Research

Roseleen M McCann, A Jonathan Jackson, Michael Stevenson, Martin Dempster, James C McElnay and Margaret E Cupples

Help needed in medication self-management for people with visual impairment:

case–control study

Abstract

Background
Visual impairment (VI) is rising in prevalence and contributing to increasing morbidity, particularly among older people. Understanding patients' problems is fundamental to achieving optimal health outcomes but little is known about how VI impacts on self-management of medication.

Aim
To compare issues relating to medication self-management between older people with and without VI.

Design and setting
Case–control study with participants aged ≥65 years, prescribed at least two long-term oral medications daily, living within the community.

Method
The study recruited 156 patients with VI (best corrected visual acuity [BCVA] 6/18 to 3/60) at low-vision clinics; community optometrists identified 158 controls (BCVA 6/9 or better). Researchers visited participants in their homes, administered two validated questionnaires to assess medication adherence (Morisky; Medication Adherence Report Scale [MARS]), and asked questions about medication self-management, beliefs, and support.

Results
Approximately half of the participants in both groups reported perfect adherence on both questionnaires (52.5% Morisky; 43.3%, MARS). Despite using optical aids, few (3%) with VI could read medication information clearly; 24% had difficulty distinguishing different tablets. More people with VI (29%) than controls (13%) (odds ratio [OR] = 2.8; 95% confidence interval [CI] = 1.6 to 5.0) needed help managing their medication, from friends (19% versus 10%) or pharmacists (10% versus 2.5%; OR = 4.4, 95% CI = 1.4 to 13.5); more received social service support (OR = 7.1; 95% CI = 3.9 to 12.9).

Conclusion
Compared to their peers without VI, older people with VI are more than twice as likely to need help in managing medication. In clinical practice in primary care, patients' needs for practical support in taking prescribed treatment must be recognised. Strategies for effective medication self-management should be explored.

Keywords
medication adherence; older people; prescriptions; primary care; visually impaired persons.

INTRODUCTION

Visual impairment (VI) constitutes a major public health burden.[1] Its prevalence is rising and is greater among older people, predisposing to difficulty in practical daily living activities,[2] reduced quality of life,[3] and increased morbidity, including falls,[4] depression,[5] suicide,[6] and cognitive decline.[7] Optimal health outcomes are associated with people's ability to self-manage illness.[8] Many older people require long-term complex therapies for the management of multiple chronic diseases: medication adherence is of key importance in optimising the overall effectiveness of their health care.[9,10] Those with reduced visual acuity may be at particular risk of medication non-adherence, with potential adverse consequences for their health, but little is known about the impact of visual impairment on medication self-management. Medication non-adherence in older people has not been well described.[10]

The use of prescription drugs is rising in both the US and the UK: over 90% of those aged >65 years take at least one prescription medication long term and almost 50% take three or more.[11,12] However, recent estimates indicate that, in the developed world, only approximately 50% of patients with chronic disease adhere to treatment recommendations.[13] Various predictors of adherence have been identified, including the complexity and costs of treatment, characteristics of the illness, and personal factors,[13] such as physical dependency,[14] concerns about medicines,[9,15] and social support.[15] GPs are the key coordinators in prescribing in primary care.[16] Their role in understanding patients' problems and ensuring that management plans are appropriate, is fundamental in promoting medication adherence and optimising outcomes. The extent to which individuals with VI, compared to their peers with normal sight, require or receive support in managing medication has not been reported but has potentially important implications for prescribing in primary care. Therefore, this study aimed to compare levels of medication adherence between older people with and without VI, and to examine issues related to their management of their medication.

METHOD

Participant recruitment
Individuals aged ≥65 years, who attended

RM McCann, PhD, research fellow, Department of Ophthalmology, Royal Group of Hospitals Belfast and Centre for Public Health Research, Queen's University, Belfast. **AJ Jackson**, BSc(Hons), PhD, MCOptom, FAAO, FBCLA; head of optometry, Belfast Health and Social Care Trust; assistant director, Integrated Care Health and Social Care Board; head of clinical services, National Vision Research Institute, Australian College of Optometry, Melbourne, Australia. **MR Stevenson**, BSc, FSS, senior lecturer in medical statistics, Centre for Public Health Research; **M Dempster**, PhD, CPsychol, CStat, AFBPsS, FHEA, senior lecturer, School of Psychology; **JC McElnay**, PhD, FPSNI, FCCP, professor of pharmacy practice, School of Pharmacy, Queen's University, Belfast. **ME Cupples**, MD, FRCGP, professor of general practice; clinical lead, Northern Ireland Clinical Research Network (Primary Care), Centre for Public Health Research and Department of General Practice and Primary Care, Queen's University Belfast, and UKCRC Centre of Excellence for Public Health Research (Northern Ireland).

Address for correspondence
Margaret Cupples, Department of General Practice and Primary Care, Queen's University Belfast, 1 Dunluce Avenue, Belfast, BT9 7HR.

E-mail: m.cupples@qub.ac.uk

Submitted: 11 January 2012; **Editor's response:** 14 March 2012; **final acceptance:** 22 March 2012.

©**British Journal of General Practice**
This is the full-length article (published online 30 Jul 2012) of an abridged version published in print. Cite this article as: **Br J Gen Pract 2012; DOI: 10.3399/bjgp12X653570**.

How this fits in

Visual impairment is an increasing health problem, particularly among older people, and contributes to comorbidities that require long-term medication in primary care. Little is known about the impact of visual impairment on medication adherence or self-management. This study shows that almost 30% of older people with defined visual impairment need help in managing their medication, despite using optical aids; they are more than twice as likely as their peers without impaired vision to receive help from friends or statutory services. To ensure optimal health outcomes, clinicians must ask about problems with vision and check that appropriate support is available for individuals to take their medication as prescribed.

the regional multidisciplinary low-vision clinic at the Royal Victoria Hospital, Belfast, and peripheral outreach clinics in Northern Ireland, were identified. They were sent information about the study, in large print, with a routine clinic appointment, and offered the information in audio format. At the clinic, the optometrist invited participation from those taking two or more different long-term oral medications daily, living within the community, not receiving daily medical or nursing care, and not participating in other research. For those who agreed, the optometrist recorded post refraction best corrected distance and near visual acuities (BCVA) using Bailey Lovie distance, and near-text reading charts.[17] Visual impairment was defined by the World Health Organization (WHO) classification — BCVA <6/18 and >3/60[18] — and those with BCVA outside these limits were excluded. Thus, all had some usable vision and were given optical aids, including spectacles.

Primary care community optometrists recruited the control (C) group. They invited people aged ≥65 years to participate if they were taking two or more long-term oral medications daily, living in the same localities as those recruited with VI (to ensure availability of similar services), not requiring daily medical or nursing care and, had a BCVA of 6/9 or better. VA was measured using standardised optometry instrumentation and the same protocol as in the low-vision clinics. Anonymous data about those who declined to participate were recorded.

Data collection
All participants were visited at home (April

2007 to February 2010), where cognitive function was assessed (12-item Clifton Assessment Schedule) (CAS)[19] and a researcher administered a bespoke questionnaire to gather information about living arrangements, educational status, falls, social support, and use of health and social care services. A measure of socioeconomic status was derived from participants' postcodes (Multiple Deprivation Measure [MDM]):[20] possible scores range from 1 to 890 and lower scores indicate greater deprivation.

Self-reported medication adherence was assessed by two validated measures, the Medication Adherence Report Scale (MARS; five questions about non-adherence behaviours, responses to each on a five-point scale)[21] and Morisky Scale[22] (four questions, yes/no responses). Beliefs about medication were examined using questions based on constructs linked to the health belief model[23] and theory of planned behaviour.[24] Quality of life (QoL) was assessed using validated generic (Short Form 12 [SF-12],[25] EuroQol 5D [EQ-5D][26]) and vision-specific (Daily Living Tasks associated with Vision [DLTV])[27] questionnaires. Questions were asked about the use of optical aids, handling medications, and reading medication-related information.

With participants' consent, for a randomly selected 10% sample, prescribing data were collected from GPs and dispensing data from community pharmacists for 6 months prior to their home visit, to attempt to verify self-reported adherence. A continuous multiple-interval measure of medication availability (CMA) was calculated for three medications for each patient (cholesterol lowering, antihypertensive, and one other), by dividing the intended prescription duration (days) by the observation period (or number of days between fills) and multiplying by 100. Scores below 80% were considered to indicate non-adherence; scores above 120% were considered over-adherent.[28]

Sample size and statistical analysis
Based on previous reports,[29] it was estimated that a sample size of 150 per group would allow detection of 15% difference between groups in reported adherence, with 90% power, 0.05 alpha and two-tailed testing. Data were analysed using SPSS for windows (version 17). Independent-sample t-tests were used to examine differences between groups in parametric variables, following testing for normality of distribution; χ^2 tests were used
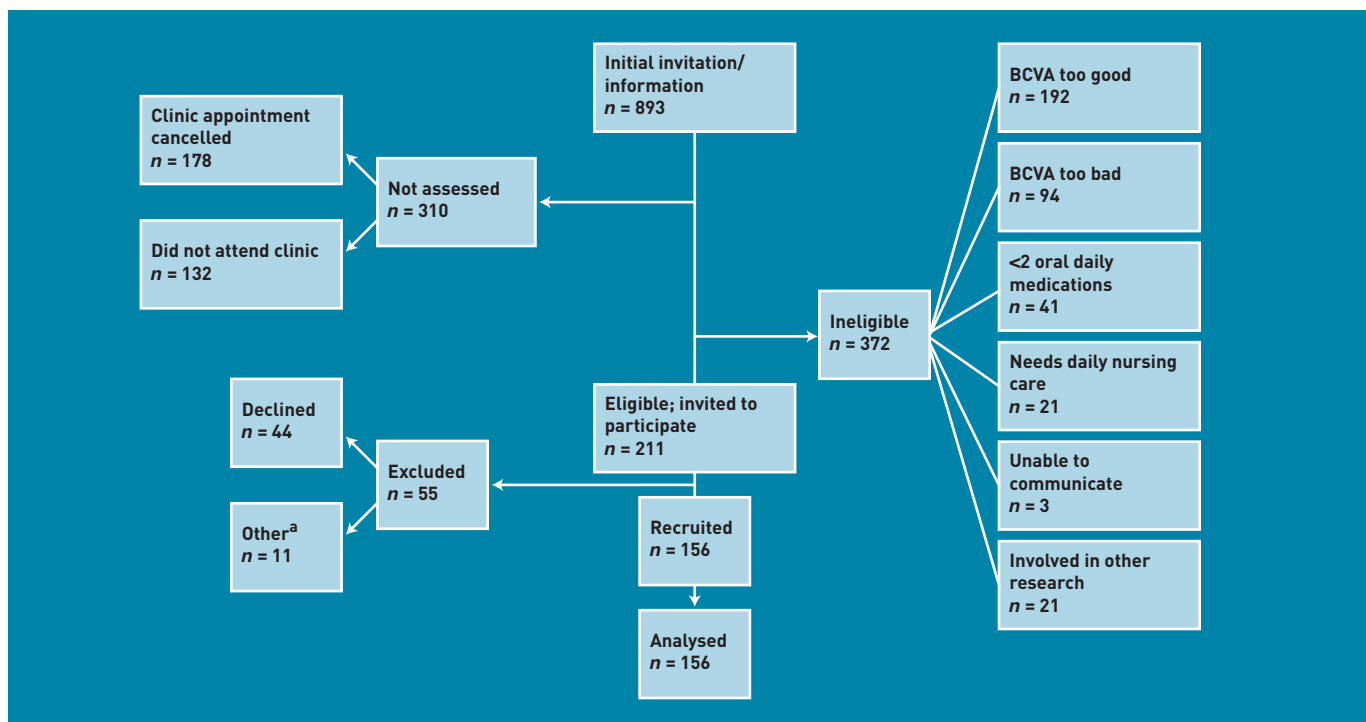
Figure 1. Flowchart for participants with visual impairment. aIncludes illness and changed caring or nursing arrangements. BCVA = best corrected visual acuity.

Figure 2. Flowchart for participants in the control group. BCVA = best corrected visual acuity.

to compare categorical data; and differences in non-parametric data were analysed using Mann–Whitney U tests. Associations between adherence scores and other variables were sought using regression analysis. Differences between groups in numbers having falls, contacts with health and social care services, and medication management were compared by calculating odds ratios (ORs).

RESULTS

Of the 893 individuals who were sent study information, for 178 their appointment was cancelled, either by the hospital or by the patient; a further 132 did not attend. Of the remainder, 372 failed to fulfil the inclusion criteria (Figure 1); 211 were eligible, 73.9% (156/211) participated. Community optometrists identified 197 potential controls; 181 met the inclusion criteria,
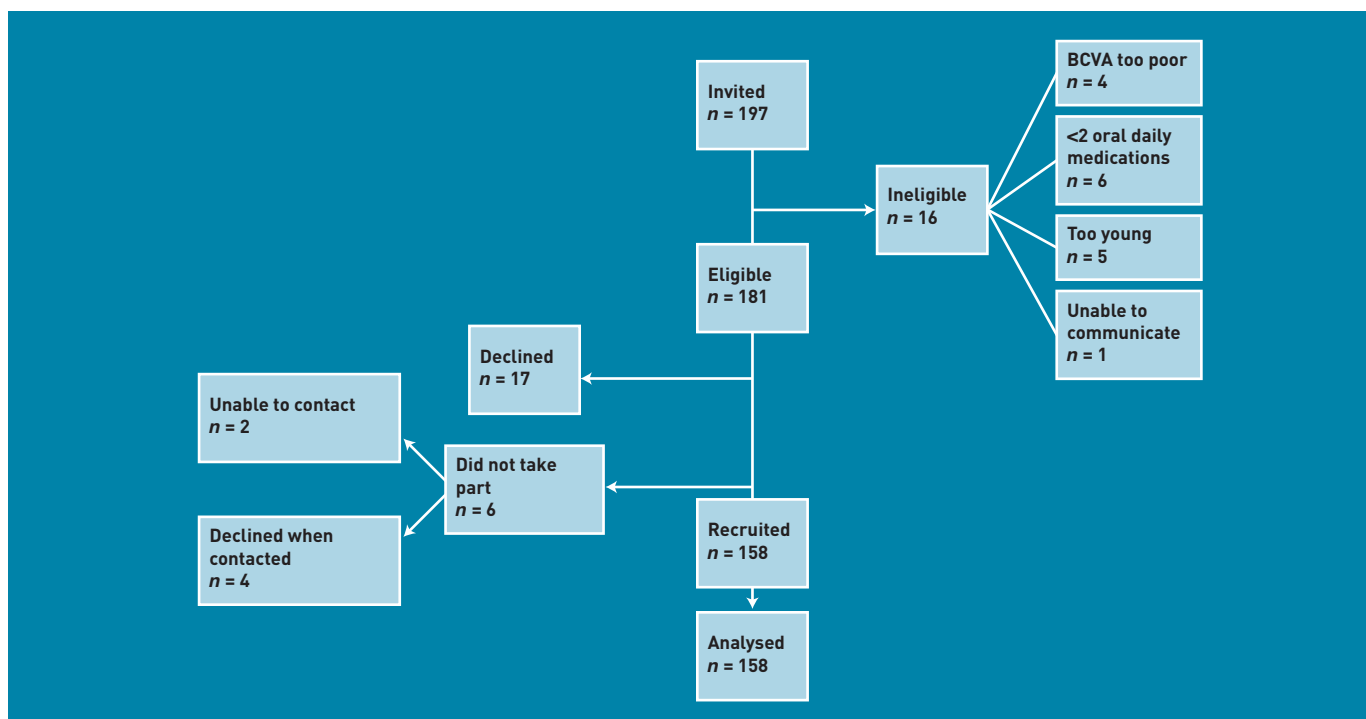
Table 1. Demographic characteristics, living arrangements, recent falls, and service use by study participants in visually impaired and control groups and the total sample

Characteristic	Visually impaired (n = 156)	Control (n = 158)	Total (n = 314)
Mean age, years (SD)[a]	81.0 (7.0)	77.8 (6.7)	79 (7.0)
Sex, n (%)			
Male	56 (35.9)	61 (38.6)	117 (37.3)
Female	100 (64.1)	97 (61.4)	197 (62.7)
Mean MDM[b] score (SD)	299 (198)	301 (211)	300 (205)
Living arrangements, n (%)			
Own house	137 (87.8)	142 (89.9)	279 (88.9)
'Sheltered' accommodation	19 (12.2)	16 (10.2)	35 (11.1)
Lives alone	77 (49.4)	70 (44.3)	147 (46.8)
Lives with partner	61 (39.1)	72 (45.6)	133 (42.4)
Lives with relative	18 (11.5)	16 (10.1)	34 (10.8)
Reported any fall in past 6 months, n (%)[a]	42 (26.9)	14 (8.9)	56 (17.8)
Number of GP contacts in the past 6 months, mean (SD)	1.8 (1.6)	1.7 (1.4)	1.8 (1.5)
Reported any social service contact in the past 6 months, n (%)[a]	(46.2)	17 (10.8)	89 (28.3)

SD = standard deviation. [a]Significant difference between groups: P<0.001. [b]MDM = Multiple Deprivation Measure Score; higher score indicates greater deprivation.

87.3% (158) participated (Figure 2).

Participant characteristics

Participants' ages ranged from 65 to 101 years. The mean age of those with VI was higher than that of controls (81.0 versus 77.8 years, P<0.001) (Table 1); more with VI (33%; n = 51) were aged ≥85 years, compared to controls (15%; n = 23). No cognitive impairment was identified in any participant. There were no significant differences between groups in sex distribution (62.7% female), socioeconomic status (mean MDM score 300, standard deviation [SD] = 205), or living arrangements (88.9% lived in their own home; 46.8% lived alone). The groups had similar educational backgrounds: the majority (65.9%, n = 207) had received only primary school education.

Falls, social services support and family physician contact

More of the group with VI (26.9%) than controls (8.9%) reported at least one fall during the previous 6 months (OR = 3.8; 95% confidence interval [CI] = 2.0 to 7.3; after adjusting for age, OR = 3.9; 95% CI = 2.0 to 7.6) (Table 1). The groups did not differ significantly in numbers of contacts with their GP; most had consulted at least once in the previous 6 months. Of those with VI, more (46%) reported contact with social care services in the previous 6 months, compared to controls (10.8%) (OR = 7.1; 95% CI = 3.9 to 12.9; age-adjusted OR = 6.6; 95% CI = 3.6 to 12.1). Most individuals who had such contact received ongoing service support in dressing, personal hygiene, preparing meals, or housekeeping, but not for taking medication. Multiple regression analysis showed no association between contact with services and age or living arrangements.

Medications, adherence and management

Individuals in both groups were prescribed similar numbers of medications (range = 2–14; mean = 5.1, SD = 2.5) and types of medications, suggesting similar comorbidity in each group. Overall, 93.3% (293/314) were prescribed cardiovascular medication, 16.6% (52/314) antidiabetic medication, 18.5% (58/314) psychotropic medication, 32.8% (103/314) analgesic medication, and 37.9% (119/314) gastroprotective medication.

No differences were found between the groups in mean adherence scores. Both scales indicated that approximately half of the participants were fully adherent (MARS: 43%; Morisky: 52%); a minority reported poor adherence. CMA scores also indicated high levels of adherence for both groups (overall mean scores: VI = 105.2 [SD = 26.0], C = 103.9 [SD = 14.2]; mean difference = 1.3, 95% CI = –3.3 to 5.9).

Significantly more with VI (29%), compared to controls (13%) (OR = 2.8 [95% CI = 1.6 to 5.0]; age-adjusted OR = 2.6 [95% CI = 1.4 to 4.7]) relied on help to take their medication each day or to sort it into a compliance aid (a container holding usually

Table 2. Medication adherence questionnaire scores and medication management for visually impaired and control groups and the total sample

Characteristic	Visually impaired (n = 156)	Control (n = 158)	Total (n = 314)
Medication adherence			
MARS score, mean (SD)	23.2 (2.4)	23.6 (2.4)	23.4 (2.4)
Score <18/25 (non-adherent), n (%)	10 (6.4)	6 (3.8)	16 (5.0)
Score ≥18 and ≤24/25 (adherent), n (%)	81 (51.9)	81 (51.3)	162 (51.7)
Score 25/25 (perfect adherence), n (%)	65 (41.7)	71 (44.9)	136 (43.3)
Morisky score, mean (SD)	3.5 (0.7)	3.5 (0.6)	3.5 (0.6)
Score ≤1/4 (non-adherent), n (%)	2 (1.2)	1 (0.6)	3 (1.0)
Score = 2/4 (medium adherence), n (%)	7 (4.5)	2 (1.3)	9 (2.9)
Score = 3/4 (high adherence), n (%)	65 (41.7)	72 (45.6)	137 (43.6)
Score = 4/4 (perfect adherence), n (%)	82 (52.6)	83 (52.5)	165 (52.5)
Medication management, n (%)			
Difficulty reading medication labels[b]	152 (97.4)	7 (4.4)	155 (50.6)
Uses optical aid[b]	125 (80.1)	2 (1.3)	127 (40.4)
Difficulty distinguishing medications[b]	38 (24.4)	0	38 (12.1)
Difficulty opening medications	74 (47.7)	70 (44.3)	144 (45.9)
Difficulty opening blister packs	59 (37.8)	55 (34.8)	114 (36.3)
Requires help to manage medication[b]	45 (28.8)	20 (12.7)	65 (20.7)
Help provided by relative/friend[b]	29 (18.6)	16 (10.1)	45 (14.3)
Uses compliance aid[c]	63 (40.4)	57 (36.1)	120 (38.2)
Pharmacist supplies medication in compliance aid[a]	16 (10.3)	4 (2.5)	20 (6.4)

[a]P<0.05. [b]P<0.001: statistical testing by χ²; significant differences between groups. [c]'Compliance aid' refers to a container, divided into compartments, each of which represents a dosage time; for example, morning, noon, evening, and night, with enough compartments usually for 7 days.

Table 3. Health Beliefs Questionnaire: scores[a] for summary statements for visually impaired and control groups

Item	Visually impaired, median (mean)	Control, median (mean)	Z	P-value
Likely to become ill as a result of not taking medication as prescribed (perceived susceptibility)	5 (5.1)	5 (4.9)	0.464	0.64
Perceived serious illness resulting from not taking medication (perceived severity)	5 (5.0)	5 (4.9)	0.101	0.92
Worry when I don't take medication as prescribed (fear/anxiety)	5 (4.4)	3 (3.4)	3.778	<0.001
Taking medication as prescribed prevents illness (perceived benefit)	5 (5.4)	5 (5.1)	1.516	0.13
Taking medication as prescribed is not a real burden (perceived barrier)	7 (6.3)	7 (6.2)	0.956	0.34
Confident in my ability to take medication as prescribed (self-efficacy)	7 (6.9)	7 (7.0)	2.737	0.006
Important to take care of own health (health motivation)	7 (6.9)	7 (6.9)	0.463	0.64
Most people who are important to me think it is necessary for me to take medications as prescribed (subjective norm)	7 (6.9)	7 (7.0)	2.384	0.017
It is possible for me to take my medications as prescribed (perceived behavioural control)	7 (6.8)	7 (6. 9)	2.052	0.04

[a]Possible scores range from 1 to 7; 7 indicates full agreement with statement; 1 indicates strong disagreement with statement.

seven daily aliquots of medication, each within separate sections). Both groups used compliance aids (VI: 40%; control: 36%) but community pharmacists dispensed medications in these for more of the VI group (10% versus 2.5%) (OR = 4.4 [95% CI = 1.4 to 13.5]; age-adjusted OR = 3.8 [95% CI = 1.2 to 12.0]). Compared to controls, more individuals with VI relied on help from relatives or friends (19% versus 10%). Almost all (97%) with VI had difficulty reading medication labels, despite 80% using optical aids; 24% had difficulties distinguishing tablets, particularly in differentiating colours, compared to none of the controls. Almost half of each group had difficulties opening medications, especially blister packages. These results are summarised in Table 2.

Beliefs and quality of life
Table 3 shows summary statements for questionnaire items representing health beliefs regarding medication. To mitigate the risk of over-reporting statistical significance when running multiple tests, a significance level of 0.01 was applied. While there were several statistically significant differences between the groups, only the 'fear/anxiety' item demonstrated a difference in mean scores of more than one unit, suggesting that the effect size for other differences is small. Thus participants with VI reported a significantly higher level of anxiety about becoming ill if they did not take their medication as prescribed.

Quality of life (Table 4), measured by the SF-12 (physical and mental health components) and EQ-5D, was worse for participants with VI than controls. The DLTV questionnaire, relating to performance of tasks requiring visual acuity, showed that those with VI reported significantly greater difficulties.

Table 4. Quality of life, measured by SF-12, EQ-5D and DLTV questionnaires, for visually impaired (VI) and control (C) groups

Quality of life measure	Visually impaired (n = 156), mean (SD)	Control (n = 158), mean (SD)	Difference in mean scores (VI–C) (95% CI)	Age-adjusted difference in mean scores (95% CI)
SF–12				
Mental health component	48.2(9.6)	52.7(8.0)	–4.5 (–6.5 to –2.5)	–5.3 (–7.2 to –3.3)
Physical component	39.3 (11.0)	43.0 (10.5)	–3.7 (–6.1 to –1.3)	–3.3 (–7.2 to –3.3)
EQ–5D				
Mobility	1.37 (0.48)	1.25 (0.44)	0.11 (0.01 to 0.21)	0.09 (–0.02 to 0.79)
Self–care	1.15 (0.40)	1.05 (0.22)	0.10 (0.03 to 0.17)	0.08 (–0.01 to 0.06)
Ability to perform usual activities	1.62 (0.61)	1.29 (0.50)	0.33 (0.21 to 0.45)	0.33 (0.21 to 0.46)
Pain	1.31 (0.49)	1.18 (0.40)	0.13 (0.03 to 0.23)	0.14 (0.04 to 0.24)
Anxiety	1.19 (0.39)	1.09 (0.31)	0.10 (0.02 to 0.18)	0.13 (0.05 to 0.21)
DLTV				
DIM 1[a]	26.5 (17.1)	97.3 (3.4)	–70.8(–73.6 to –68.1)	
DIM 2[b]	66.3 (22.9)	100 (0.3)	–36.7(–40.3 to –33.1)	

DLTV = Daily Living Tasks associated with Vision. SD = standard deviation. SF = Short Form. EQ = EuroQol. [a]DIM 1: dimension 1, relates to tasks that require optimal visual acuity (for example, watching TV, distinguishing a person's features across the street, reading normal-sized newspaper print). [b]DIM 2: dimension 2, relates to tasks less dependent on optimal visual acuity (for example, distinguishing a person's features at arm's length, reading newspaper headlines).

Discuss this article

Contribute and read comments about this article on the Discussion Forum: http://www.rcgp.org.uk/bjgp-discuss

DISCUSSION

Summary

These findings indicate that, while older people with and without VI achieve similar levels of medication adherence, those with VI require and receive significantly more support in medication self-management: they were more than twice as likely to require help and four times as likely to receive support from a community pharmacist. Almost 30% of participants with VI required help daily in taking their prescribed medication: despite using optical aids, almost all had difficulty reading information. Compared to their peers, significantly more with VI had difficulty distinguishing between medications but almost half of both groups had difficulties opening packaging. This report provides novel information about people with defined levels of VI, and indicates that the impact of VI on medication self-management should be considered when planning health and social care.

Strengths and limitations

The study achieved a high level of participation from all those identified as eligible, and the study groups were well matched in sex, prescribed medications (suggesting comparable comorbidity) and socioeconomic status, thus suggesting that the findings are not biased by these factors. Fewer individuals aged >85 years were recruited from community optometrists than from low-vision clinics but the characteristics of the participants with VI were similar to those described previously,[30] suggesting that a representative sample was recruited: they reported more falls[4,31] and poorer quality of life[2,32] than their normally sighted counterparts. The sample reported levels of adherence that were similar to those reported previously for people with chronic disease in the developed world,[13,29] so the findings of this study are likely to be generalisable.

In assessing adherence, there is no 'gold' standard:[13] best practice is to use a multi-method approach. The study used two validated self-report questionnaires and an objective, although indirect, measure, based on community pharmacy and GP records. Self-report may overestimate adherence, but this study's triangulation of measures provides robust data. Nonetheless, by selecting those who attended appointments, the sample may be biased towards adherence: those who miss appointments and decline to participate in research may be less adherent to prescribed treatment. However, this does not alter the finding that

while similar adherence behaviour was reported by both groups, those with VI needed significantly more assistance.

Comparison with existing literature

There are few reports of levels of adherence to long-term therapies in general practice. This work adds to a previous report of older people with a range of self-reported vision impairments:[33] its finding of a smaller proportion (10.8%) reporting difficulty managing medication may be because it included people with minor visual deficits, potentially corrected by spectacles. The study has defined participants' visual acuity and described the problems experienced and help received, thus informing future strategies for medication self-management that should improve healthcare access for people with VI.[34]

Use of social care services was greater among those with VI. However, individuals mostly relied on informal social and family networks for help in managing medication. Older Australians have reported increased reliance on community and family support services as their VI increased.[30] VI adversely influences people's ability to care for themselves and their dependents.[35] As society ages and VI increases in prevalence, sources of informal support for those needing help will become less and a need for other resources will increase. Multimodal interventions are likely to be required: recognising patients' problems is the initial step in relevant intervention design.[36]

Major problems relating to pharmaceutical packaging have been reported.[37] Lack of standardisation in packaging can cause confusion, particularly for older people, and is a barrier to their self-management. Several participants' 'coping strategies', including memorising medications by touch, shape, or colour, were upset when, with generic prescribing, the size, shape, and colour of tablets and/or packaging varied for prescriptions dispensed on different occasions. There is a need for pharmaceutical companies and policy-makers to engage more with patients, to determine cost-effective ways of minimising problems due to different generic preparations of the same medicine, and to design more accessible packaging (while recognising child safety issues).

Health beliefs are significant predictors of medication adherence.[13] The study participants with VI reported fear of the consequences of not taking medication as prescribed, a feeling that may contribute to their poorer quality of life. Recognising their

need for support in medication management is important.

Implications for research and practice

This study was set in the context of the UK NHS, within which the potential influences of costs of treatment and services on medication adherence are removed, as these are free at the point of care. However, the findings indicate an insidious rising tide of need for help in medication self-management, as the numbers of older people with VI increase. Healthcare professionals should ask patients about their vision,[34] and check that they have sufficient support in opening packaging, distinguishing tablets, measuring liquids, or using eye drops or injections. Practical help may include providing more accessible information through large-print labels, different textures and shapes of containers,[38] electronic devices with pre-recorded voice messages ('talking labels'), devices for scanning labels and converting to audio format ('pen-friends'), syringe-filling aids, and 'pillboxes' with medication packed in daily quantities. Clinicians' and pharmacists' awareness of solutions to patients' problems should prompt them to inform policy-makers and pharmaceutical companies regarding ways to improve their health care, recognising the associated cost implications for commissioning of future services. Further research, exploring how best to address their needs, is warranted, to avoid potential adverse health consequences from non-adherence to prescribed medication, and to inform strategies for cost-effective support programmes.

REFERENCES

1. Owen CG, Fletcher AE, Donoghue M, Rudnicka AR. How big is the burden of vision loss caused by age related macular degeneration in the United Kingdom? *Br J Ophthalmol* 2003; **87(3):** 312–317.

2. Mangione CM, Gutierrez PR, Lowe G, *et al*. Influence of age related maculopathy on visual functioning and health related quality of life. *Am J Ophthalmol* 1999; **128(1):** 45–53.

3. Williams RA, Brody BL, Thomas RG, *et al*. The psychological impact of macular degeneration. *Arch Ophthalmol* 1998; **116(4):** 514–520.

4. Ivers RQ, Cumming RG, Mitchell P, Attebo K. Visual impairment and falls in older adults: The Blue Mountain Study. *J Am Geriatr Soc* 1998; **46(1):** 58–64.

5. Rovner BW, Ganguli M. Depression and disability associated with impaired vision: the MoVies Project. *J Am Geriatr Soc* 1998; **46(5):** 617–619.

6. Waern M, Rubenowitz E, Runeson B, *et al*. Burden of illness and suicide in elderly people: case-control study. *BMJ* 2002; **324(7350):** 1355–1357.

7. Lin MY, Gutierrez PR, Stone KL, *et al*. Vision impairment and combined vision and hearing impairment predict cognitive and functional decline in older women. *J Am Geriatr Soc* 2004; **52(12):** 1996–2002.

8. Bayliss EA, Ellis JL, Steiner JF. Barriers to self-management and quality-of-life outcomes in seniors with multimorbidities. *Ann Fam Med* 2007; **5(5):** 395–402.

9. Bane C, Hughes CM, McElnay JC. The impact of depressive symptoms and psychosocial factors on medication adherence in cardiovascular disease. *Patient Educ Couns* 2006; **60(2):** 187–193.

10. Gellad WF, Grenard JL, Marcum ZA. A systematic review of barriers to medication adherence in the elderly: looking beyond cost and regimen complexity. *Am J Geriatr Pharmacother* 2011; **9(1):** 11–23.

11. Gu Q, Dillon CF, Burt VL. Prescription drug use continues to increase: US prescription drug data for 2007–2008. *NCHS Data Brief* 2010; **(42):** 1–8.

12. National Audit Office. *Prescribing costs in primary care. Report by the Comptroller and Auditor General.* London: HMSO, 2007.

13. World Health Organization. Adherence to long-term therapies: evidence for action. Geneva: WHO, 2011. http://www.who.int/chp/knowledge/publications/adherence_report/en/index.html (accessed 2 Jul 2012).

14. Ruscin JM, Semia TP. Assessment of medication management skills in older outpatients. *Ann Pharmacother* 1996; **30(10):** 1038–1088.

15. Karamanidou C, Clatworthy J, Weinman J, Horne R. A systematic review of the prevalence and determinants of nonadherence to phosphate binding medication in patients with end stage renal disease. *BMC Nephrol* 2008; **9:** 2.

16. Kerse N, Buetow S, Mainous AG, *et al*. Physician–patient relationship and medication compliance: a primary care investigation. *Ann Fam Med* 2004; **2(5):** 455–461.

17. Bailey IL, Lovie JE. New design principles for visual acuity letter charts. *Am J Optom Physiol Opt* 1976; **53(11):** 740–745.

18. H54. Blindness and low vision. In: World Health Organization. *International statistical classification of diseases and related health problems.* 10th revision. Geneva: WHO, 2003. http://www.who.int/classifications/icd/en/ (accessed 2 Jul 2012).

19. Pattie AH, Gilleard CJ. A brief psychogeriatric assessment schedule. Validation against psychiatric diagnosis and discharge from hospital. *Br J Psychiatry* 1975; **127:** 489–493.

20. Northern Ireland Statistics and Research Agency. www.nisra.gov.uk/ (accessed 2 Jul 2012).

21. Horne R. Non-adherence to medication: causes and implications for care. In: Gard P (ed.). *A behavioural approach to pharmacy practice*. Oxford: Blackwell, 2001: 111–130.

22. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care* 1986; **24(1):** 67–74.

23. Becker MH. Health belief model. The health belief model and personal health behaviour. *Health Educ Monogr* 1974; **2:** 324–473.

24. Ajzen I. Theory of planned behaviour. From intentions to actions: a theory of planned behaviour. In: Kuhl J, Beckman J (eds.). *Action-control: from cognition to behaviour.* Heidelberg: Springer, 1985: 11–39.

25. Ware J Jr, Kosinski M, Keller SD. A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996; **34(3):** 220–223.

26. Kind P. The EuroQol instrument: an index of health-related quality of life. In Spilker B (ed.). *Quality of life and pharmacoeconomics in clinical trials* (2nd edn). Philadelphia, PA: Lippincott-Raven Publishers, 199: 191–202.

27. Hart PM, Chakravarthy U, Stevenson MR, Jamison JQ. A vision specific functional index for use in patients with age related macular degeneration. *Br J Ophthalmol* 1999; **83(10):** 1115–1120.

28. Steiner JF, Prochazka AV. The assessment of refill compliance using pharmacy records: methods, validity and applications. *J Clin Epidemiol* 1997; **50(1):** 105–116.

29. Roth MT, Ivey JL. Self-reported medication use in community-residing older adults: a pilot study. *Am J Geriatr Pharmacother* 2005; **3(3):** 196–204.

30. Wang JJ, Mitchell P, Smith W, *et al*. Impact of visual impairment on the use of community support services by elderly persons: The Blue Mountain Eye Study. *Invest Ophthalmol Vis Sci* 1999; **40(1):** 12–19.

31. Coleman AL, Stone K, Ewing SK, *et al*. Higher risk of multiple falls among elderly women who lose visual acuity. *Ophthalmology* 2004; **111(5):** 857–862.

32. Varma R, Wu J, Chong K, Azen SP, Hays RD. Impact of severity and bilaterality of visual impairment on health related quality of life. *Ophthalmology* 2006; **113(10):** 1846–1853.

33. Crews JE, Campbell VA. Vision Impairment and hearing loss among community-dwelling older Americans: implications for health and functioning. *Am J Public Health* 2004; **94(5):** 823–829.

34. Cupples ME, Hart PM, Johnston A, Jackson AJ. Improving healthcare access for people with visual impairment and blindness. *BMJ* 2012; **344:** e542.

35. Stevenson MR, Hart PM, Montgomery A-M, *et al*. Reduced vision in older adults with age related macular degeneration interferes with ability to care for self and impairs role as carer. *Br J Ophthalmol* 2004; **88(9):** 1125–1130.

36. Ho PM, Bryson CL, Rumsfeld JS. Medication adherence: its importance in cardiovascular outcomes. *Circulation* 2009; **119(23):** 3028–3035.

37. Rigby M. Pharmaceutical packaging can induce confusion. *BMJ* 2002; **324(7338):** 679.

38. The American Society of Consultant Pharmacists Foundation, and the American Foundation for the Blind. *Guidelines for prescription labelling and consumer medication information for persons with vision loss.* http://www.afb.org/section.aspx?FolderID=3&SectionID=3&TopicID=329&DocumentID=4064 (accessed 9 Ju1 2012).