Comparison of the eating behaviour and dietary consumption in older adults with and without visual impairment

Comparing the dietary consumption of older adults with and without VI

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Key words

Dietary consumption, Eating behaviours, Visual Impairment, Activities of Daily Living

Abbreviations

Black Asian Ethnic Minority (BAME)

BMI (Body Mass Index)

Do Not Drive (DND)

Sight Impaired (SI)

Severely Sight Impaired (SSI)

Royal National Institute for the Blind (RNIB)

United Kingdom (UK)

Visual Impairment (VI)

Abstract

Globally a high prevalence of obesity and under-nutrition has been reported in people with visual impairment (VI), who have reported multifactorial obstacles that prevent them from achieving a healthy diet, such as having restricted shopping and cooking abilities. This study is the first to investigate the relationship between VI and dietary consumption using a representative sample size, standardised methods to categorise VI, and a detailed analysis of dietary consumption. Ninety-six participants with VI and an age-matched control group of 50 participants were recruited from across the UK. All participants were aged 50 years or over. Participants completed a 24 hour food recall for a period of three days. Participants also answered questions about their abilities to shop for and cook food as well as their knowledge of healthy eating. Participants with VI in this sample consumed significantly fewer calories and other nutrients than is recommended for their age group and when compared to an age-matched control group. Participants with VI mainly made food choices irrespective of nutritional value. The results of this study highlight for the first time, that a large proportion of older adults with VI in the UK are undernourished. These results suggest local and government led initiatives should be implemented to support the diets of older adults in the UK, these initiatives could include healthy eating workshops, café clubs or skills training and rehabilitation.

Introduction

Previous studies have reported that people with visual impairment (VI) do not consume enough dairy products, meats and wholegrains [(1)] and do not consider the nutritional value of food before purchase [(2, 3)]. It has been reported that people with macular degeneration in the United Kingdom (UK) do not consume the recommended daily amounts of nutrients for their age group[(3)]. It has also been reported that those with ocular conditions such as macular degeneration and glaucoma do not have nutritious diets and are unsure about what foods they should consume to maintain optimal eye health [(3-13)]. The cost of malnutrition in the UK is £19.6 billion annually [(14)], with £16 billion being related to being overweight or obese [(14)]. It is reported that malnourished adults account for 30% of hospital admissions and 35% of care home admissions in the UK [(14)].

Studies that have investigated the impact of VI on nutritional status have concluded that interventions are required to improve the diets and dietary habits of people with VI [(15-17)]. These

studies have suggested that the interventions could take the form of skills training [15], development training packages for the young [16] or rehabilitation packages for the elderly [17]. It has been reported that nutritional interventions save the National Health Service 172.2-229.2 million pounds due to reduced health care use [14].

Systematic review of the literature demonstrates that VI significantly impacts on nutritional status [18]. Previous studies have used a variety of methods to assess nutritional status, such as nutritional screening tools to assess whether a person is at risk of undernutrition [19], measuring BMI (Body Mass Index) [20-22] and qualitative and quantitative analysis on the ability to acquire, cook and eat food [2, 15-17, 23-26]. Some of these studies did not use representative sample size [1, 15, 16, 21, 24-27] and some used non-standardised methods to categorise participants as visually impaired [19, 20]. Two studies conducted a dietary consumption assessment; one carried out a gross categorisation assessment of foods eaten into meat products, wheats and grains [1]; the other carried out a detailed analysis of dietary consumption but the dietary consumption assessment was conducted for school children and was not done in the UK [20].

This study is the first to investigate the impact of VI on nutritional status in older adults and whether dietary consumption is affected by shopping and cooking abilities.

Materials and Methods

Survey design

Following a systematic review of the literature [18] a 37 question, cross-sectional questionnaire was designed to evaluate the impact of VI on dietary consumption , vision related quality of life and activities of daily living [28]. The questionnaire was piloted and validated prior to the start of the study. Full details of the validation process and questionnaire design are reported elsewhere [28].

Sample size

Using previously reported nutritional analysis data [3], sample sizes were calculated for individual nutrients. The effect sizes chosen for each nutrient were based on published mean and standard deviation data [3]. The minimum sample size (*n)* required for a two tailed t-test at an alpha error level of 0.05 and a power (1-β) of 80% was calculated (see Table 1).

*Table 1 Sample size calculations for each nutrient**

Nutrients	unit	Mean	Difference to Detect (DD)	Standard deviation (SD)	Effect size (Cohens d) ES=(DD/SD)	Sample size for each group; *(n)* (two tailed test, power (1-β) 80%, α error level of 0.05) $(16/(ES)^2)$
Calories	kcal	2074	687	±870	0.8	27
Carbohydrates	g	257	82	±86	0.95	19
Of which Sugars	g	62	14	±27.8	0.5	63
Protein	g	82	27.2	±28.8	0.94	19
Fat	g	82.3	18	±46	0.39	105
Saturated Fat	g	30.5	3.6	±18	0.25	394
Fibre	g	22.4	5.8	±6.2	0.94	31
Cholesterol	g	407	148	±348	0.42	88
Vitamin C	mg	82.2	25	±73	0.35	136
Vitamin D	IU	143	32	±153.8	0.20	364
Vitamin E	mg	6	1	±3.6	0.27	205
Calcium	mg	980	306	±496	0.61	43
Iron	mg	20.4	5.1	±8.8	0.57	48

*Mean Values for effect size calculations taken from STEVENS R., B. H., and COOKE R. 2015. Dietary Analysis and nutritional behaviour in people with and without age-related Macular disease. *Clinical Nutrition*, Vol. 10 p. e112–e117

In total, 146 participants were recruited for this study. Ninety-six participants were recruited for the VI group and 50 participants for the control group.

For fats, saturated fats, cholesterol, vitamins C, D and E the sample size required to detect the desired effect sizes was large. This study was therefore underpowered for these nutrients at

powers (1-β) 0.6, 0.3, 0.6, 0.5, 0.2, and 0.4 respectively. It would have been time consuming and impractical to collect data for these nutrients in order to detect the desired effect sizes.

Inclusion and exclusion criteria

For both the VI and the control participants, exclusion criteria were dietary restrictions relating to conditions such as coeliac disease, inability to communicate in English, or inability to hear well over the telephone.

Following the criteria for the certification of visual impairment (CVI), proposed by the Royal National Institute for the Blind (RNIB) participants were categorised:

- Registered severely sight impaired (SSI) or sight impaired (SI)
- Eligible for SSI or SI registration but not actually registered
- Not eligible for SSI or SI registration, but experiencing a level of VI that precludes driving. Or in other words, a reduction in vision that significantly impairs day to day activities (RNIB, 2016b)

For the control group, participants were aged 50 years or over, and had to demonstrate binocular visual acuity of at least better than 6/9.5; i.e. a visual acuity that would meet the level of sight required to be able to drive legally.

Participant recruitment and setting

In all, 109 participants with VI were recruited from across the United Kingdom from October 2017 to July 2018. Advertisements were placed with the Macular Society, the Royal National Institute for the Blind (RNIB), and Visionary a membership organisation for VI charities. Participants were also recruited by being directly approached by the researcher at Focus and Aston, low vision clinics in Birmingham. They were also approached by the researcher at Sight Concern, a support group for those with VI in Worcestershire, New Outlook, a sheltered accommodation in Birmingham, designed specifically for people with VI and at local macular society support groups.

Participants responded to the advertisements in the Macular Society Sideview magazine. In all written information the Macular Society use at least a size 16 font. They also produce ‘accessible’ versions of their publications in PDF form, which can be read aloud by screen readers. There are other types of text processing and screen readers available as apps as well,

which people may use a mixture of. Additionally the Macular Society offer the option for people to receive audio versions of publications – they provide this as a CD for their Sideview magazine and their leaflets are available on their website as mp3 files. The study was also advertised through RNIB Connect (radio) whereby participants provided their contact details to the researcher via email and telephone. The researcher then called the participants and read out the participant information sheet and arranged a convenient time and date to deliver a structured telephone interview.

Of the 109 VI participants recruited, only 13 were aged under 50 years, and so although their data was included in the qualitative analysis [28]; a decision was made to restrict the dietary analysis to a subgroup of VI participants aged 50 years and over.

In all, 50 control group participants without VI were recruited from December 2018 to January 2019. The records of patients at the Aston University Eye Clinic who had given consent for their records to be accessed and to be contacted for research and teaching purposes were reviewed. Those that met the inclusion criteria were contacted by telephone and invited to take part.

Procedure for 24 hr food recall

Participants were asked to recall over the telephone all the food and drink they had eaten over the previous 24 hours for three days in the same week.

Studies using telephone interviews for 24-hr recalls have reported that they are comparable to the standard in-person method [29, 30]. Concerns about this method in the literature pertain to non-covering bias i.e. excluding those unable to use a telephone or those without a telephone [31] however studies have also reported that the dietary intake reported over the telephone is comparable for participants of different ages, gender and BMI [32].

The 24-hr food recall is a methodological tool often used in dietary consumption studies, but presents advantages and limitations [33]. Advantages include short administration time, high precision when performed three or more times and low literacy requirements [30, 33-35]. Among the limitations falls the cooperation of the interviewee and their memory, in the case of the elderly this can be compromised[36] . In addition, difficulty of estimating the size of portions[37] and recall bias can lead to over and under-reporting [33, 38].

Method

Materials

- A password protected file of the participant's names and contact details.
- A list of predefined questions for dietary analysis.
- A telephone equipped with a headset.
- Quiet surroundings.
- A digital voice recorder to collect verbal informed consent.

A spreadsheet to record dietary information (separated into morning, afternoon, evening and snacks).

The interviewer received training on how to conduct the interview and input data into the dietary analysis software A la calc by the project lead.

A telephone protocol was used in order to remain neutral and not react adversely to any responses given. The interviewer had a list of predefined questions. These questions were screened for clarity and wording by a focus group of six people with VI prior to the start of the study. The same interviewer conducted the interview for each participant.

Participants quantified the portions of foods consumed using the Zimbabwe Hand Method [39-42], this method has been shown to be more accurate than using household measures when measuring portion sizes [43]. The method was explained to participants at the start of the first telephone call and they were reminded of how to quantify each food as they recalled each food item. This step was then repeated at each telephone call. This 24 hr food recall exercise was carried out on two week days and one weekend day of the same week to ensure precision and validity of reporting [44].

- To aid co-operation verbal digitally recorded consent was taken at the start of each food diary; participants were reminded they could withdraw at any time if they wished.
- The participants were first asked to recall foods eaten for breakfast, lunch, and supper as well as any snacks consumed. They were asked about fluids they drank (alcohol, coffees, fruit juice, teas, milk)
- To aid participants recall they were probed to check if they had missed any information i.e. vitamin, supplements, or other foods.
- They were then asked to provide a detailed description of the food items. Examples of

the questions asked include; what type of milk (full fat, semi-skimmed, and skimmed), whether milk, sugar and sweeteners were added to drinks, whether bread was white, seeded, and wholemeal, whether cereal was fortified or unfortified and if vegetables were fresh or frozen.

- Food quality was assessed where possible, participants were asked if spreads were cholesterol reducing and low in and fat, as well as whether foods were baked or fried, shop bought or homemade.
- To further support participant's recall, they were asked one final time if they might have missed any other foods or drinks.

Recommended Daily Allowance (RDA) analysis

The three day 24 hour food recalls were analysed using nutritional software called A La Calc (Red Hot Rails LLP, Doncaster, UK.). This software provided a detailed nutritional analysis for each participant based on their self-reported food and drink consumption. This software has been used in previous research [3] and has been designed to be used by nutritionists, schools, consultants, manufacturers, and for research purposes. The software uses McCance and Widdowson's composition of foods dataset to ensure an accurate breakdown of the nutrients contained within each food item entered[45]. This UK nutrient database is maintained by the Food Standards Agency, and contains the nutritional information of foods commonly consumed in the UK. All calculations are also compliant to the EC Directive 90/496/EEC [46]. For each participant the mean dietary consumption across the three reported days was calculated.

Data analysis

Statistical processing was performed using Microsoft Excel and exported to SPSS Software version 23.0 (IBM UK Ltd, Portsmouth Hampshire). The descriptive analysis is demonstrated in mean, standard deviation, median, and interquartile range.

Normally distributed data that had two independent variables and a continuous variable was analysed using an independent t test $p<0.05$. The t test was used to analyse if dietary intake was influenced by gender both the control and VI group and living arrangements for the control group (living with family/living on own). A one-way between groups ANOVA was used for normally distributed data that included one independent variable (grouping variable) that had three or more levels and one dependent continuous variable $p<0.05$. Post hoc analysis was

performed using a Tukey's test. The one way between groups ANOVA test was used to analyse dietary intake was influenced by shopping abilities (myself/myself with support/do not shop) and cooking abilities (do not cook/cook with support/ cook myself), level of VI (DND/SI/SSI) and if level of VI was influenced by living arrangements (sheltered accommodation/family/living alone)

Where data was not normally distributed the non-parametric equivalents the Mann-Whitney U test $p<0.05$ and Kruskal Wallis test with Bonferroni corrections for multiple comparisons was used $p<0.02$. The Mann-Whitney U test was used to determine if there was a significant difference between the ages of the two groups of this sample and the analysis of the dietary intake for males and females. The Kruskal Wallis test was used to determine if living arrangements, shopping and cooking abilities and level of VI influenced dietary intake for nutrients that were not normally distributed.

Fishers exact test was used to determine if there was a relationship between level of VI and ability to shop and cook $p<0.05$.

Results

Demographics

Three-day 24-hour recalls were analysed for 64 females and 32 males with VI. Ages of those with VI ranged from 51-96 years. The mean age was 76 ± 11.7 years. The majority of the participants sampled were living with family members or on their own, were retired and were Caucasian.

VI in this sample was caused by multiple factors. For example, participants had congenital blindness due to measles, or lost sight due to neurological conditions such as stroke. They also reported VI due to ocular trauma and retinal diseases such as diabetic retinopathy and macular degeneration. Genetic causes were reported such as; ocular albinism, macular dystrophies, and retinitis pigmentosa as well as corneal degenerations and optic nerve head disease i.e. glaucoma.

Those that were classified as SSI had been affected for longer compared to the other VI participants (H 17.2) $p<0.01$. In all 81% of the participants were registered SSI or SI with most being SSI, see Table 2.

Table 2 Demographic characteristics of participants with and without visual impairment

* These participants may have been eligible for SI registration #Not Applicable

Characteristic		Proportion of participants with visual impairment (%)	Proportion of participants in the control group (%)
Living Arrangement	on own	48	40
	with family	48	60
	sheltered accommodation	4	0
Level of visual impairment	Severely sight impaired (blind)	46	#
	Sight impaired (partially sighted)	35	#
	Not driving due to poor sight when fully corrected*	19	#
Employment status	Employed	8	20
	Unemployed	6	0
	Voluntary Employed	18	0
	Retired	68	80
Ethnicity	South Asian	4	0
	Caucasian	96	100

In all, 26 females and 24 males were recruited as part of the control group. The mean age was 75.4 ± 7.2 years old. All the control participants were Caucasian and either lived with their

family or on their own. In comparison to the VI group a larger proportion of the control were in paid employment; either fulltime, part time or ad hoc, see Table 2.

The mean age of females with and without VI was 77.0 ± 12 years and 75.1 ± 6.4 years respectively with no significant difference between groups (U 1033), p = 0.07. The mean age for males with and without VI was 74.9 ± 11.5 years and 75.5 ± 8.3 years respectively with no significant difference between groups, (U 299), p = 0.1.

Dietary consumption analysis

Dietary consumption compared to RDA

Table 3 displays the three-day, mean and median results for macro and micro nutrients for the females and males in each group. These are compared to the RDA for each constituent for those aged over 74 years as reported by Public Health England[47].

Similar amounts of macro and micronutrients to RDA were found for the dietary consumption of participants with and without VI. Both groups were consuming fewer amounts of carbohydrates, dietary fibre, fats and vitamin D as recommended for their age group. Both groups were consuming sugars, iron, protein, vitamin C and calcium in excess. The control group exceeded the recommended daily amounts of saturated fat intake.

Dietary consumption of participants with and without VI

Females with VI consumed significantly fewer nutrients compared to their age-matched counterparts, including, calories, fats, saturated fats, protein, salt, calcium, cholesterol and vitamin C; see Table 3. Despite consuming fewer calories, the amounts of vitamin d (U 704), p= 0.29, fibre (t 1.4), p= 0.10 and sugars (U 707), p=0.26 they consumed did not significantly differ from the control group.

Males with VI consumed significantly lower amounts of most nutrients compared to males from the control group see Table 3. The amounts of vitamin C (U 307), p =0.20, vitamin D (U 304), p= 0.18, vitamin E (t 1.2), p=0.20, and cholesterol (U 313), p=0.24 they consumed was not significantly different from that consumed by males without VI.

Table 3 Mean and Standard deviations and median and interquartile ranges of nutrients consumed by females and males with and without visual impairment aged over 50 years (VI) compared to the recommended UK government guidelines (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/618167/government_dietary_recommendations.pdf)

**STD Standard Deviation, IQR interquartile range*

	Unit	Female VI n=64	STD/IQR	Female without VI n=26	STD/IQR	Test statistic and significance p<0.05 value	Male VI n=32	STD/IQR	Male without VI n=24	STD/IQR	Test statistic and significance p<0.05 value	RDA Females >74 years	RDA Males >74 years
Energy	Kcal	1384	±391	1673	±360	(t 3.2) p=<0.01	1600	±369	2023	±31	(t4.5) p=<0.01	1840	2294
Fat	g	50	±20.6	67	±28	(t 3) p=<0.01	58	±19	78	±23	(t3.6) p<0.01	72	89
Of which saturates	g	18	±7	25.6	±9	(t 4.1) p=<0.01	17.5	10.7 IQR	34	12 IQR	(U 139) p=<0.01	<23	<29
Carbohydrates	g	160	±55	187	±52	(t 2.1) p=<0.01	197	±56	235	±53	(t2.6) p= 0.01	245	306
Of which sugars	g	63	38 IQR	67	40 IQR	(U 707) p= 0.26	58	±27	77	±40	(t 2.1) p =0.03	25	31
Protein	g	59	±17	70	±14	(t 2.8) p=<0.01	65	±14	81	±17	(t3.6) p=<0.01	46.5	53.5
Fibre	g	16	±7	18	±6	(t 1.4) p= 0.10	15	±6	20.2	±7	(t2.7) p=<0.01	30	30
Salt	g	4	2 IQR	4.	2 IQR	(U 565) p =<0.01	4.4	±1	6	±2	(t-4) p=<0.01	<6	<6
Cholesterol	mg	155	134.9IQR	262	220 IQR	(U 442) p= <0.01	190.6	207 IQR	202	202IQR	(U 313) p=0.24	**	**
Calcium	mg	652	±214.2	850	154.3	(t 3.6) p=0.01	788	±325	1085	±661	(t2.2) p=0.03	700	700
Iron	mg	8	4.75 IQR	10	5 IQR	(U 624) p= <0.01	8.6	5 IQR	12	6 IQR	(U 212) p =<0.01	8.7	8.7
Vitamin D	µg	2	3 IQR	3	4 IQR	(U 704) p= 0.29	1.58	2 IQR	4	2IQR	(U 304) p= 0.18	10	10
Vitamin E	mg	5	5.26 IQR	7	5 IQR	(U 605) p= <0.01	4.9	±3	6.0	±3	(t1.2) p=0.20	**	**
Vitamin C	mg	59	62IQR	89	89 IQR	(U 519) p= <0.01	43	51IQR	49.2	69 IQR	(U 307) p =0.20	40	40

**data not provided

Dietary consumption and living arrangements

Living arrangements influenced the dietary consumption of participants with VI. Those who lived with family members (M=1559 kcal ±406) or in sheltered accommodation (M=1759 kcal ±385) had a higher intake of calories ($F(2, 93) = 5.7$), $p<0.01$ compared to those living on their own (M=1327 kcal ±345). Those living independently were found to be eating an average of 332 kcal less than those who lived in sheltered accommodation or with family. Post hoc Tukey's test did not reveal any significant difference between those living with family and sheltered accommodation. Those living with family were found to be eating 16g more fat (H 11.35), $p <0.01$ and 25g more carbohydrates (H 11.52), $p<0.01$ compared to those living in their own home.

Among the control group, those living with family members showed no difference (t 1.8), $p = 0.08$ than those living on their own.

Dietary consumption and level of VI

Participants classified as SSI consumed an average of 25.7 mg less vitamin c than other VI participants (H 12), $p< 0.01$.

Ability to cook was affected by level of VI with more SSI participants being unable to cook than other VI participants (Fishers Exact test: 25.9), $p<0.01$.

A one-way between-groups ANOVA revealed VI participants that cooked with support (M=1826 kcal ±396) consumed significantly $p<0.05$ more calories ($F(2, 93)$ 8.8), $p<0.01$ than those who did not cook (M=1504kcal ±396) or cooked for themselves (M=1327kcal ±334).

Post-hoc comparisons using the Tukey's HSD test revealed those that cooked with support consumed an average of 411 kcal more calories, than the other groups. Cooking with support also resulted in a higher dietary intake of carbohydrates (M=200g ±85), ($F(2, 93)$ 4.8), $p=0.01$ when compared to not cooking (M=185g ±54) and when people with VI cooked by themselves (M=154g ±47). The dietary intake of fats ($F(2, 93)$ 3.8) $p=0.03$ for those cooking with support was higher (M=64.8g ±14) than those that did not cook (M=54g ±23) or cooked independently (M=48g ±17).

Kruskal-wallis with Bonferroni corrections revealed that those that received support consumed 6.7 mg more vitamin E (H 10.7), $p<0.01$, and 93.6 mg more vitamin C (H 23.89),

$p<0.01$ than those who cooked by themselves or sourced ready meals.

Eating behaviours of participants with and without VI

Meal preparation and shopping

All participants without VI stated they had no difficulty cooking and could cook a hot meal if they were required to. The control group mainly reported no difficulty shopping, with 96% stating they shopped independently. The 4% that required support reported that physical limitations, such as arthritis, left them unable to lift heavy goods.

In contrast, 50% of the participants with VI in this sample could not cook food by themselves. They required support, relied on a family member or purchased ready meals. Only 29% of participants with VI shopped independently, 42% required support and 29% did not shop but relied on family members or used meal delivery services. Level of VI affected ability to shop with more participants that were SSI or SI being unable to do so or requiring support (Fishers Exact test: 11.5), $p=0.02$. However, no relationship was found between reported shopping ability and dietary consumption.

When asked about food choices, participants with VI stated preference as the primary factor. Those without VI stated that perceived impact of foods on their health determined what they purchased (see figure 1).

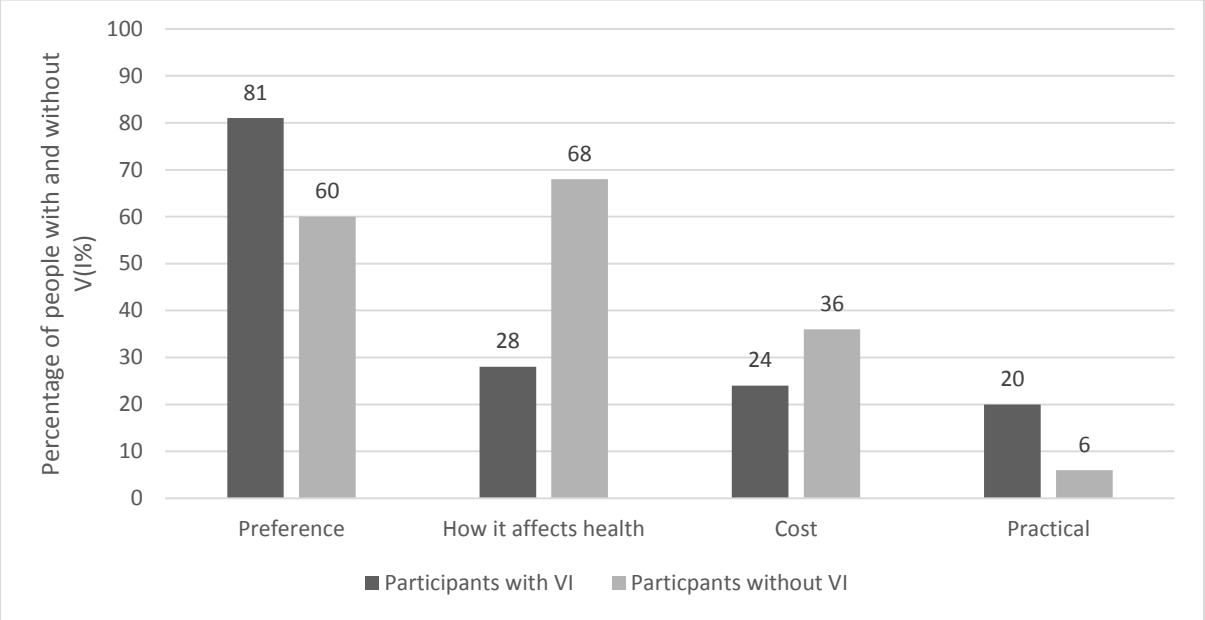

Figure 1 Main factors deciding the choice of foods purchased in a sample of participants with and without visual impairment (VI).

Attitudes towards diet and knowledge of healthy eating

In all, 59% of participants with VI and 94% without VI stated they were satisfied with their current health. In all, 61% of participants with VI stated they were happy with their diet, giving this as the reason for why they would not change it. The 39% that stated they would change their diets provided a variety of reasons. The main reasons given were "eat more fresh fruits, vegetables" "have a diet that was varied and be aware of foods available", and "improve knowledge of healthy eating". Similarly 62% of the control group stated they would not change their current diet. Of these 50% believed they had already adopted healthy eating behaviours and 12% stated they would not change their diet because they were happy with it. The 38% of participants without VI who reported they would like to change their diets stated they would mainly like to "eat healthier foods" or "be more disciplined with sugary foods". Other reasons given were they would like to eat "more expensive foods like caviar" and would consider changing their diets if "healthier foods tasted nicer".

Participants were asked "can you name the five food groups for a balanced diet". More of the control group were able to name the food groups compared to those with VI (see figure 2). The participants without VI strongly agreed that the foods we eat affect our health. Of the

participants with VI, 18% stated that they believed that our health is not affected by the foods we eat.

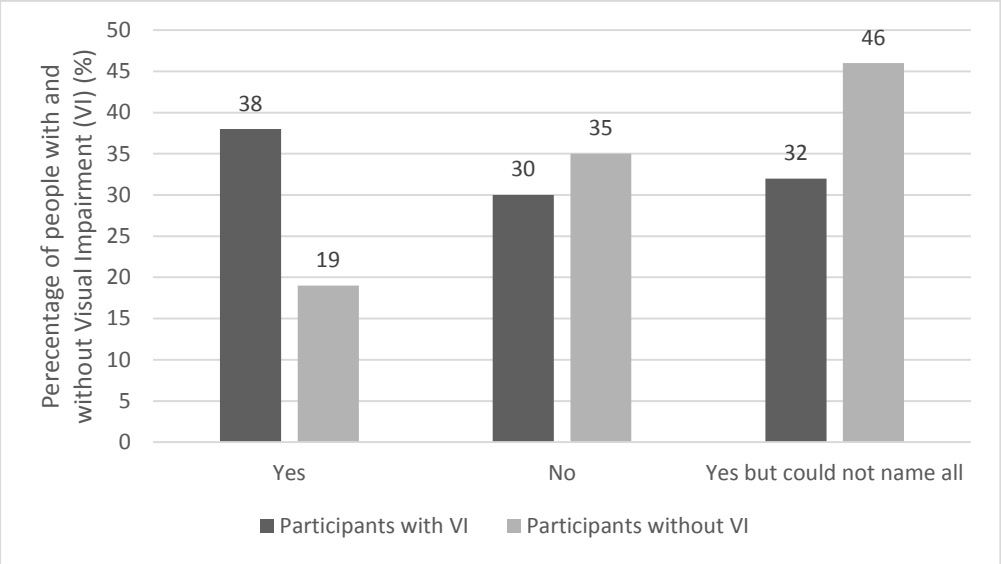

Figure 2 Participant's ability to name the five food groups for a balanced diet.

Discussion

This study is the first to report that older adults with and without VI are not meeting the recommended daily requirements as recommended by Public Health England[47]. This finding suggests additional factors other than VI could play a role in the undernourishment of participants in this study. Factors reported in previous studies that cause a compromised nutritional status in older adults include physical changes associated with aging, as well as cognitive, psychological, and social factors such as dementia, depression, isolation, and limited income[48]. Researchers have also found that older adults' have smaller appetites and feel that portion sizes of foods in shops are inappropriately large [49].

For the first time using detailed dietary analysis, this study reports that people with VI are consuming significantly fewer nutrients than age-matched controls. This study supports the view that there are multifactorial obstacles that make it difficult for people with VI to maintain healthy feeding, including difficulties shopping for, preparing and cooking food [2, 3, 15, 27]. People with VI have reported having an aversion to cooking [15] and report that meals could take up to two hours to cook [2]. It has also been reported that people with VI eat more intuitively and the loss of visual cues may drive a reduced appetite in people with VI [50-53].

This study found that participants with VI who were living alone and cooking for themselves consumed significantly less food sources of calories, fats, vitamin C, and vitamin E nutrients than those with VI that lived with family or received support to cook. The reduction in calories consumed by the participants with VI who were living alone (332kcal) almost equates to missing an entire meal, such as breakfast (400kcal) as recommended by UK government guidelines[54]. The participants in the age-matched control group who were living alone also consumed fewer calories (191kcal) than those living with family although this was not significant. It has been previously documented that older adults living alone have less favourable diets than those who live with family or receive support [55, 56]. Bereavement has been reported as a substantial change that has been linked to poor dietary intake and quality[57]. A recent Canadian study suggested eating alone might act as reminder of bereavement and result in reduced pleasure from eating [58]. Another study reported British men who were married and living with family had a better diet quality than those living alone[57]. Lack of motivation to cook has also been reported as a contributory factor in older women who had lost their partner, who report preferring to cook less [49]. Other studies have reported that food wastage when buying for one could play a role in participant food choices and food quality with specific food groups being affected more so than others[57]. Vegetables in particular were reported as the food group that participants had the greatest difficulty with when buying for one [57].

Participants with VI in this study were less able to recall the five food groups for a balanced diet. Those with VI were mainly making food choices irrespective of its nutritional value whereas those without VI made food choices based on how healthy foods were. To improve dietary consumption knowledge of where to obtain healthy ready meals, support with cooking and supporting the knowledge of the recommended portion sizes of food may therefore be helpful for people with VI. The results of this study suggest that interventions are required to improve the nutritional awareness of people with VI. These could take the form of skills training or rehabilitation [15] to support activities of daily living.

Strengths

Participants from across the United Kingdom took part in this study and so the study was not restricted by geographical location. The method of using 24-hr hour recalls has been reported

to be affected by age and a trend of underreporting of foods consumed has been reported. In an attempt to reduce this bias the 24 hr food recalls were collected for three non-consecutive days as they have been reported to have precision and when multiple days are assessed validity [44]. The 24 hr food recall was also the first question asked at the initial telephone call to attempt to reduce this bias.

Limitations

The results of this study are subject to limitations. This study was performed over a three-day period of the same week. This method would significantly influence the dietary intake analysis, as this data was not representative of what participants ate throughout the year. Future studies should perform the dietary analysis on multiple days throughout the year to capture the macro and micronutrients consumed more completely.

The same interviewer collected the data for each participant the dietary analysis may therefore be subject to interviewer bias. Participants also required notice for the 24-hr food re-calls and therefore the recalls were not truly spontaneous; this time to prepare may have also influenced the results of this study.

The 37-question item survey was disseminated prior to the second and third telephone calls. The questions asked may have influenced the participants eating habits for the subsequent phone calls although the researchers did not find a significant variation in the dietary consumption reported at the follow up telephone calls.

Participants could not always report with accuracy about the quality of the food consumed, for example, if they went to a pub or restaurant they could not report if the food was prepared with heart healthy oil or not, this may have affected the accuracy of reporting and therefore the dietary consumption analysis.

VI may have also affected the ability of participants to relay portion sizes accurately and therefore have affected the dietary analysis for this group.

The aim of this study was to recruit participants from all ages and ethnicities however very few participants who were under the age of fifty years, identified as BAME, and were in employment participated.

Measurements such as BMI, waist circumference, and activity levels would be useful in future studies to evaluate the nutritional status of people with VI more completely.

Conclusion

This study is the first to highlight that older adults with VI in the UK are eating fewer nutrients when compared to their age matched counterparts. Both adults with and without VI are not meeting the recommended amounts nutrients according to government guidelines. These results suggest local and government led initiatives should be implemented to support the diets of older adults in the UK, these initiatives could include healthy eating workshops, café clubs or skills training and rehabilitation.

Conflict of interests

All authors declare they have no conflict of interest or financial interest.

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Ethics

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Aston University School of Life and Health Sciences Ethics Committee, #1398. Verbal informed consent was obtained from all subjects/patients. Verbal consent was witnessed and formally digitally recorded by the first author.

Consent for publication

All participants gave verbal digitally voice recorded, informed consent for their data to be published.

Author's contributions

Nabila Jones contributed to the acquisition of data, analysis and interpretation of data. Hannah Bartlett made substantial contributions to conception and design. Both authors participated in drafting the article and revising it critically. Both authors gave final approval of the version to be submitted for review.

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