

Willingness-to-pay for spectacles studies: a scoping review of rationales and methodologies

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Abstract

Background

The global recognition of uncorrected refractive error as the main cause of vision impairment has increasingly demand for affordable, available and accessible refraction and spectacle dispensing services. Willingness to pay (WTP) for spectacles studies afford context-specific planning for integration of these services into eye care service delivery. The aim of this scoping review was to identify the rationales and the range of methods used when conducting WTP for spectacles studies.

Methods

We undertook this scoping review, using a search from EBSCO (host), Medline, PubMed, SCOPUS, Google Scholar and ProQuest databases. We also searched Google and eyecare organisation's websites for grey literature. We analysed the articles using the scoping review methodological framework proposed by Arskey and Marley.

Results

The search identified 237 from and only 14 were eligible. 79% (n=11) were published articles and 21% (n=3) were grey literature. All studies were from developing countries. Most of the studies reported rationales with a few that were vague. The majority of the studies used survey-based techniques, where the limitation and strengths were reported.

Conclusion

The scoping review highlighted the knowledge gap in reporting the WTP for spectacles methodologies that need to be considered in reporting future research.

Keywords: Willingness to pay, spectacles, eyeglasses

Introduction

Public health services are recognised as a common good that is beneficial to users in terms of life and, to a certain extent, improved quality of life. However, due to limited available resources, decision-making about new initiatives in public health interventions is increasingly guided by economic evaluation theory [1]. Economic evaluation is rationalised as the comparison of cost and outcomes of health care intervention [2–4]. The supply of a health intervention has to be balanced with its demand. Hence, researchers tend to analyse the consumers' willingness to pay for the intervention to improve or achieve a better health outcome [4, 5].

Willingness-to-pay (WTP) analysis is derived from economic evaluation theory, which allows for an understanding of preferences and wishes of individuals and society's overall budget constraint [6, 7]. This analysis is thus deemed essential to measure the 'strength of preferences' as it will inform decision making by maximising the value of benefits and the integration of the outcomes of these assessments [8]. However, WTP methods have also shown to have several flaws as they are usually conducted in hypothetical situations which can produce inaccurate results [9]. These results can show how participants underestimate or overestimate

WTP responses according to the environment they are in at the moment [5, 9]. Furthermore, participants may be unaware of the value of the product and since the results depend on how participants value the outcome, this becomes subjective [10]. Finally, it ignores the socio-economic value, leading to discriminatory effects on low income individuals and social groups [5, 6].

In general, there are two approaches for determining WTP preferences, and both have been used in WTP for spectacles. They are:

- the **stated preferences**, which are determined by contingent valuation methods undertaken through survey-based techniques [1,9]. The contingent valuations surveys are either direct in terms of participants being asked to state their WTP (designed in a binary response or binary-with-follow-up) for a specified health outcome [1,10,11], or indirectly where participants are asked to state their WTP from a set of options. Both direct and indirect valuations have been considered to have potential biases as most of the time, assessments are conducted in hypothetical situations [8,12].
- The **revealed preferences** are determined from experiments conducted in real settings with actual products or services with the results obtained from participant's price responses [9,10,13]. One technique used is Vickrey Auctions where the participants do the valuation of the product and then each submits a sealed bid [10]. The highest bid will determine the purchase price. Another technique that has been used is Becker-DeGroot-Marschack (BDM) which permits participants to buy the product based on the final sale price which has been randomly drawn from their submitted bids [10].

Willingness-to-pay for spectacles can only be understood in the context of broader eye health developments. For over a decade, the global estimates on visual impairment focussed on elimination of blindness where the leading causes were seen as cataract, trachoma, glaucoma, onchocerciasis and others [14]. These estimates excluded refractive error as a cause of visual impairment leading to 'significantly underestimate the actual burden of uncorrected refractive error [15]. However, notable recognition was the World Health Organisation (WHO) press release of the global data of uncorrected refractive error announced on the 2006 World Sight Day. The data revealed that 153 million people worldwide have uncorrected refractive errors which can certainly be corrected with spectacles, 'yet millions of people in low and middle income countries do not have access to these basic services' [16].

It was consequently acknowledged that cataract and uncorrected refractive error were the biggest causes of visual impairment and confirmed the latter as a matter of public health concern [17, 18]. Nonetheless, there is not much evidence of WTP in eye health and most of the studies have been conducted for cataract surgery [19–21]. Despite uncorrected refractive error being the leading cause of vision impairment and spectacle correction being a cost-effective management, few studies have been conducted to determine the WTP for spectacles. The lack of studies determining the WTP for spectacles can be explained by the belated recognition of uncorrected refractive error as a public health issue and the provision of spectacles services being primarily in private settings.

To achieve effective investments in the reduction of uncorrected refractive error, a self-sustaining system that has a competent eye health workforce and provision of spectacle correction according to needs would be required [22]. However, lack of screening and the accessibility and affordability of refractive services hinders the provision of needs. Even where services are available compliance remains low due to either costs or

cultural barriers [17]. Accordingly, WTP for spectacles has been seen as an appropriate measure to address the aforementioned issues and for planning for integration into eye care services. This scoping review does not report and compares the results of the WTP for spectacles in the selected studies because the results are context-specific in terms of external and internal influences. Instead, we aim to describe the range of methodologies used and the defined rationales in conducting studies of WTP for spectacles.

Methods

We searched the PROSPERO database for any previous reviews of WTP for spectacles as the initial step in conducting this scoping review and found none. The need to identify the rationales and methods used to conduct WTP for spectacles [23], obliged us to conduct this scoping review as the body of literature is so small (many are related to programme development) that we might lose important information by excluding grey literature.

The scoping review employed the methodological framework proposed by Arskey and Marley [24], which was further elaborated by Levac et al., [25]. This framework is comprised of five stages; 1) identifying the research question, 2) identifying relevant studies, 3) study selection, 4) charting the data and 5) collating, summarising and reporting the results.

Research question

Identifying the research question as the first step in conducting a scoping review is significant as it provides direction as to how search strategies are developed [24]. The research team defined the research question as: "What is the existing knowledge in the literature about willingness-to-pay for spectacles?" Initially, the question sounded quite broad. However, the intended outcome of the study guided our scope of inquiry [25] to include the mapping of the methodology used and their justifications in conducting the studies.

Search Strategy

The search strategy was undertaken in June 2019 to capture all relevant literature in several electronic databases, which included EBSCO (host), Medline, PubMed, SCOPUS, Google Scholar and ProQuest. To achieve precision and recall in the results, a search strategy was conducted using the following specific keywords: "willingness-to-pay" and "spectacles". We extended the term "spectacles" to a related word, "eyeglasses". By using MeSH and Boolean operators, we sought the search terms in either the title, abstract or full text. We also searched Google and eyecare organisation's websites for grey literature (non-peer-reviewed literature or unpublished reports).

Study Selection

The selection of available literature was undertaken systematically. The reviewer first searched databases for keywords based on the inclusion and exclusion criteria. We included all published and unpublished research articles, reports and any related documents which assessed willingness-to-pay, spectacles or eyeglasses in the review. We excluded all duplicate articles, reports and documents that were not reported in English and all research articles that combined willingness-to-pay for other eye health issues such as spectacles after cataract

surgery and the provision of eye health services were excluded. When uncertain about a document, the reviewer kept the article and discussed with the second reviewer.

Charting the data

We developed a data charting template from a Microsoft word formatted table to capture all the selected studies. In this standardised form we extracted the following details from the articles; year, country, study design, unit of study, sample, outcome measure and rationale, methods, findings, limitations, strengths and recommendations. Two members of the research team independently extracted data of the included studies and later met to determine whether the captured studies were aligned to the research question [25]. The whole process was iterative with the researchers updating the data charting template constantly. We resolved any disagreements by compromising and accommodating through discussion and consensus.

Collating, summarising and reporting

We presented the collated information obtained from the studies in three categories. Firstly, we organised the studies based on their reported study rationale, counted them with their percentages. Secondly, we organised the studies according to the methods used in terms of characteristics of participants, sampling strategies and tools used for data collection. Thirdly, we organised the studies according to their identified strengths and limitations. Since we intended to explore the scope of knowledge in these three categories regarding willingness-to-pay for spectacles, we summarised information as presented across articles.

Results

Literature search

Figure 1 outlines the results of the search strategy and study selection processes. Since, a variety of disciplinary perspectives (economics, business, marketing and others) used the willingness-to-pay concept, the search process from several databases produced many irrelevant articles. We, therefore, limited a selection to the first 50 articles and identified 252 articles through all defined searches. Using the eligibility criteria, we condensed the number to 14 articles.

Characteristics of the studies

In this scoping review, we located 14 articles regarding WTP for spectacles with eleven articles published (79%) in journals, and the other three (21%) were internet documents. One was a preprint article, and two were reports from non-governmental organisations (One-Dollar-Glasses [ODG] and Sight Savers in collaboration with Seeing is Believing).

The reported rationale of the studies

The reported rationales for the WTP assessment in these studies were 1) to understand potential pathways of spectacle provision and planning for eyecare service delivery [26–31], 2) initiated by low levels of spectacle acceptance [32], 3) to construct a business model [33] and 4) to improve outreach refraction and spectacle

dispensing services [34, 35]. In some studies, the rationale was unclear as WTP for spectacles was a small component of a bigger study. The reported rationale of the WTP studies is shown in Table 1.

Table 1. Study rationale for conducting a willingness-to-pay study (n = 14)

Rationale	No. of studies	Percentage
To understand the demand and potential pathways of spectacles provision to improve eye care services	4	29%
Limited or no information available for planning of spectacle service	2	14%
Low levels of spectacle acceptance	1	7%
A need to construct a business model	1	7%
Improve outreach refraction and spectacle dispensing services	2	14%
None reported	4	29%

The reported methodologies from eligible studies

The general WTP methodology used in the 13 selected articles was the survey-based techniques which establish stated preferences. These techniques used a contingent valuation approach with binary/dichotomous and binary-with-follow-up questions, and included indirect surveys with more choices where the minimum and maximum prices are available to the participants. Table 2 shows the methodologies used in the selected articles.

Table 2
The methodology of willingness-to-pay studies

Year	Country	Participants/n	Calculated sample size /determination	Tools for data collection
2007	Timor-Leste	*Adults ≥ 40 years / 1414	1470 / systematic random sampling/cluster sampling	Survey Face to face interview
2008	Cambodia	*People prescribed spectacles / 252	*293 / not specified	Interview – questionnaire -Binary-with-follow-up (BWFU) technique
2008	Fiji	*Households individuals / 174	174 / systematic random sampling	A rapid appraisal technique – semi-structured interviews - WTP determined – five-choice modified payment card
2008	China	* Children – junior high school / 674	2100/ cluster-based random sampling	Interview - questionnaire
2009	Timor-Leste	*Adults ≥ 35 years / 152	168 / a prevalence of stated WTP U\$0.10 of 75% $\pm 10\%$, at 5% level of significance, cluster design effect of 2.0, assuming a 15% non-response rate	Survey – Questionnaire -Binary-with-follow-up technique
2010	Tanzania	*Adults ≥ 40 years of age / 323	400 / estimated prevalence of 61.7% -precision – 5% and 95% confidence level	Interviews *open question
2012	Timor-Leste	*Adults ≥ 40 years / 1974	2250 / cluster random sampling; precision $\pm 1.5\%$ (20% relative difference), with 95% confidence, a design effect of 1.6, a response rate of 80%	Survey – Interview – questionnaire
2013	Nicaragua	*Adults ≥ 34 years / 353	353 / sample from the records	Retrospective review
2015	Papua New Guinea	* Individuals (16–96 years) / 614	614 / convenience sampling	Interview - questionnaire

Year	Country	Participants/n	Calculated sample size /determination	Tools for data collection
2015	Bangladesh	* households / 1600 *individuals /558	* 1600 household randomly selected *558 / randomly selected - diagnosed with refractive error	*Household survey *Patient exit Interviews (eye care facilities and optic shop) - Contingent valuation method (CVM) -Triple-bounded format consists of dichotomous choice design
2016	Nigeria	* Presbyopic Adults ≥ 40 years / 52	600 / cluster random sampling using probability proportion-to-size	Survey - interviews
2017	China, India, Eritrea, Mexico, Vietnam, Ecuador, Guatemala, Paraguay	Adults ≥ 30 years / 1909	*Not specified	Not mentioned but most probably through interviews
2018	Ethiopia	*presbyopic adults – age 35–73 / 322	*340 / simple random sampling - single proportion formula – $p = 82.9\%$ and 4% margin of error	Interviews – Questionnaire
2018	Burkina Faso	*persons prescribed glasses / 412	* 412 / self- select – not clear	Beck-DeGroot-Marschack (BDM) approach – Bidding 1. participants price WTP 2. auction at market price

Limitations, strengths and recommendations

Although several studies did not report any WTP technique limitations [30, 32, 36], some reported general survey biases such as recall bias and selection bias [27, 29, 35, 37]. Only one study reported WTP using BDM technique with follow-up questions [31]. The studies reported a variety of limitations, strengths and recommendations on the methodology used, as shown in Table 3 below.

Table 3
Limitations, strengths and recommendations of included studies

Year	Country	Limitations	Strengths	Recommendations
2007	Timor-Leste	*Weaknesses of rapid assessment methods *Not determining maximum WTP for spectacles	*none reported	*None reported
2008	Cambodia	*Selection of starting price with Binary-with-follow-up (BWFU) may potentially introduce bias *Reliability of WTP may be affected as spectacles have not demonstrated significance or minimal perceived-need to the respondent *Future WTP may alter intentions of first-time buyers and may not aligned with the assumptions of the study *WTP may not be an accurate predictor of actual WTP due to changes in individual circumstances	*BWFU is an appropriate technique as it reduces the range within which respondents measured WTP	*None reported
2008	Fiji	*Recall bias – the sampling unit was at a household level. Hence responses might be from individuals that were not involved in the issues asked	*The methodology used was useful for planning purposes and investigation of anticipated behaviour in the community	*Further investigations to ascertain the maximum price each individual is willing to pay for spectacles to enhance financial equity
2008	China	*WTP for spectacles was assessed by children aged 13 to 17 – the validity of such data may be questionable *Unable to conclude with certainty that any families purchasing spectacles did so as a result of the intervention	*None reported	*A randomised trial will address the limitations of the study
2009	Timor-Leste	*WTP may overestimate actual WTP	*BWFU good to be utilised as a predictor of behaviour	*BWFU likely to be used for the planning of spectacle provision by eye care programmes in other countries
2010	Tanzania	*Difficulty in recruiting individuals aged 40–50 years *Responder bias – aware of receiving free spectacles	*None specified	*Further research -an assessment of tiered payment with cross-subsidies and assessment of the wider community benefits.

Year	Country	Limitations	Strengths	Recommendations
2012	Timor-Leste	None reported	*None reported	*None reported
2013	Nicaragua	*WTP scale had fewer choices on the lower end of the scale *Likely response biased – due to free glasses	*None reported	*Questions relating to WTP for replacement should be modified to a lower scale or perhaps changed to the binary-with-follow-up method
2015	Papua New Guinea	*Likely selection bias as convenience sampling was used hence sample may not be representative *Test-retest was not undertaken, thus unable to report the stability *The questionnaire was not translated to the diverse local languages. The survey was conducted verbally.	*The development of the questionnaire included ideas for focus groups and eye health workers	*None reported
2016	Nigeria	*Participants awareness that they might receive free spectacles might have influenced their responses	*None reported	*None reported
2017	China, India, Eritrea, Mexico, Vietnam, Ecuador, Guatemala, Paraguay	*Likely an underestimate of WTP for spectacles estimate to the actual price paid for glasses	* A large sample size	*None reported
2015	Bangladesh	*None reported	*Contingent valuation method with simulation of refractive error appears to produce reliable and valid WTP estimates	*None reported
2018	Ethiopia	*Likely response bias thus many not guarantee valid responses *Outreach services might have inflated spectacle coverage and likely to increase the proportion of WTP	*None reported	*None reported

Year	Country	Limitations	Strengths	Recommendations
2018	Burkina Faso	*The BDM is too complex to understand	*The Becker-DeGroot-Marschak (BDM) confronts the person with a real purchase decision *BDM allows observing the exact price of WTP *BDM allows drawing a detailed demand curve *BDM incentivise truthful responses *BDM approach prevents conflicts between bidders	*None reported

Discussion

The literature search identified 237 articles of which 14 were eligible for this scoping review. 79% (n = 11) of these articles were published and 21% (n = 3) were grey literature. All studies were from developing countries. Most of the studies reported rationales with a few that were vague. The majority of the studies used survey-based techniques, where the limitation and strengths were reported.

Our scoping review showed that very little had been researched into WTP for spectacles despite the global burden of uncorrected refractive errors. Perhaps the fairly recent recognition as a public health issue that included visual impairment caused by uncorrected refractive errors into VISION 2020 global initiative of elimination of avoidable blindness [38] explains why the scoping review found the earliest published article in 2007. Additionally, all the studies undertaken were mainly from developing countries because low socio-economic status is one of the risk factors of visually impairment - socio economic status that affects 90% of vision impaired people live in developing countries [38]. Although the justification of using certain methods in research is considered to be essential [39], little is reported on the pros and cons of WTP for spectacles methodology.

The reported rationale of WTP analysis for spectacles in the eligible studies

As mentioned previously, WTP is a cost-and-benefit measure. The rationale for WTP analysis in health care is due to the financial dilemma inherent in all service delivery. In developing countries, health services are paid out of pocket, and WTP assessment ascertains the potential for cost recovery and the demand for service delivery of a specific health issue [40–42]. Accordingly, the assessments are viewed as a premise for financial sustainability and development of cross-subsidisation procedures that allows for equity, affordability, accessibility, availability and quality [43, 44]. Our scoping review found a similar rationale in several of the eligible studies in terms of understanding the demand through participant’s preferences that could facilitate the provision of affordable and accessible spectacle services [26–31, 33, 34].

Similarly, another study defined its rationale in terms of improving the quality of spectacle delivery [32]. Further, in most of the eligible studies in this scoping review, WTP for spectacles was reported as a small component of

a bigger study of eye care service delivery. Hence, the rationale for conducting a WTP analysis was not mentioned. It is clear, however, that the rationale to undertake these studies was to improve refraction services, spectacle dispensing and financial sustainability.

Methodologies

The scoping review has demonstrated how the eligible studies reported their methods in terms of study participants, sampling method and sample size calculation in the assessment of WTP for spectacles. Most of the participants in the selected studies were adults due to the 2004 estimated prevalence of uncorrected refractive errors which was 2.43% for people aged 40–49 years and 7.83% for people aged 50 and above [17].

Regarding sampling methods the majority of studies used probability sampling which comprised of simple random sampling [28, 30, 35], systematic sampling [26, 27] and cluster sampling [32, 33, 36, 45]. All are advantageous as simple random sampling is usually representative of the general population, systematic sampling spreads the sample evenly over the population and cluster sampling is economical and feasible for larger populations [46]. Although there are various disadvantages, probability sampling is still appropriate as there is a possibility for each individual to be selected in the study.

Conducting sample size determination is a pre-requisite step in the study design to enable researchers to make inferences about the wider study population. In reporting the sample size determination adequately allows for a study to be conducted on a defined sample size that leads to the precision of estimates and a power of the results [47, 48]. It simply means that an appropriate sample size will yield precise and accurate conclusions. Our scoping review found only four studies that reported sample size determination [28, 33, 35, 36]. Since most of the studies did not report the sample size determination, the interpretation of these studies [26, 27, 29–32, 34] needs to be approached with caution. Further, the replication of these studies will be problematic as the methodology is not explicit.

Limitations, strengths and recommendations

Although several studies did not report any WTP technique shortcomings [30, 32, 35, 36], some reported general survey biases such as recall bias and selection bias [27]. In light of these limitations, WTP does not enforce restrictions on the scope of benefits in which participants are allowed to express their preferences [6]. All preferences are observed as appropriate for WTP results, both beneficial and the non-beneficial.

Criticism of stated preferences techniques are mainly based on hypothetical situations where studies are undertaken, leading to a hypothetical bias [4, 12]. It is claimed that the dichotomous nature of the questions, comprising a defined price and choice on a pre-defined set of prices, may lead participant's to overestimate the responses of WTP depending on the environment or conditions at the time [4, 9, 49]. It is possible, however, to remove hypothetical bias by a follow-up certainty question, which may result in realistic WTP [12]. While 13 studies in this scoping review were conducted in similar hypothetical conditions most did not report this shortcoming while others explicitly stated the overestimation and underestimation of WTP [28, 33, 34, 45, 50]. It is thus unclear whether these flaws were observed in any of the included studies.

Alternatively, WTP studies expected to address hypothetical biases used revealed preferences techniques such as BDM as it estimates WTP in real settings of the phenomenon of study. Elicitation of WTP using BDM is

claimed to be incentive-compatible as the distribution of maximum prices is offered by the participants [9, 10]. Participant WTP that is greater than or equal to the randomly determined price must pay for the product. BDM similar to survey techniques is vulnerable to strategic bias, which affects WTP in terms of overestimation or underestimation [49]. Hence, it has been stated that efforts to employ different techniques to correct WTP estimate may reduce bias but not eliminate it [5]. Wertenbroch and Skiera stated that the BDM technique is realistic, transparent to participants, operationally efficient in terms of time, cost and effort to conduct [10]. Only one study reported WTP using BDM technique with follow-up questions [31]. The follow-up questions seem to validate the estimated WTP as participants express their satisfaction with the product [9]. The selected studies of this review concurred with most of the pros of BDM method, such as being realistic and incentivising truthful responses [31]. However, it also claimed that it was too complex to understand during implementation. The incentive of BDM has been seen as irrelevant as the determined sale price is not independent of distribution prices [51].

This scoping review is instructive for the future of WTP for spectacles as it has highlighted the strengths and weaknesses of reporting research methods which may be deemed necessary in guiding future research. However, studies were searched in the English language only, which might demonstrate its limitation. Further, despite our attempt to search published and grey literature on databases, webpages and others as well as not having contacted researchers for further identification, we might have missed some studies during the process.

Conclusion

This scoping review has identified several studies that have estimated WTP for spectacles. These studies have pursued survey-based and experiment techniques to estimate WTP. The scoping review highlighted the gaps in the way of presenting these methodologies that need to be considered in reporting future research.

Abbreviations

BDM
Becker DeGroot-Marschack
WTP
Willingness to pay
WHO
World Health Organisation

Declarations

Ethics approval and consent to participate

Not applicable

Consent to publish

Not applicable

Availability of data materials

All data generated during the study can be found in the supplementary information files and some are included in the study.

Competing Interest

The authors have no competing interest.

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Authors Contribution

CG: Contributed in conceptualising the idea, literature search and data analysis, drafting the manuscript and provided the final approval. VFC: Conceptualised the idea, contribution in literature search, critical review on the manuscript and provided final approval.

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Figures

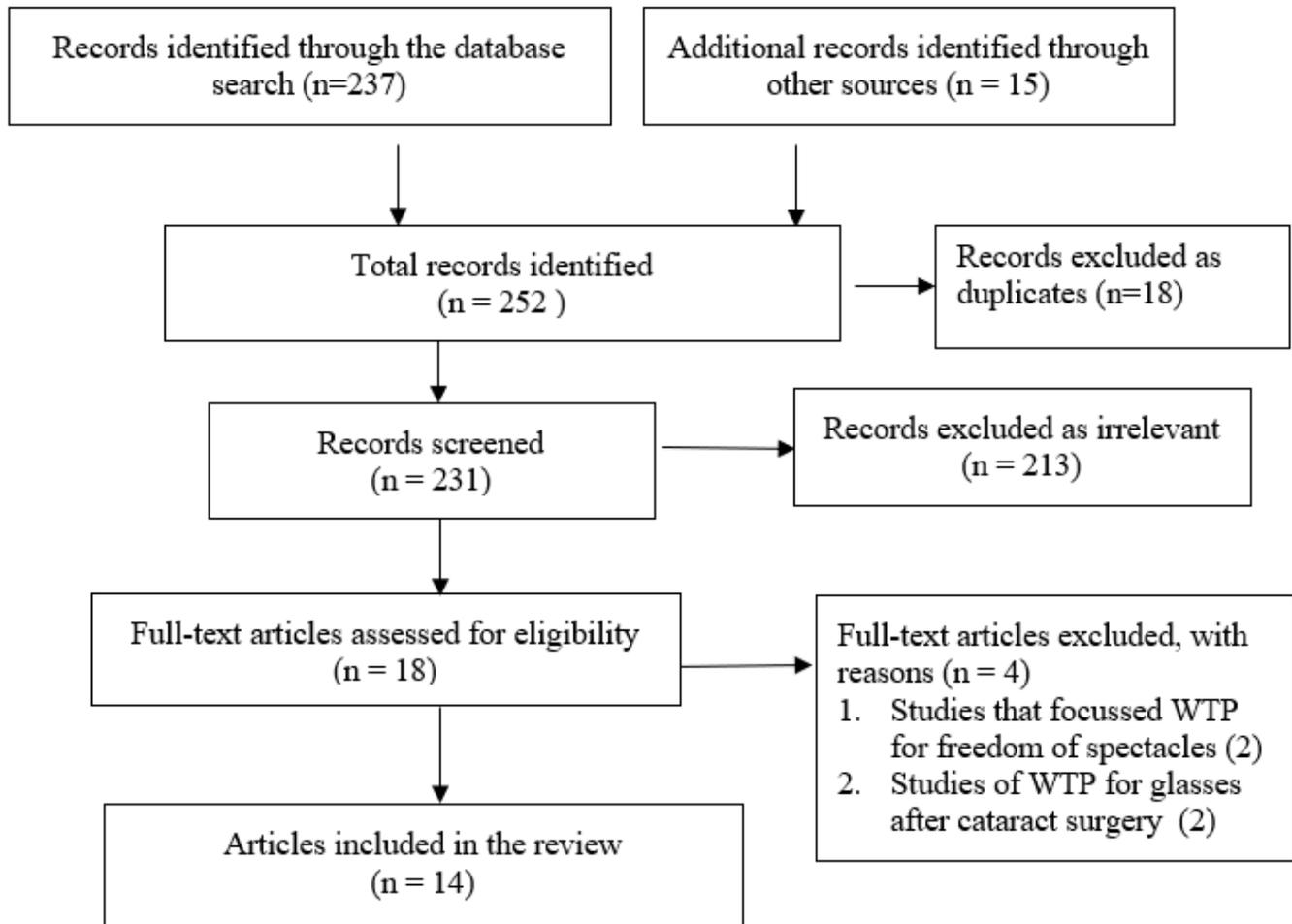


Figure 1

Flow chart of the process of search and selection of articles included in the review

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