental is proportionally rather than linearly. The WTP amount was from 5% to 200% GDP per capita of Pakistan. Those who could not provide their PC WTP were asked an open-ended question to state their WTP. WTP questions were followed by the certainty question of whether they were really sure about their WTP amount.

2.5. Data collection

The data for this study was collected through quantitative interviews conducted in person and via online surveys. The interviewers in this survey were postgraduate students. All interviewers were required to attend one-week training sessions. Respondents were recruited by the interviewers, and for those who met the criteria, interviews were taken from them. For the online survey, the questionnaires were uploaded to the Google Form (Google LLC, Mountain View, California, United States) and shared in different groups on social media platforms like Facebook (Meta Platforms, Inc., Menlo Park, California, U.S.A.) and WhatsApp (WhatsApp LLC, Meta Platforms, Inc., Menlo Park, California, U.S.A.).

2.6. Ethics statement

The ethical approval for this study was taken from the Research and Ethics Committee (REC) of Riphah Institute of Pharmaceutical Sciences, Riphah International University, Islamabad, following all ethical guidelines for research involving human participants (Reference Number: REC-RIPS/RARE/2024/29).

An informed consent was obtained from all the participants before the survey. For interviews, the consent process was explained verbally, and participants provided verbal consent, which was subsequently documented by the researcher in the consent form. For the online survey, participants were provided with a written explanation of their study and informed consent details and their participation was considered implied consent upon survey completion. Moreover, all the participants were informed that participation in this study was voluntary and that they could withdraw at any time. All participants were assured that their data would remain confidential, and they were informed that their data would be used for publication purposes. All the study procedures adopted complied with the Principle of the Declaration of Helsinki, Good Clinical Practices, and within the applicable laws and regulations of research involving human subjects in Pakistan.

2.7. Data analysis

The disaggregated method was used to estimate individuals' WTP for an additional QALY, considering the diversity of preferences and marginal effects between health and money [28]. This means that the first individual WTP for QALY was calculated and subsequently the mean WTP/Q was estimated. The health utilities for EQ-5D-5 L were not evaluated for the Pakistani population yet, therefore, health utilities for calculating WTP for QALY were adopted from the Indian population [29]. The descriptive statistics (median, standard deviation, minimum, maximum value, 25^{th} percentile, and 75^{th} percentile) of the WTP/Q were first estimated for the whole sample and then for the subgroups. sensitivity analysis was performed by removing 1% of WTP/Q data. Considering the discrete-continuous WTP question, the two-part regression model was used to estimate the determinants of WTP/Q [30]. In the first part, the probit model was used to estimate the probability of a 'yes' response to the WTP question. In the second part, the generalized linear model (GLM) with gamma distribution and log 'link' function was used. From the previous studies, statistically significant variables in the univariate analysis were included in the multivariate analysis. The data was imported from Google Forms into Microsoft Excel for cleaning, and after that, the data was imported to RStudio for data analysis.

3. Results

3.1. Descriptive statistics of the respondents

A total of 750 individuals were approached and 650 participants voluntarily provided consent to participate in the survey. Among them, 50 responses were excluded due to the incomplete survey completion, resulting in a final sample of 600 responses included in the analysis. Out of 600 participants included in the final analysis, 58.7% of them were Male. The respondents ranged between 18 and 65 years old, and the age group 35–44 was prominent in the sample compared to the age group 25–34 (50% vs 41.3%). In terms of educational background, 26.5 % of the participants held a bachelor's degree while 38.2% had a master's degree. Among the respondents, 14.1% were teachers and 5% were pharmacists. 49% of the study population belonged to the lower middle-income group (PKR 50,000–100,000) and 25.7% were from the middle-income group (PKR 100,000 to 200,000). Most of the participants were from the Punjab province (75.3%) and 82.7% of them lived in urban areas (Table 1).

In the EQ-5D-5 L section, most of the participants reported that they had no problem with walking, performing usual activities, and self-care (70.7%, 76.2%, and 82.3%, respectively). Additionally, 47.8% reported they experienced slight pain or discomfort while 74.7% indicated mild depression. Among the participants, 39.2% rated their current health state at 80 on VAS. WTP amount was followed by a certainty question, 54.5% were confident that they needed this treatment. Furthermore, 51.5% reported that they partially understood the questionnaire.

Table 1. Demographic characteristics of the survey respondents.

Demographic characteristics	Count (%)
Gender	
Male	352(58.75)
Female	248(41.35)
Age group	
25–34	219(36.55)
35–44	300(50)
Marital status	
Single	64(10.75)
Married	478(79.95)
Education	
Bachelor's	159(26.55)
Master's or above	270(45)
Occupation	
Laborer	19(3.29)
Bank Manager	25(4.2)
Business Owner	18(3)
Pharmacist	30(5)
Rideshare Driver	30(5)
Teacher	85(14.1)
Income	
50,000–1,00,000	294(49)
More than 1,00,000	154(25.7)
Residence	
Urban	496(82.7)
Rural	104(17.3)
Province	
Punjab	452(75.3)
EQ-5D-5L	
No problem in walking	424(70.7)
No problem with self-care	494(82.3)
No problem in doing usual activities	457(76.2)
Slight pain/discomfort	287(47.8)
Slight depression/anxiety	448(74.7)
VAS rating	
80	235(39.2)
90	101(16.8)
Certainty about treatment	
I am sure about receiving this treatment	654(54.5)
Understanding of questionnaire	
Partially understood	45(7.5)
Not completely understood	310(51.7)

3.2. Descriptive statistics for WTP and WTP/Q

Out of 1200 WTP responses, there are 147 (12.25%) zero WTP values as the participants responded 'no' to WTP questions. A total of 1053 WTP responses were included for further analysis. 473 (44.9%) were related to QoL improvement and the remaining 580 (55.08%) were related to extending life years scenarios.

In WTP amount, most of the respondents chose between PKR 50,000 to PKR 80,000, while fewer chose the higher WTP values. The mean WTP for the whole sample was PKR 74,311.5 (267.23 USD). For QoL improvement, the mean WTP value was PKR 54,271 (195.23 UD) while in the life-extending scenario, the mean WTP value was PKR 90,665.2 (326.15 USD).

Figure 1 demonstrates the descriptive statistics of WTP/Q for the subgroups (Figure 1). Table 2 shows that the mean WTP/Q for the whole sample is PKR 114,006.4 (410.11 USD) which equals 0.29 times GDP per capita, while the median WTP/Q is PKR 101,265.8 (364.28 USD) which equals 0.25 times GDP per capita. For QoL improvement scenarios, the mean WTP/Q is 101,657.5 PKR (365.69 USD) which equals 0.27 GDP per capita. However, the mean WTP/Q for extending life years scenarios is higher than that of quality-of-life improvement, at PKR 114,753 (412. 80 USD), equivalent to 0.29 GDP per capita (Table 2).

3.3. Determinants of WTP/Q

According to the literature review and univariate analysis, the following variables are included in the two-part regression model: gender, age, education, income, employment status, residence, type of residence (urban or rural), family role (sole provider or not), province, and EQ-5D-5 L [24,31,32].

3.4. Two-part regression model for the subgroups

The first part of the two-part regression model demonstrates the coefficients from the probit model that estimates the

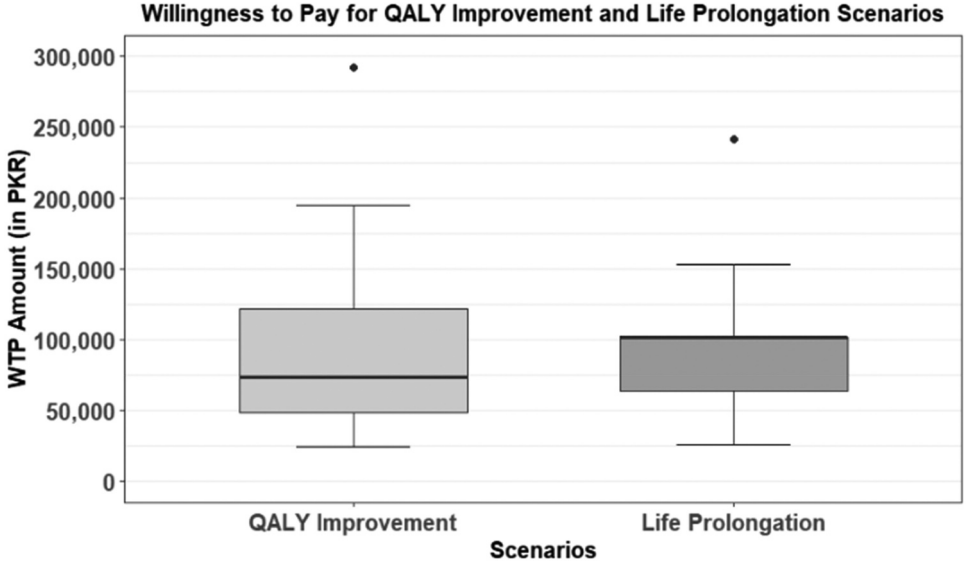

Figure 1. Boxplot shows the descriptive statistics of willingness to pay (WTP) for a quality-adjusted life year (QALY) scenarios.

Boxplot depicting willingness to pay (WTP) amounts (PKR) on the Y-axis for two hypothetical scenarios on the X-axis: life prolongation and QALY improvement. WTP values are 5% trimmed to minimize the influence of extreme values and outliers.

Table 2. Descriptive statistics of willingness to pay for one additional quality-adjusted life year.

	Whole sample		Quality-of-life improvement		Life extension	
	Base case	Sensitivity analysis	Base case	Sensitivity analysis	Base case	Sensitivity analysis
N	1046	1025	473	463	580	568
Mean	114,006.4 PKR	106,575.7 PKR	113,090.4 PKR	105,474.1 PKR	114,753.4 PKR	110,467.8 PKR
Standard Deviation	115,169.2 PKR	73433.72 PKR	124,953.1 PKR	75255.74 PKR	106,632.2 PKR	84802.35 PKR
Median	101,265.8 PKR	101,265.8 PKR	96153.846 PKR	73170.73 PKR	121,265.82 PKR	101,265.8 PKR
Minimum	9.240506 PKR	25316.46 PKR	24038.46 PKR	24038.46 PKR	9.24 PKR	25316.46 PKR
Maximum	195,1220 PKR	463,414.6 PKR	191,1219.51 PKR	462,287.1 PKR	101,2658.22 PKR	594,936.7 PKR
25th quantile	63291.14 PKR	63291.14 PKR	48780.49 PKR	48780.49 PKR	63291.14 PKR	63291.14 PKR
75th quantile	121,951.2 PKR	121,951.2 PKR	121,951.22 PKR	121,951.2 PKR	151,898.73 PKR	151,898.7 PKR

Sensitivity Analysis: 1% of the data is removed from the sample's top and bottom.[1]

Table 3. Two-part regression model for the subgroups.

	Improving quality of life				Extending life length			
	Probit		GLM		Probit		GLM	
Variables	Coeff	SE	Coeff	SE	Coeff	SE	Coeff	SE
Gender (vs Female)								
Male	**−1.001*****	0.2076	**0.18168***	0.07237	**−0.79106***	0.308	0.010	0.066
Age group (vs 18–24)								
25–34	−0.4718	0.5926	−0.1786	0.280	−0.19431	0.572	**−0.650****	0.210
35–44	0.6887	0.5726	−0.19288	0.280	0.176	0.533	**−0.762*****	0.208
45–54	0.3645	0.747	−0.2574	0.303	−0.298	0.783	**−0.825*****	0.236
Education (vs Primary/No education)								
Bachelor's degree	**1.0938*****	0.3236	0.0588	0.231	**0.854***	0.385	**0.399****	0.410
Master's or above	0.4614	0.3719	0.0134	0.236	**1.049***	0.511	**0.401****	0.153
Income (vs < 50000)								
50,000–100,000	**1.2811*****	0.2629	**0.2073.**	0.1133	0.783	0.363	**0.603*****	0.101
>100,000	**1.6094*****	0.3022	**0.6259*****	0.1294	0.471	0.415	**1.569****	0.192
Employment (vs Unemployment)								
Employed	**1.5385*****	0.4512			**1.563****	0.521	−0.325	0.275
Residence (vs Rural)								
Urban	**−0.8536****	0.2878	0.046	0.097	−0.412	0.409	**−0.311*****	0.08
Residence type (vs Own)								
Rented	0.1522	0.4867	−0.2031	0.1239	−0.735	0.506	−0.209	0.116
Solo Provider (vs No)								
Yes	−1.986	0.219	**−0.2228****	0.0706	0.099	0.310	−0.071	0.063
Province (vs Others)								
Punjab	**0.4859***	0.2065	−01897	0.088	−0.525	0.432		
Usual activities (vs Severe problem)								
No problem	**−1.7318***	0.8585	0.035	0.3693	−0.5999	0.861		
Slight problem	−0.8781	0.813	0.065	0.354	0.463	0.916		
Pain/Discomfort (vs Severe problem)								
Slight problem	0.1772		−0.1067	0.0712	0.338	0.326	**−0.197****	0.064
Moderate problem	−0.4345	0.405	0.251	0.1703			−0.116	0.315
Anxiety/Depression (vs Severe problem)								
Slight problem	−0.2602	2.266	**−0.1804.**	0.1121	−0.217	0.599	0.134	0.135
Moderate problem	**−1.6207*****	0.3825	**−0.278.**	0.1631	−0.252	0.419	**0.274***	0.136
Probability (vs 50%)								
75%	**0.7582*****	0.137	−0.158	0.195	−0.393	0.09	−0.05	0.09
100%	**1.02*****	0.146	4.32	178.4	−0.104	0.09	0.03	0.09
WTP/Q estimate				**101,657.4**				**114,753.4**
N	600		453		600		580	
Pseudo R square	0.434		0.03		0.321		0.0228	
AIC[2]	389.99			9958.9	182.57		13607	

*** Indicates that they are statistically significantly different at the 0.1% level (p <0.001), ** Indicates that they are statistically significantly different at the 1 % (p < 0.01), and * Indicates that they are statistically significantly different at the 5% level (p < 0.05) and . indicates that they are statistically significantly different at the 10% level (p <0.1).[3]

probability of a 'yes' response to the WTP question. The second part shows the coefficients for the GLM model, estimating the relationship among those who reported positive WTP responses (Table 3).

Higher education (bachelor's degree, β = 1.0938, p < 0.001) and income (50,000–100,000, β = 1.2811, p < 0.001; >100,000, β = 1.6094, p < 0.001) are positively associated with WTP in both subgroups. However, age group 25–34 (β = −0.650, p < 0.01) is associated with a lower probability of positive WTP for extending life years. Compared to females, males (β = −1.001, p < 0.001) show a negative association with positive WTP for both subgroups. Additionally, individuals from the Punjab province (β = 0.4859, p < 0.05) and those who are employed (β = 1.5385, p < 0.001) are more likely to have a positive WTP response.

Furthermore, the probability of positive WTP was higher when the health outcome had a probability of 100% (β = 1.02, $p < 0.001$) compared to 75% (β = 0.7582, $p < 0.001$) for the quality-of-life improvement scenario. In contrast, the probability of positive WTP was lower for the extending life years scenario at both 100% (β = −0.393, not significant) and 75% probability (β = −0.104, not significant). Regarding EQ-5D-5 L measures, respondents with moderate anxiety (β = −1.6207, $p < 0.001$) were negatively associated with WTP for quality-of-life improvement but showed a higher probability of positive WTP for life extension scenarios (β = 0.274, $p < 0.05$).

4. Discussion

This is the first study that assessed the monetary value of one additional QALY among the general population in Pakistan. Economic challenges, including instability, fluctuation of GDP, resource scarcity, and lack of UMC necessitate an economic evaluation in Pakistan that reflects the local economic condition and health priorities [15,16]. Our findings suggested that higher education (Coeff = 0.654, $p < 0.001$) and income (Coeff = 0.821, $p < 0.001$) were positively associated with the probability of higher WTP values that comply with the theoretical validity of WTP research [33,34]. The mean WTP for one additional QALY was PKR 114,006 (USD 410), with a 12.8% greater WTP for life extension (PKR 114,753 vs. PKR 101,657 for QoL improvement), reflecting greater societal value for terminal health gains. This aligns with studies in Iran [35], where life extension was prioritized as compared to QoL improvement. The two-part regression model indicated that determinants of WTP/Q were age, education, income, employment status, and moderate anxiety. The higher probability of health outcome (100% vs 75%) was one of the main driving factors for the higher probability of positive WTP for improving QoL scenarios (100% Coeff = 1.02, $p < 0.001$, and 75% Coeff = 0.7582, $p < 0.001$), which contradicted the prospect theory which suggests that people tend to assign a large value to a small chance and a small value to a large chance [36]. In contrast, life extension scenarios support the prospect theory by highlighting a lower probability of positive WTP for both 75% (Coeff = −0.104, $p = 0.09$) and 100% probabilities (Coeff = −0.393, $p < 0.001$). Our findings show that WTP for one additional QALY among the general population of Pakistan ranges from 0.27 (383.25 USD) to 0.29 (412.66 USD) times GDP per capita.

Research has shown that people prioritize a higher probability of positive outcomes for health conditions that affect their day-to-day lives [37]. Studies suggest that individuals tend to prefer immediate and certain improvements in their well-being over low-probability, high-reward scenarios, which aligns with the emphasis on certainty found in healthcare WTP studies [38]. For life extension scenarios, the context shifts to the future and involves greater uncertainty about long-term outcomes. Thus, when the probability of extending life is high, the extra life year may be viewed as less special (reflecting diminishing marginal utility) compared to when the chance is low where individuals overweight the rare opportunity to extend life. Therefore, a higher probability of life extension is associated with a lower WTP as a treatment value becomes less pronounced when the success is almost guaranteed [36].

Our results align with the cost-effectiveness threshold (CET) for low and middle-income countries (LMICs), which is less than 0.5 times GDP per capita. A study estimating the CET per QALY and life year for Pakistan reported CET per QALY for Pakistan is 299 USD (153–379 dollars), 0.20 (0.10–0.26) GDP per capita, that almost equals our estimated value for QoL improvement. For CET per life year, it was estimated to be 253 USD (120–320) and 0.17 (0.09–0.22), which is a bit lower than our estimated value for extending life years. Overall, for LMICs, CET for QALY ranges from 171 to 3249 USD (0.12–0.94 GDP per capita) and our estimated WTP lies within this range [39]. Our results also show a considerably lower threshold than those postulated by WHO [40]. More interestingly, our empirical results comply with Wood et al., who estimated the relationship between GDPs per capita and CE threshold based on the countries' income levels. It reveals the appropriate range of CE threshold varies from 0.1–0.51 and 0.18–0.71 GDP per capita for low-and-middle and middle-and high-income countries, accordingly [14].

Despite facing severe resource constraints, LMICs often overlook economic evaluation tools that could enhance the efficiency of healthcare resource utilization. A few empirical studies have been conducted in these countries, such as Iran and Thailand [1,2,41]. It is also important to determine which type of scale is used to elicit the WTP when using the PC method. Using the ordered scale from high to low, reading down the list would lead to inflated WTP or interviewer bias as compared to the low-to-high or randomly sorted list. In other studies conducted in LMICs, the bidding technique and double-bounded dichotomous choice (DBDC) method were used, therefore, to avoid starting bias common in the bidding technique and iterative process in DBDC, we used the low-to-high ordered PC method [27,42]. Respondents who refused to assign any WTP value are referred to as zero WTP. Zero WTP is very common in all WTP surveys. For instance, in a population-based survey in China, about 16.5% of total responses were zero WTP [24], while in the European value of QALY, 30% of respondents stated their WTP value as zero [34]. In our research, 12.5% of total responses are zero WTP. Policymakers in health economics must understand the public's WTP value for a QALY. As shown in our study, with previous literature, WTP for life-extension scenarios is higher than quality-of-life improvement scenarios, and given these public preferences, policymakers should incorporate these preferences while deciding on health interventions [35]. Factors like education and income strongly influence WTP, therefore, policymakers could consider initiatives to reduce these barriers. Pakistan should adopt country-specific CETs, ensuring that CEA aligns with real economic constraints and societal preferences. These findings suggest that healthcare policymakers should reassess health resource allocations to ensure a balanced approach between life-prolonging therapies (e.g. cancer treatment) and QoL improvement therapies (e.g. palliative care). Pakistan should implement a tiered pricing model for healthcare services [43], ensuring subsidized or free access to cost-effective treatments for low-income populations and institutionalizing the HTA in national health policy.

There are several limitations of this study that need to be mentioned. First, sampling bias arose from the overrepresentation of younger (25–34 age group), educated, and urban

population that could potentially skew the WTP estimates. Secondly, most of the data was collected via web-based surveys, it may exclude digitally marginalized groups; face-to-face interviews could improve validity and reduce protest zero or cognitive biases [34,44]. Thirdly, the use of a convenient sampling technique due to budget constraints limits the generalizability. Fourth, while the PC method provided a direct WTP estimate with minimal starting bias, it relies on introspection that oversimplifies complex health-economic-making [45]. While the income was categorized based on the national average to address the participants' reluctance to disclose exact earnings, finer stratification was limited by data constraints and model convergence issues. Nearly half (41.3%) of the study population were females, and gender dynamics in financial decision-making were not explored, as cultural norms in patriarchal settings may influence WTP responses [46–48]. Future studies should prioritize stratified random sampling and face-to-face surveys in underserved areas to enhance validity and inclusivity. Methodologically, adaptive valuation techniques (such as DECs or iterative bidding games) and mixed-method approaches could capture nuanced preferences, reduce hypothetical introspection, and clarify the drivers of zero WTP. Finally, developing predictive algorithms for WTP incorporating socioeconomics, geographics, and psychological variables could aid policymakers in tailoring cost-effective interventions across subpopulations.

5. Conclusion

This study provides the empirical evidence of WTP for one additional QALY in Pakistan, emphasizing the impact of socioeconomic and health-related factors. The findings suggest that existing global WTP thresholds may not be applicable, necessitating locally tailored cost-effectiveness criteria. The lower WTP among individuals with poorer health highlight the financial protection measures to ensure equitable healthcare access to life saving treatments. Policymakers should integrate WTP into priority settings to enhance the affordability and sustainability of healthcare interventions. The understanding of WTP can aid in optimizing price strategies for essential treatments, improving patient access, and reducing health disparities.

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Notes

1. **PKR**: Pakistani rupees.
2. AIC: Akaike Information Criterion.
3. **SE**: Standard Error **Coeff**: Coefficients.

Declaration of interest

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

Authors contributions

All authors contributed to the design and completion of this survey. A Ahmed and F Rehman helped with conceptual background, questionnaire design, and manuscript writing. F Rehman, MW Shahid and M Riaz helped with questionnaire design supervised and reviewed by A Ahmed. F Rehman, MW Shahid and M Riaz helped with data collection, data analysis, and manuscript writing. MM Umair, F Azhar and M Amer helped in drafting the manuscript. A Ahmed supervised and reviewed the all steps of study and manuscript development. All the authors reviewed the final manuscript and are responsible for their contributed work.

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Data availability statement

Data will be available upon reasonable request by contacting the corresponding author.

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