The impact of uncorrected refractive error (URE) on the elderly population: a systematic review

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Abstract

Background: Ageing and growth of the global population is expected to lead to a large increase in the number of persons wearing and/or needing vision corrections. However, little is known about the impact of uncorrected refractive error (URE) and vision corrections specifically in the elderly population.

Objective: To systematically review relevant literature investigating the impact of URE on the elderly population and the impact of correcting refractive error in this population.

Design: Systematic review.

Participants: Older adults, 65 years of age and above globally.

Methods: A systematic search of 14 data bases and the reference lists of retrieved studies were conducted using the standard methodology that adhered to the PRISMA statement. Identified studies were assessed independently for methodological quality and validity by two independent reviewers, prior to inclusion in the review using the corresponding checklists from the Critical Appraisal Skills Programme (CASP) and Consolidated Standards of Reporting Trials (CONSORT) guidelines tools. Descriptive statistics were used to analyse the data.

Main Outcome Measures: Quality of life.

Results: The initial search retrieved 9480 studies and only 2 met the set inclusion criteria, one being a randomised control trial (RCT) and the other a cross sectional study.

Conclusions: This review has demonstrated that there is a minute number of high quality studies that have investigated specifically the impact of uncorrected refractive error on the quality of life of elderly persons suggesting the need for further research in this area.

Introduction

There is an increasing ageing population, due to improved living conditions and advances in the medical field.[1] According to the United Nations,[2] the world's older persons (60 years and older) was estimated at 901 million in 2015 and increasing to 1.4 billion by the year 2030 with the majority living in developing countries. The most recent estimates of global blindness and vision impairment in 2015 has placed them at 36 million and 216 million respectively.[3] A study by Dey[4] reported that more than two-thirds of all severely vision-impaired people are 65 years old and above. Furthermore, an estimated 153 million have impaired vision due to uncorrected refractive errors[5] and 517 million due to uncorrected or under-corrected presbyopia.[6]

The resulting vision impairment can be detrimental to the elderly leading to many functional and societal effects. In particular, vision impairment affects older adults' ability to perform tasks necessary for physical self-care which include difficulties in activities of daily living;[7] increased risks of falls, hip fracture and other accidents;[8,9] and increased mortality.[10,11] Thus, their quality of life may significantly deteriorate and become a burden to family members and community.[12] Psycho-social factors such as social isolation and loneliness;[13] lower life satisfaction, anxiety, depression, and suicide[14,15] are also associated with visual impairment. Cognitive impairment and dementia are also listed among the problems.[16,17] While several investigations[7–19] have studied the impact of vision impairment on health, socio-economic and quality of life related factors, only a few studies have focused specifically on the impact of uncorrected refractive error (uRE) on these factors.

Refractive errors place a large burden on society and can be treated simply with increased access to low-cost eyeglasses. While health care services may be widely available, not all the needs of the older adult are being met: one such need is refractive services.[20] The reasons for this include older adults themselves not being aware of the need for screening and treatment for refractive errors, the perception that the eye and health challenges associated with ageing are inevitable and not preventable, a lack of eye health care workers and a lack of an integrated approach to the health of the older person.[21–23]

To the best of our knowledge, no systematic review or meta-analysis of the impact of uRE on the elderly has been published, or registered, to date. Therefore, the aim of this systematic review was to evaluate published scientific research studies on the impact of uRE on the elderly in terms of their visual functioning, social behaviours, socio-economic status, mental health and quality of life status, and to review the impact of correcting refractive errors.

Methods

This systematic review followed the reporting items for systematic reviews as described in the PRISMA statement.[24]

Eligibility Criteria

The review included papers that focused on the elderly population, 65 years and above globally. Research papers on the correction of refractive error by spectacles, or contact lenses were included for assessment. The main outcome measures that we set out to determine were visual functioning, psychosocial (behavioural, well-being, quality of life), economic outcomes (cost-effectiveness; cost-benefit; cost-utility) and educational outcomes (geriatric education). We also searched for papers that showed the emotional and psychological impact of wearing spectacles. We included research papers that were population based studies, randomised controlled studies, cohort studies, cross-sectional and qualitative studies.

Information Sources and Search Strategy

The search strategy used in the review was devised by an Information Specialist (IS) who developed a set of terms with filters to exclude studies not of interest (e.g., laboratory and children studies). A sample of the records removed by the filter was reviewed to ensure that no potentially relevant records were being discarded. The search was performed in the following databases: MEDLINE, PubMed, EMBASE, the Cochrane Library, CINAHL, Global Health, PsychINFO, Web of Science (SCI, SSCI, A&HCI, CPCI-S, CPCI-SSH), Open Grey, New York Academy of Medicine Grey Literature Report, Clinicialtrials.gov, and the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP).

The databases were searched for studies from January 1994 to August 2018 and no language limits were applied.

Study Selection

Citations from the search results were imported from the bibliographic databases into EndNote to screen for eligibility. The IS pre-screened the results to remove duplicates and records which were not relevant to the scope of the review. EndNote files consisting of the pre-screened abstracts were sent to two reviewers who independently screened the remaining titles and abstracts. Full-text articles were obtained for the retained studies. Critical appraisal of the studies that were considered to meet the review inclusion criteria were performed by the two independent reviewers.

Qualitative Assessment and Data Extraction

The Critical Appraisal Skills Programme (CASP) tools[25,26] were used to assess the quality of the full text articles for inclusion in the review. The CASP tools assisted in critically evaluating the relevance of the research studies to the review, consequently limiting the studies that were included in the data extraction process. A quality appraisal checklist derived from CASP was used in this review.[26] Data extracted from the final selected studies were captured into an Excel database that required the

following information from the research papers: first author, publication year, and study title, country in which the study was performed, study design, sample size, type of refractive error, refractive error correction, main outcome measures and study findings. A modified critical appraisal tool was used since there were different study designs to be incorporated. Ultimately the tool used had 15 questions, with each question being rated from 0 to 2. The quality of appraisal scores were critically appraised and compared by two reviewers and any differences were settled through mutual agreement. Randomised control trials were appraised using the evidence-based tool known as the Consolidated Standards Reporting Trials (CONSORT) tool.[27] This tool consisted of 25 items which focussed on reporting how the trial was designed, analysed, and interpreted, and a flow diagram which displayed the progress of all participants through the trial.

Assessment of Risk

The validity of the data from the selected studies about the effects of interventions was assessed using the Cochrane Handbook for Systematic Reviews of Interventions. Different ways of categorising were incorporated which include; randomisation sequence generation, allocation concealment, blinding of participants, detection bias, incompleteness bias, reporting bias and other sources of bias should there be any.

Data Synthesis and assessment of robustness

As a process of data synthesis, all studies were evaluated by first developing a strategy to check if the studies met the inclusion criteria set out for evaluating the impacts of uRE on the elderly, 65 years and older. Possible studies were extracted and relationships among them were examined in the form of grouping and clustering. Data transformation and vote counting were tabulated as a form of descriptive statistics for analysis. Due to the heterogeneity of these studies in term of diverse outcomes and interventions, quantitative synthesis was not planned and only descriptive analysis was reported. The review was conducted and presented in 4 main categories: 1) Studies that were selected and the screening process, 2) Characteristics of the studies and exploring their relationships, 3) Quality assessment of studies as it was applied from CASP and CONSORT, and 4) Synthesis of results on different impact factors.

Results

Study Selection

The search yielded a total of 9480 records; after 3578 duplicates were removed, the IS pre-screened 5902 records and removed 5235 records which were not relevant to the scope of the review. This large number of excluded papers was due to the search also capturing the many prevalence and incidence papers which did not have measureable outcomes on the impact of corrected or uREs. The reviewers screened the remaining 667 records and discarded a further 486 records as ‘not meeting the inclusion criteria’. A total of 181 full text reports were acquired for further assessment. After reading the full text, only two met the inclusion criteria and 179 were excluded as ‘not relevant’. Grey literature searches did

not highlight any studies that could be considered. Figure 1 is a flow diagram of the study selection process for inclusion in the systematic review.

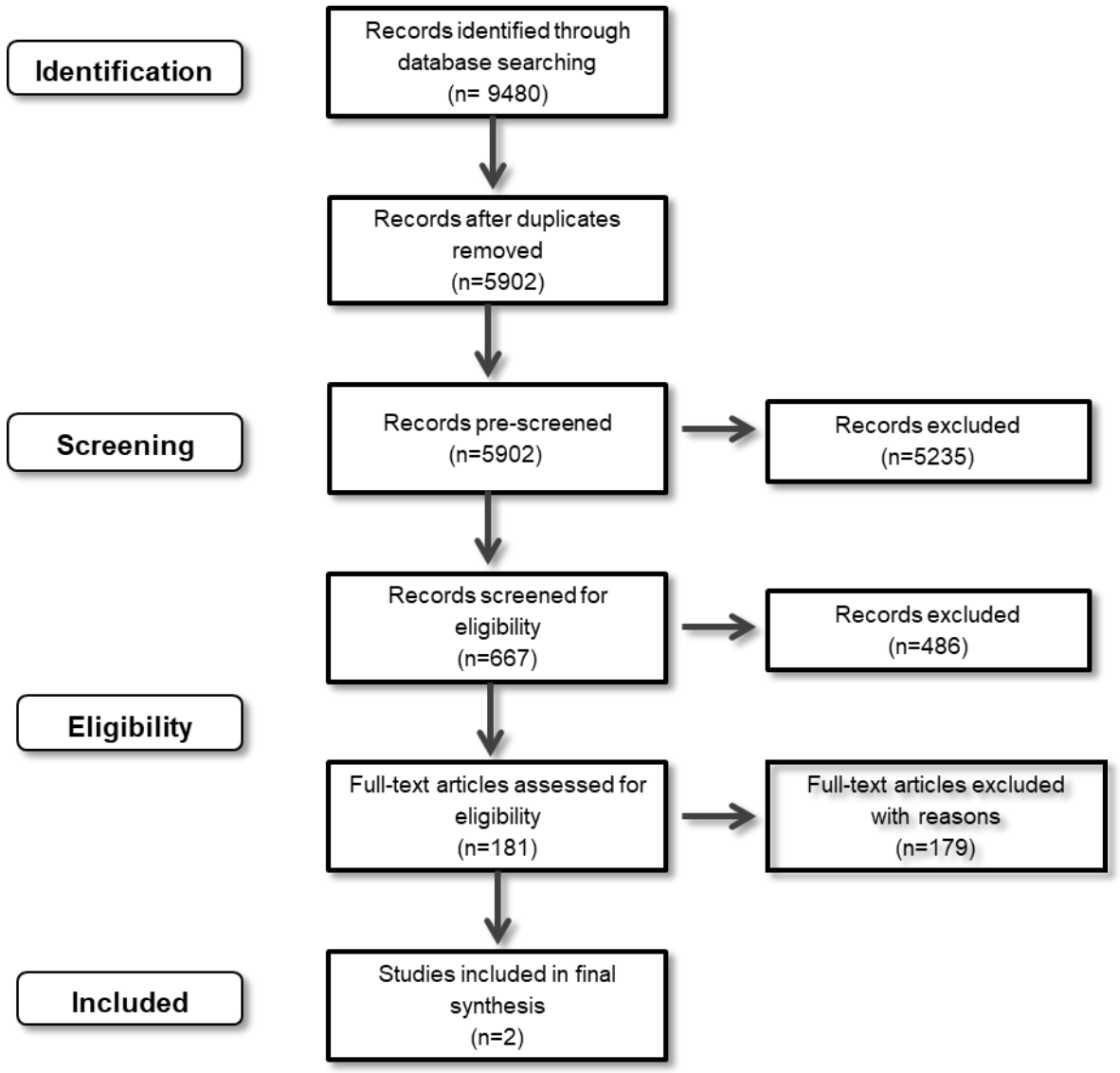

Figure 1. Flow chart for the study selection process for inclusion in the systematic review

Study characteristics

The main characteristics of the two studies that met the inclusion criteria are shown in Table 1. One study was conducted in California, United States of America[28] and the other in the district of Taipei, Taiwan[29]. The studies were published between 2006 and 2007. A random sampling strategy was employed for both studies. Sample sizes of the study populations ranged from 131 elderly subjects in the randomised controlled trial[28] to 1361 subjects in the community-based Taipei study[29]. Coleman et al.[28] addressed quality of life issues such as experiences with better general visual acuity, near visual acuity, distance visual acuity and mental health with prescriptions for eyeglasses and magnifiers, while Kuang et al.[29] measured physical functioning (also a quality of life outcome measure) with the use of spectacles.

Table 1: Study designs and impact issues identified in the included articles

Design	Quality of life	Refractive error correction
Randomized control trial Coleman et al.[28]	Vision-specific, visual function Mental health	Spectacles Magnifiers
Cross-sectional Kuang et al. [29]	Physical functioning	Spectacles

Quality assessment

General limitations of the studies were identified by using the application of the quality assessment tools, CASP and CONSORT. The studies included in the review did not clearly state in the methodology how the missing values were treated within the process of data analysis. The randomised control trial study design considered by Coleman et al.[28] implied that the measurement of impact was not open wide to bias. The population for sample sizes considered were representative, however, there was vast difference between the eligible and ineligible participants in the study by Coleman et al.[28] A more rigorous study in terms of selection of appropriate sample was displayed in Kuang et al.[29] however, the measurement of impact was vulnerable to bias since the study design was cross-sectional.

Table 2. Illustration of the application of the CONSORT quality assessment tool to the RCT

Title and abstract	Author(s)	Coleman et al.
	Year of Publication	2006
	Country	Los Angeles, California, USA (1)
	Title of paper	Treatment of uncorrected refractive error improves vision-specific quality of life (1)
	Abstract	Attached
Introduction	Background	There have been no RCTs evaluating the effect of refractive correction or use of magnifiers in persons with URE and near-normal vision or moderate-low vision, although there was a non-randomized clinical trial evaluating the effect of LV services on vision-specific and overall quality of life
	Purpose	To determine if education promoting the wearing of glasses aimed at school children would improve children's glasses wear and improve their academic performance.
Methods	Study Design	Community based, RCT, single centre, prospective (1)
	Type of Study	Randomised Control Trial (1)
	Participants	131 community-dwelling persons 65 years and older (1)
	Interventions	Vouchers for eyeglasses, magnifier or both (1)
	Outcomes	Participants who received the eyeglasses prescription and voucher immediately had greater improvement in NEI-VFQ composite scores

	Outcome Measures	Primary outcome for this clinical trial was change in vision-specific functioning as measured using the 25-item National Eye Institute Visual Functioning Questionnaire (NEI-VFQ)
	Sample Size	131
Randomisation	Sequence generation	stratified sampling (2)
	Allocation of concealment mechanism	random (2)
	Implementation	Peppercenter Data Management Core (2)
	Blinding	Not stated
	Method of analysis	Fisher exact or chi-square tests, multiple linear regression, t-test, explanatory subgroup analysis
Results	Participant flow	Not explained
	Recruitment	September 2001 - August 2003 (3)
	Baseline data	attached
	Numbers analysed	131(3)
	Outcome and estimation	The difference between groups was smaller than what the study was powered to detect. The observed effect size of 0.11 SD was the equivalent of approximately half a semester of additional learning. (4)
	Ancillary analyses	In subgroups (AMD, with and without), scores of immediate treatment groups improved yet those of delayed groups worsened. (4)
	Harms	Nothing stated
Discussion	Limitations	Difficult to find participants with URE, distance and near vision did not improve as expected, participants could not me masked. (8)
	Generalisability	Significant benefits in perceptions of general, distance and near visual acuity and mental health/well-being were found. (7-8)
	Interpretation	Older persons and their providers should be made aware of the prevalence of URE. (8)
Other information	Registration	Registered but information not provided (5)
	Protocol	Not provided
	Funding	UCLA Claude D. Pepper Older American Independence Centre, under research Grant AG10415-12 from the National Institute on Aging (NIA), Bethesda, Maryland. (8)

Risk of Bias

Allocation (Selection Bias):

In the randomised control trial, randomisation was used in allocation of participants who received prescriptions and vouchers for eyeglasses and magnifiers (Coleman et al. 2006). Kaung et al. 2007 did not randomise the participants, instead a non-random selection method was used and as a result, the study was classified as high risk. In both studies, allocation concealment was not mentioned in detail, which can lead to a greater risk of bias.

Blinding (Performance Bias and Detection Bias).

Neither of the studies were blinded and were classified as unclear on masking of the participants and the assessors. They were not classified either as high risk nor low risk.

Incomplete outcome data.

Among the selected participants in the study by Coleman et al.[28], 15% were not part of the follow-up examination due to non-response to phone calls, certified letters, unable to schedule or complete follow-up, some participants had moved and some refused follow-up. Kaung et al.[29] reported a response rate of 66.6% for participants in both questionnaires and ophthalmic examination. Both studies were classified as low risk.

Selective reporting (Reporting Bias)

Results from the final study should always be compared to what has been proposed in the protocol. From both the studies considered, no protocol could be found. The risk of reporting bias amongst these studies was therefore, classified as unclear.

There were no other potential sources of bias identified.

Quality of Life outcomes extracted from the included studies

Synthesis of results was done in the similar manner as in a systematic review since a meta-analysis was not planned. The selected studies were assessed on the quality of life impact factors. The randomized controlled trial by Coleman et al.[28] whose aim was to investigate the benefits of eyeglasses and magnifiers in elderly patients with uREs, was used to address quality of life outcomes. In this study, a stratified sampling method was used to implement a self-administered questionnaire. Coleman et al.[28] determined that applicants who acknowledged prescriptions for eyeglasses and magnifiers experienced better general visual acuity, near visual acuity, distance visual acuity and mental health ($P<0.01$, $P=0.02$, $P=0.01$, $P=0.01$ respectively).

Kuang et al.[29] addressed quality of life in a community-based, cross-sectional study. In their study, the comparison between participants with visual impairment and participants without visual impairment was found to be statistically significant ($P<0.001$). The authors found an association between correctable visual impairment and older age (greater than 75 years (OR, 3.05)). On physical functioning, participants with correctable visual impairment scored lower than participants without visual impairment ($P<0.01$) and participants requiring supportive services scored lower than participants who did not require support services ($P<0.01$). The study also explored the issue of diabetes and stroke and showed that participants who had diabetes mellitus scored lower than participants without diabetes mellitus ($P=0.02$). Similarly, participants who had a history of stroke scored lower than participants who had no history of stroke ($P<0.001$).

Discussion

While there are numerous studies that have investigated the impact of visual impairment on the quality of life and functioning in the elderly[7,8,17–19,9–16] there are a limited number of studies that distinguish the impact of uRE from other reversible and irreversible causes of vision loss. Advances in medicine, education and healthcare have resulted in an increase in lifespan and therefore an increase in the elderly population.[1] This makes it imperative to understand the issues impacted by vision decrease in relation to all of the other age-related conditions that the elderly face. Uncorrected refractive error is the leading cause of vision impairment[30] and is easily treatable. This review demonstrated the impact of uRE and therefore would serve as an advocacy tool in motivating for refractive services in the elderly.

A vast range of studies showed a decrease in quality of life, impaired physical functioning and difficulties with activities of daily living in the elderly. However, little to none have demonstrated measureable impact due to uRE alone. Therefore, even though many studies were reviewed, only two studies met the scientific rigour and requirements for inclusion in this review. Of the impact issues investigated, quality of life was the main outcome issue revealed in the two studies.

Coleman et al.[28] evaluated the impact of correcting refractive errors using the NEI-VFQ-25 questionnaire. The validated NEI-VFQ-25 questionnaire considered health and vision, general health and vision, difficulty with visual activities, and emotional responses to vision problems. In addition, the findings of the questionnaire were supplemented by visual acuity changes and overall functioning as determined by the validated Rosow-Breslau function questionnaire[28]. The study found according to the composite score, statistically significant improvements in general health, mental health and the overall measure of vision-targeted health-related quality of life.

Depression has been found to be a concern in the elderly due to feelings of hopelessness, loss of independence and physical difficulties associated with activities of daily living, such as grooming.[31] While Coleman et al.[28] did find this to be significantly improved with the provision of spectacles, more studies are needed to emphasize the psychological impact of uRE.

Physical function is an essential component contributing to the quality of life in the elderly.[12] It comprises of a range of activities including activities of daily living (self-care which comprises of personal hygiene, dressing, eating, etc), instrumental activities of daily living (including shopping, cooking, managing finances, etc) and physical movements.[32] Kuang et al.[29] found that participants with correctable visual impairment scored lower than participants without visual impairment ($P<0.01$) in the physical function domain thereby emphasising the importance of physical function. The ability to function optimally is a key component to independent living in the elderly. Participants requiring supportive services scored lower than participants who did not require support services ($P<0.01$) according to Kuang et al.[29] While

research explores the quality of life of elderly individuals in independent living and assisted living situations, they are limited in number, quality of the research processes and analysis involved.

The management of age-related conditions is complemented by an assessment of quality of life and functional status of the elderly. However, scientific evidence is required to catalyse this process. The rigorous screening of the studies identified in this review revealed only two studies of acceptable quality. This highlights the need for studies that can provide direct evidence to justify practices and inform policies and management strategies. While there are numerous cross-sectional studies investigating the impact of vision on quality of life in the elderly, the absence of rigorous study design (randomised control trials) limits its value in generalising outcomes to the elderly population.

Conclusion

There is a paucity of scientifically rigorous literature that has investigated the impact of uRE on a number of parameters in older adults. Similarly, there is weak evidence on the short- and long-term impact of correcting refractive errors in this group. A significant limitation in elucidating and emphasising the impact of uRE on quality of life in the elderly is the lack of studies exploring these aspects in a defined elderly sample. This review therefore highlights the need for further research that is able to generate the unambiguous evidence of the relationship between uRE and quality of life in the elderly.

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