

RESEARCH ARTICLE

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# Nutri-eSCREEN®: descriptive analysis of a self-management site for older adults (50+ years)

Heather H. Keller

## Abstract

**Background:** Older adults (50+ years of age) are a prime target for prevention programs and nutrition education that can improve their eating habits. Yet, most programs target specific disease groups or more vulnerable older adults. As well, the majority of nutrition education programs evaluated to date have been delivered in-person by a health provider. Self-management for upstream nutrition problems that lead to nutrition risk is needed. The internet has made possible the opportunity for the spread of credible nutrition education that can promote awareness and improve knowledge. The purpose of this paper is to describe an internet-based self-management site for older adults focused on nutrition behaviours and present descriptive results of users between 2012 and 2015.

**Methods:** Nutri-eSCREEN® (<http://www.nutritionscreen.ca/escreeen/>) is based on SCREENII, a valid and reliable nutrition screening tool for older adults. It was developed over an 18-month period, which included focus groups, key informant interviews and a usability analysis. Descriptive and bivariate analysis have subsequently been completed on over 15,000 Nutri-eSCREEN® users over the age of 50 years.

**Results:** Most older adult users were between the ages of 50 and 74 years and were women (80.2 %). Nutrition risk was common and increased with age (e.g. 68 % of 85+ year olds were high risk). Several age and gender differences in prevalence of nutrition behaviours were noted. For example, swallowing problems were more likely to occur in the oldest age group ( $\chi^2 = 511.8$   $p < 0.0001$ ). Key nutrition behaviours were also associated with each other. For example, chewing problems were associated with lower intake of fruits and vegetables ( $\chi^2 = 825.7$   $p < 0.0001$ ).

**Conclusions:** Nutri-eSCREEN® appears to be a viable self-management site focused on the nutrition issues of adults over the age of 50 years. Future work should include formative and outcome evaluations, as well as determine how Nutri-eSCREEN® can be incorporated into primary care for older adults.

## Background

Nutritional risk, a vulnerability to malnutrition that can result from poor food intake and/or the presence of risk factors that lead to poor food intake [1], is very prevalent in community-living older adults [2–4]. A high quality diet is anticipated to delay chronic disease progression, geriatric syndromes such as frailty and sarcopenia, and mortality [3, 5, 6] and modest improvements in diet are expected to promote gains in health outcomes regardless of age [7]. As with other age groups, promoting and supporting dietary changes to more healthful eating behaviours is needed for this segment of the population [7].

Older adults themselves can be part of the solution by increasing their awareness on the importance of diet to their overall health and wellbeing and being empowered to make positive changes in their diet [8, 9].

Screening for nutrition risk in primary care can promote the identification of vulnerable older adults who can benefit from nutrition education and services to support food intake [10]. Typically, screening is done in a clinical setting, preferably followed by a nutrition assessment and individualized intervention. Yet, screening tools can also identify nutrition behaviours that can be improved and this information can be used to develop education programs [11]. Screening tools that include various risk factors and behaviours could also be used

Correspondence: [hkeller@uwaterloo.ca](mailto:hkeller@uwaterloo.ca)  
Schlegel- University of Waterloo Research Institute for Aging, University of Waterloo, Waterloo, Canada

for self-management, which is strongly advocated to promote individual health [9].

Nutrition education can improve the diet of older adults [6, 12]. Most research to date has been focused on a health provider, in-person delivery model that is limited in its reach. These efforts are commonly focused on the most vulnerable or those with specific disease conditions such as diabetes [12]. Technology may be one mechanism for reaching a broader group and especially those between the ages of 50 and 75 years of age, who may have upstream risk factors that impair food intake and can lead to malnutrition over time. A recent systematic review identified that although self-management of chronic conditions is growing, only 5 % of evaluated programs were 'pure self-management', meaning that a health professional was not directly involved in the intervention [13].

Learning about diet through interactive electronic media is an innovation that is gaining acceptance [9, 14] and could support self-management for upstream, nutrition risk behaviours. A recent systematic review found that e-learning focuses on a variety of topics, such as losing/maintaining weight, but only one of the 43 studies was directed specifically to older adults (>60 yrs) [9]. The internet has the capacity to reach a geographically diverse audience and can thus be a valuable resource for health promotion, but more research on the best use of this modality for credible health education is needed [14]. Internet applications to support health behavior change for specific disease conditions exist, but few are targeted specially to the older adult and their specific nutrition behaviours and challenges (e.g. cooking for one). The purposes of this paper are to: a) describe the development of Nutri-eSCREEN<sup>®</sup>, an internet application designed for those 50 years of age or more, that raises awareness and educates the user with tailored messages, and b) provide descriptive results of Nutri-eSCREEN users between June 2012- May 2015, focusing on their demographic and nutrition risk profiles.

## Methods

### Development of Nutri-eSCREEN<sup>®</sup>

Nutri-eSCREEN<sup>®</sup> is an internet version of SCREENII (Seniors in the Community Risk Evaluation for Eating and Nutrition, Version II), a valid and reliable nutrition screening tool for adults aged 50+ [15, 16]. In addition to the original SCREENII questions, the Nutri-eSCREEN internet site also offers the opportunity for self-management by providing individualized guidance and feedback to users based on how they answered these questions. SCREENII was specifically developed to be self-administered and to include upstream behaviours such as consumption of fruits and vegetables and fluid intake, while also identifying common risk factors

known to influence food intake in this segment of the population (e.g. swallowing problems, grocery shopping or cooking difficulty, eating alone). SCREEN II has 16 questions that receive a score, with a total score range of 0-64. Each question has response options with scores of 0 to 4. Lower scores indicate increased nutrition problems or risk. Different cut-points for nutrition risk have been suggested for SCREEN II [16]: low risk (score <54), high risk (<50) and very high risk (<45). Implementation research with SCREEN identified that older adults were interested in seeing if their eating habits were comparable to guidelines such as Canada's Food Guide and wanted educational material to help them improve their eating habits and diet [17]. This knowledge and the use of behaviour change theory (specifically the Health Belief Model, COM-B) [18, 19] resulted in the development of Nutri-eSCREEN<sup>®</sup> designed as a self-management platform for nutrition risk in those over the age of 50 years. Specific aspects of the Health Belief Model incorporated into Nutri-eSCREEN are: a) perceived susceptibility to poor nutrition; participants are given information on 'how they are doing well' and 'where they need to improve' and b) perceived benefits; educational material outlines the benefits of improved eating habits. The COM-B model identifies that behaviour is influenced by capability (e.g. knowledge, skills), opportunity (e.g. resources, interpersonal support), and motivation (e.g. behaviour seen as a good thing, emotional reactions to behaviour). The tailored messages provided to respondents are designed to increase knowledge, help participants to identify opportunities that support behaviour change, and see the improvement in their eating habits as positive and feasible. Linkages in the site to recipes and other materials help users to develop skills.

A rigorous development process was undertaken over an 18-month period. The first step in this process was to conduct focus groups with diverse older adults (rural, francophone, urban, low income) to determine interest and expectations for an internet platform. Focus groups were digitally recorded and underwent qualitative content analysis [20] to identify key areas for consideration in building the platform. Barriers to the use of such a site and considerations for format and function was also ascertained from older adults participating in these four focus groups ( $n = 29$  participants: Grp 1  $n = 6$ , 1 M; Grp 2  $n = 5$ , 3 M; Grp 3  $n = 11$ , 1 M; Grp 4  $n = 7$ , 0 M). Informants indicated that a self-management site like Nutri-eSCREEN<sup>®</sup> would be useful to many older adults. In addition to communications, such as email, health information and recipes were voiced as primary reasons why these older adults searched and used the internet. Examples of key functional considerations were font, keeping pages uncluttered, and being aware that many older adults may not have a printer, even if they do have

a personal computer. Other considerations were: credibility of material, maintaining privacy and providing information in short, focused messages. Prior research suggests that professional bodies, universities, and governments are considered as credible bodies for health information [21]. As such, Nutri-eSCREEN® was built in collaboration with Dietitians of Canada and EatRight Ontario.

Subsequent to these focus groups, an advisory group was established to guide the development of Nutri-eSCREEN®. This group consisted of public health nutritionists and experts in health communications ( $n = 5$ ) and three older adults who had extensive experience in internet communications. Next, ten key informants ( $n = 4$  Male) who had developed internet platforms or had experience educating the public using the internet were also interviewed with a semi-structured questionnaire to gain their insights and learn from their experiences. Content analysis of digitally recorded individual interviews identified that principles of design echoed the comments of the older adults who had participated in focus groups. Examples of further considerations for developing Nutri-eSCREEN® gleaned from interviews were: in-person follow-up post screening if the older adult so desired; tracking of functionality and use of the site by seniors (e.g. how long it takes to complete the questions); promoting accessibility through visual cues, font, page style etc.; use of personalized, motivating messages; and making it easy for users to make diet changes by linking results to recipes and other relevant online content. These findings are consistent with prior work on development of high quality health information internet sites [14, 22].

With the assistance of the older adult advisors, a prototype platform was developed. Three draft versions of the prototype were developed. The final draft was tested for usability with 46 older adults who had a range of computer (use per week:  $n = 16$  never;  $n = 4$ , < 1 hr/wk;  $n = 6$ , 1-3 hrs/wk;  $n = 12$ , 4-15 hrs/wk;  $n = 8$ , 15 + hrs/wk; ) and internet experience (searches per week:  $n = 7$ , never;  $n = 7$ , <1/wk;  $n = 13$ , 2-9/wk;  $n = 2$ , 10-20/wk) including a group of low income seniors ( $n = 7$ ) with limited to no experience. As they moved through each page of the site, they described what they were thinking about when they interacted with the webpage [23]. Usability analysis was conducted in an iterative manner; ideas and suggestions from prior participants were asked of subsequent ones to determine if these modifications would be an improvement. These suggestions were recorded in hard-copy by the two assessors. Results post each interview were reviewed among the team to identify those suggested changes worth pursuing with subsequent participants. The primary focus of usability analysis was to identify challenges in functionality of the site; for

example the size of the radial buttons and challenges posed by using a mouse to click on these buttons. Older adults were also asked specific questions to determine their perceptions of the look and feel of key aspects of the site. These seniors also completed the paper version of SCREENII approximately two-weeks prior to assess the inter-modal reliability of the internet platform.

The internet platform was found to be highly reliable (ICC = 0.89 for average measures 95 % CI 0.80, 0.94; F test significant at  $p < 0.0001$ ) with the paper form of SCREENII and the results of this usability testing were used to improve and finalize the platform. For example, font was made larger and bolding removed in some areas to promote readability and the SCREENII score was removed, as this was not readily interpretable or meaningful to the older adult users. Prior work with older adults, identified that 'risk' terminology was not well understood and could be inflammatory [24]. Thus with the removal of the score, concepts of 'where you are doing well' and 'where you can improve' were used to build the tailored messaging. Tailored messages were developed by the health professional advisory team and a clear language consultant wrote and revised these messages. Messages were focused on building capability, identifying opportunity for supporting the behaviour, and motivating the participants to change key behaviours identified by the questions as needing improvement. Older adult advisors were involved in all aspects of redesign until completion. Nutri-eSCREEN® was launched as a useable platform in January 2012. Data from users is stored in aggregated spreadsheets on a secure server managed by Dietitians of Canada. In addition to the SCREENII questions, users provide their profile (age, gender, location, how heard about the site). As the site is linked to EatRight Ontario, users from Ontario have access to a dial-a-dietitian service for follow-up. Ethics clearance for the descriptive analysis of Nutri-eSCREEN® presented here was provided by a University of Waterloo ethics board.

### Descriptive analysis

A three-year period from June 1, 2012- May 31, 2015 was chosen to complete a descriptive analysis of the Nutri-eSCREEN® and its participants. The purpose of this analysis was to characterize users (e.g. age, gender), including their self-reported nutrition behaviours based on the results from the SCREENII questions embedded within the Nutri-eSCREEN® platform. Frequencies and mean (+/-SD) are provided. Associations between SCREENII items and demographic characteristics of users were also completed using Chi square and Student's t-test to examine associations and make group comparisons. Associations beyond gender and age group comparisons were also examined where theoretical

relationships were believed to exist, such as difficulty chewing being associated with reported lower meat and alternatives intake. As anyone can use the internet site, any users who identified that they were less than 50 years of age were excluded from this analysis. Due to the large number of users and to avoid the identification of spurious associations, statistical significance for associations and group comparisons was only noted when the  $p$  value was  $<0.0001$ .

## Results

During the three-year period examined there were 23,193 visits to Nutri-eSCREEN®. A third of these users self-identified their age to be less than 50, resulting in a total of 15,545 over the age of 50 years used in this analysis. Descriptive results are provided in Table 1. Of these older adults, 93.2 % were first time users; there was no statistically significant difference in first time use by age group, but men were more likely to be first time

**Table 1** Characteristics of Nutri-eSCREEN® users over the age 50 years ( $n = 15,545$ )

Characteristic	n	% of Total
Gender:		
Male	3077	19.8
Female	12468	80.2
Age group (years):		
50-64	9486	61.0
65-74	4084	26.3
75-84	1535	9.9
85+	440	2.8
Region live in:		
Canada		
Ontario	14626	94.1
British Columbia	10875	70
Alberta	1171	7.5
Quebec	709	4.6
Other Canadian Provinces	577	3.7
United States	1294	8.3
United Kingdom	211	1.4
Australia	106	0.7
New Zealand	70	0.50
Other	148	1.0
Other	384	2.5
How found out about the site:		
Friend	938	6.0
Health professional	2652	17.1
Internet search	5153	33.1
Advertising	3197	20.6
Other	3605	23.2

users as compared to women (96.6 % vs. 92.4 %  $\chi^2 = 66.7$   $p < 0.0001$ ). The most common referral source for Nutri-eSCREEN® reported was an internet search (33.1 %). There was a statistically significant association ( $\chi^2 = 301.6$   $p < 0.0001$ ) between referral source and age group. With increasing age, users were more likely to report a friend (e.g., 85+ yrs, 14.5 %) or a health professional (85 + yrs, 32.3 %) and a smaller proportion reported using an internet search (50-64 yrs 34.7 % vs. 85+ yrs 25.7 %) or advertising (50-64 yrs, 21.3 % vs. 85+ yrs 9.1 %) to find out about the Nutri-eSCREEN® site. There was also a significant association between gender and referral source ( $\chi^2 = 63.7$   $p < 0.0001$ ), where women were more likely to be referred by a health professional than men (17.7 % vs. 14.5 %) and men more likely to report seeing advertising for the site than women (24.7 % vs. 19.6 %).

On average, users required 400 seconds (~6.5 minutes) to complete the screening tool and 7.9 % used help buttons to support the completion of questions. Almost all participants reviewed results pages on where they were doing well (88 %) and where they could improve (87.2 %), however only 3.6 % printed and 2.15 % used email to retain their results. Although almost all reviewed their results, only 10.5 % went to a resource page and only 8.7 % clicked on a specific resource link.

The mean Nutri-eSCREEN® score was 45.4 (SD 8.3; range 0-64) with no statistical difference by gender. However, as a user became older, mean scores decreased for each age group with those reporting being 85+ years of age, having the lowest mean score of 37.3 (SD 12.4). Prevalence in the very high risk category was 39.9 % and there was an age gradient noted with 68 % of those over the age of 85 years being very high risk; these differences by age were statistically significant (Nutri-eSCREEN® score  $< 54$   $\chi^2 = 45.4$   $p < 0.0001$ ;  $< 50$   $\chi^2 = 101.4$   $p < 0.0001$ ;  $< 45$   $\chi^2 = 257.6$   $p < 0.0001$ ).

Age and gender comparisons for each SCREENII item embedded into Nutri-eSCREEN® are provided in Table 2. Several age differences were statistically significant. For example, those aged 50-64 years were more likely to report a weight gain, while those over the age of 75 years reported a weight loss in the prior six months ( $\chi^2 = 495.1$   $p < 0.0001$ ). Younger age groups were more likely to be trying to change their weight ( $\chi^2 = 530.94$   $p < 0.0001$ ) or thought they were too heavy ( $\chi^2 = 1098.2$   $p < 0.0001$ ) as compared to older adults, who were more likely to see themselves as just right or underweight, especially for the 85 and above age group. Unintentional weight change was reported at 31 % in those over the age of 85 years. Key eating behaviours were different as well by age with older groups more likely to skip meals ( $\chi^2 = 77.3$   $p < 0.0001$ ), eat alone ( $\chi^2 = 449.8$   $p < 0.0001$ ) and have cooking ( $\chi^2 = 816.2$   $p < 0.0001$ ) and shopping

**Table 2** Proportions of Nutri-eSCREEN® Items and Comparisons by Age and Gender (n = 15,545)

Item	Total	Male (n = 3077)	Female (n = 12468)	50-64 yrs (n = 9468)	65-74 yrs (n = 4084)	75-84 yrs (n = 1535)	85+ yrs (n = 440)
	Proportion (%)						
<b>Weight</b>							
Gain 10+ pounds	8.7	7.1*	9.0	9.8#	8.2	3.8	5.2
Gain 6-10	9.7	7.1	10.3	11.2	8.0	6.0	3.4
Gain 5	12.2	9.6	12.9	13.5	11.9	7.6	3.4
Stayed same	47.1	49.8	46.4	46.2	48.8	49.4	41.6
Lost 5	7.3	8.5	7.0	6.4	7.7	9.7	13.6
Lost 6-10	6.8	7.7	6.5	5.6	7.0	12.0	10.9
Lost 10+ pounds	6.3	8.1	5.9	5.5	6.5	8.2	15.5
Don't know weight	2.0	2.1	2.0	1.6	1.9	3.4	6.4
<b>Trying to change weight</b>							
Yes	48.4	41.3*	50.1	52.7#	48.1	31.8	15.2
No	40.0	48.4	38.0	36.9	41.9	50.4	53.6
No but changed anyway	11.6	10.3	11.9	10.3	10.0	17.8	31.1
<b>Weight Perception</b>							
More than want	70.8	63.9*	72.5	75.7#	71.5	49.5	30.5
Just right	21.9	25.9	21.0	19.5	21.9	33.0	36.4
Less than want	7.3	10.2	6.6	4.7	6.5	17.5	33.2
<b>Skip Meals</b>							
Never/rarely	59.9	56.0*	60.9	60.6#	60.8	57.4	45.7
Sometimes	29.3	31.1	28.8	28.7	29.6	30.8	33.4
Often	5.6	7.4	5.2	5.6	5.1	6.2	9.1
Almost everyday	5.2	5.5	5.1	5.1	4.5	5.6	11.8
<b>Limiting foods</b>							
Eat most foods	47.3	46.5*	47.5	46.7	48.2	49.8	43.4
Some/manage	38.0	41.4	37.2	38.5	37.8	36.4	35.2
Some/difficult	14.7	12.1	15.4	14.8	14.0	13.9	21.4
<b>Appetite</b>							
Very good	43.7	42.8	43.9	47.3#	42.9	30.3	18.6
Good	43.7	45.0	43.4	43.9	44.9	41.9	34.1
Fair	10.1	9.7	10.2	7.5	10.2	20.5	29.1
Poor	2.5	2.5	2.5	1.3	1.9	7.4	18.2
<b>Fruit/ Vegetable</b>							
5 +/-day	32.1	25.9*	33.6	33.8#	32.6	24.3	15.9
4	23.5	20.6	24.2	23.8	22.6	24.3	20.0
3	22.8	24.0	22.5	21.9	23.0	26.0	27.5
2	13.2	16.9	12.3	12.4	13.8	15.6	17.7
<2 /day	8.5	12.5	7.5	8.0	8.0	9.8	18.9
<b>Meat/alternatives</b>							
2+ per day	25.9	23.3*	26.5	29.5#	21.7	16.7	17.3
1-2	40.0	38.1	40.5	39.9	41.4	39.3	32.0
1	26.0	28.0	25.4	23.2	28.6	33.8	34.1
<1 per day	8.2	10.5	7.6	7.4	8.3	10.2	16.6

**Table 2** Proportions of Nutri-eSCREEN® Items and Comparisons by Age and Gender (*n* = 15,545) (*Continued*)

Milk products/alt							
3+ per day	11.8	11.2*	11.9	11.7	12.0	11.5	13.0
2-3	27.4	22.7	28.5	28.2	25.4	29.3	21.4
1-2	30.6	29.4	30.9	30.2	32.0	29.8	29.8
1	19.5	22.7	18.7	19.2	19.9	19.8	21.6
<1 per day	10.7	14.0	9.9	10.7	10.8	9.7	14.3
Fluid							
8+ cups/day	23.3	21.0*	23.9	27.3#	20.0	11.6	8.6
5-7	43.6	42.0	44.0	43.6	45.5	40.8	33.4
3-4	26.1	28.4	25.5	23.4	28.0	33.9	38.0
about 2	5.5	6.2	5.3	4.4	5.1	11.0	12.3
<2 cups/day	1.6	2.4	1.4	1.2	1.4	2.7	7.7
Swallowing difficulty							
Never	62.4	61.8	62.6	67.2#	59.8	47.3	37.0
Rarely	23.7	25.3	23.3	21.3	25.5	32.2	28.6
Sometimes	12.4	11.0	12.7	10.5	13.2	18.1	25.9
Often or always	1.5	1.9	1.4	1.1	1.5	2.4	8.4
Chewing difficulty							
Never	71.6	69.6*	72.1	77.5#	69.9	51.6	30.9
Rarely	16.5	17.5	16.2	14.3	17.0	25.6	25.5
Sometimes	10.1	10.1	10.1	7.2	11.0	18.9	32.0
Often or always	1.8	2.7	1.6	0.9	2.1	3.9	11.6
Use meal supplements							
Never or rarely	81.9	79.0*	82.6	83.8#	82.5	74.2	61.6
Sometimes	15.3	17.7	14.7	13.7	15.2	22.3	25.0
Often or always	2.8	3.2	2.7	2.5	2.3	3.5	13.4
Eats with others							
Never or rarely	14.7	14.4*	14.8	11.6#	16.4	25.3	30.9
Sometimes	20.2	18.3	20.6	19.3	20.5	24.1	22.7
Often	16.6	19.1	16.0	19.4	12.6	11.6	12.0
Almost always	48.5	48.2	48.5	49.8	50.5	39.0	34.3
Who prepares meals							
They do	67.0	37.2*	74.4	67.2#	69.7	64.8	46.6
They share	22.0	31.5	19.6	24.5	19.4	15.8	13.0
Someone else does	11.0	31.3	6.0	8.3	10.9	19.5	40.5
Meal Preparation							
Enjoy	40.0	37.4*	40.7	42.5#	41.3	28.7	14.8
Sometimes a chore	35.3	22.9	38.3	36.1	35.3	32.4	27.3
Usually a chore	13.7	8.4	15.0	13.0	12.6	19.5	17.5
Satisfied with others cooking	9.3	28.4	4.6	7.1	9.9	16.1	28.9
Not satisfied with others cooking	1.7	2.9	1.4	1.2	1.0	3.4	11.6
Grocery Difficulty							
Never or rarely	83.4	86.9*	82.5	87.3#	83.2	68.6	52.5
Sometimes	12.1	9.1	12.8	9.7	12.1	23.0	25.9
Often	2.9	2.6	3.0	2.0	3.1	6.2	10.5

**Table 2** Proportions of Nutri-eSCREEN® Items and Comparisons by Age and Gender ( $n = 15,545$ ) (Continued)

Always	1.6	1.4	1.6	1.1	1.5	2.2	11.1
Total Score							
Mean	45.4	45.4	45.4	46.2	45.4	42.6	37.3
SD	8.3	8.1	8.4	7.6	7.9	10.0	12.4
Risk Score < 54	85.6	87.1	85.2	84.4#	86.5	88.7	93.0
Risk Score < 50	66.2	67.7	65.9	64.1#	67.2	72.1	83.2
Risk Score < 45	39.9	39.8	39.9	36.9#	39.5	50.7	68.2

\* gender comparison statistically significant difference at  $p < 0.0001$

# age comparison statistically significant difference at  $p < 0.0001$

for food difficulties ( $\chi^2 = 819.4$   $p < 0.0001$ ) than younger seniors. Poor appetite ( $\chi^2 = 1190.2$   $p < 0.0001$ ) and chewing ( $\chi^2 = 1081.9$   $p < 0.0001$ ) and swallowing difficulties ( $\chi^2 = 511.8$   $p < 0.0001$ ) were also more common in older age groups. Not surprisingly, older age groups also had poorer consumption than younger age groups (fruit and vegetable:  $\chi^2 = 175.1$   $p < 0.0001$ ; meat and alternatives  $\chi^2 = 287.7$   $p < 0.0001$ ; fluid intake  $\chi^2 = 592.1$   $p < 0.0001$ ; meal replacement use:  $\chi^2 = 314.9$   $p < 0.0001$ ).

No statistically significant differences in risk score or risk cut-points were identified by gender, however several behaviours were different. Notably, women as compared to men, were more likely to have reported weight gain ( $\chi^2 = 97.5$   $p < 0.0001$ ) and were trying to change their weight ( $\chi^2 = 111.9$   $p < 0.0001$ ), and they were more likely to believe that they were too heavy ( $\chi^2 = 98.5$   $p < 0.0001$ ). However, men were more likely to skip meals than women ( $\chi^2 = 36.1$   $p < 0.0001$ ) and have a poorer quality diet (milk products  $\chi^2 = 91.8$   $p < 0.0001$ ; fruit and veg  $\chi^2 = 174.1$   $p < 0.0001$ ; meat and alternatives  $\chi^2 = 44.9$   $p < 0.0001$ ; fluid intake  $\chi^2 = 38.8$   $p < 0.0001$ ). Men also reported more chewing difficulties than women ( $\chi^2 = 22.1$   $p < 0.0001$ ). Men were more likely than women to eat in the company of others ( $\chi^2 = 20.8$   $p < 0.0001$ ) but were less involved in meal preparation ( $\chi^2 = 2096.3$   $p < 0.0001$ ) and reported meal preparation ( $\chi^2 = 1775.3$   $p < 0.0001$ ) and grocery shopping difficulty ( $\chi^2 = 35.6$   $p < 0.0001$ ) less often than women.

Other anticipated associations were also identified in the data. Appetite was significantly associated with skipping meals ( $\chi^2 = 2759.3$   $p < 0.0001$ ), and those with poor appetite were more likely to skip meals almost every day (43 % vs. very good appetite 2.8 %). Similarly, having difficulty with meal preparation was significantly associated with skipping meals ( $\chi^2 = 696.9$   $p < 0.0001$ ); of those who were not satisfied with others cooking, 15.1 % skipped meals every day as compared to those satisfied with others cooking (7 %). Those who enjoyed cooking were less likely to skip meals every day (3.5 %) as compared to those who usually found cooking a chore (11.1 % skipped every day). Grocery shopping difficulty was similarly associated and skipping meals ( $\chi^2 = 1133.0$

$p < 0.0001$ ), where 29.4 % of those who reported difficulty skipped meals daily (in comparison to no difficulty, 4.2 % skipped). As expected, having difficulties with cooking and shopping were positively associated ( $\chi^2 = 1308.0$   $p < 0.0001$ ).

Appetite was positively associated with eating with others ( $\chi^2 = 712.1$   $p < 0.0001$ ); 39.4 % of those with a poor appetite never or rarely ate with others, whereas only 11.3 % of those with a very good appetite typically ate alone. Eating with others was also associated with less skipping of meals ( $\chi^2 = 804.1$   $p < 0.0001$ ), and those who didn't know their weight were more likely to never/rarely eat with others than those who were stable, gained or lost weight ( $\chi^2 = 216.8$   $p < 0.0001$ ). All food intake questions were positively associated with eating with others and thus higher reported intakes for these food groups (fruit and vegetables:  $\chi^2 = 613.9$   $p < 0.0001$ ; meat and alternatives:  $\chi^2 = 536.7$   $p < 0.0001$ ; milk products:  $\chi^2 = 151.5$   $p < 0.0001$ ).

Those who had difficulty swallowing or chewing were more likely to report a lower intake of meat and alternatives (swallowing: ( $\chi^2 = 200.6$   $p < 0.0001$ ; chewing:  $\chi^2 = 389.9$   $p < 0.0001$ ) and of fruits and vegetables (swallowing:  $\chi^2 = 619.1$   $p < 0.001$ ; chewing:  $\chi^2 = 825.7$   $p < 0.0001$ ). For example, of those who consumed two or more servings a day of meat and alternatives, only 1 % reported always having a problem with swallowing as compared to the 4.7 % having this problem who also consumed less than one serving a day. Of those who consumed five or more fruits and vegetables per day, 80.9 % never had a problem chewing. Not surprisingly, swallowing and chewing problems were highly and positively associated ( $\chi^2 = 3371.8$   $p < 0.0001$ ).

## Discussion

This descriptive analysis of more than 15,000 older adult users of Nutri-eSCREEN® demonstrates not only that older adults are interested in self-management, but also that they report increasing nutrition challenges and risk behaviours with age. Prevalence of estimates on these risk behaviours needs to be interpreted with caution, as it is unlikely that those who chose to complete the

questions, especially those who happened upon the site by internet search, are representative of the general older adult population in Canada. It is anticipated that these Nutri-eSCREEN® users were sufficiently motivated to complete the questionnaire and view their results [21]. Yet, the range of nutrition problems reported denotes that these users had some nutrition concerns. Compared to a population sample where the abbreviated (8-item) version of SCREEN II was administered during a telephone survey in over 15,000 older Canadian adults, the Nutri-eSCREEN® sample had fewer nutrition problems [4]. For example the Statistics Canada sample had higher proportions than the Nutri-eSCREEN® sample for: poor (6.7 %) appetite; skipping meals everyday (14.7 %), and often having swallowing problems (6.6 %) [4]. Yet, Wham et al. [25] who used the full version of SCREEN II in 85/86 year olds in New Zealand found lower proportions at high risk (49 %) than the Nutri-eSCREEN® sample of a similar age. The New Zealanders had higher proportions of at risk items such as chewing difficulty (22 %) and eating alone (49 %), but similar proportions for some items like unintentional weight loss (24 %) and limiting foods (20 %). This demonstrates the need to consider the various risk factors that characterize nutrition risk for a specific group of older adults rather than just the total score.

Another limitation of the prevalence estimates for risk factors is the assumption that users have been truthful in their responses. There is no way of knowing if the older adult themselves completed the questions. It is also not known if they truly represented their behaviours when answering the questions. For example, in prior use of SCREEN with community samples [11, 15, 16], no individual has had a score of 0. However, a few respondents in this Nutri-eSCREEN® sample had such a score. We do however know that Nutri-eSCREEN® results are comparable to self-administered SCREENII when the paper version is used. We have made the assumption that questions are answered truthfully; the associations identified are confirmed by presuppositions and theories around nutrition behaviours. Yet, use of administrative data such as this, must take into consideration the quality of this evidence when used for policy decisions.

This analysis has only provided a description of the usage of the site and the nutrition behaviours of users and how they compare among gender and age groups. Future work should formally evaluate the Nutri-eSCREEN® site. Prior research suggests that the greatest potential of internet sites such as Nutri-eSCREEN® is to raise awareness [13, 14, 21]; behaviour change should not be an anticipated outcome from education sites such as this, especially when they are a single exposure [14]. As a first step, a formative evaluation to determine what

users do with the information they attain from Nutri-eSCREEN® and if they access other resources as a result of this exposure should be undertaken. For example, do they discuss nutrition issues with primary care providers or seek out services in their own community to support their nutrition?

Nutri-eSCREEN® provides tailored messages in addition to identifying where older adults need to improve their habits. Such tailored messages may support intentions to change behaviours [21] and have been shown to be key in changing behaviour in older adults, as they have unique knowledge needs and barriers to food intake [6]. In this analysis, almost all users did review these tailored messages. Prior work also suggests that well-designed nutrition education delivered through the internet can be as effective as in-person education for improving knowledge [26, 27]. The tailored educational messages are a noted benefit of Nutri-eSCREEN® and future evaluations should consider knowledge and attitudes changing as a result of use of the platform, as well as reported intentions to change their behaviour [6, 21]. As only 10 % of users went beyond the site to resource pages, further evaluation of these tailored messages is essential. Web interventions can enhance motivation for change, yet positive intentions do not always result in behaviour change as this depends on self-efficacy and the environment in which the older adult lives and consumes food, which cannot be addressed with an internet application [21]. More distal outcomes, such as weight loss or improved food intake may not show the same degree of change; relatively few internet applications have demonstrated longstanding behaviour change [13].

A key benefit of nutrition education and awareness programs like Nutri-eSCREEN® is the potential for large geographic reach [14, 21]. The majority of users were from Canada and specifically the province of Ontario, which is where EatRight Ontario, a partner in Nutri-eSCREEN® is based. Others within and outside Canada used Nutri-eSCREEN® demonstrating its potential for a large reach. Uptake of this platform in other countries requires some adaptation. For example, Nutri-eSCREEN® has been adapted for older adults in New Zealand and Australia. Modifications in food examples, as well as units for body weight and food/fluid consumption were required. Partnering with a credible sponsor who developed educational messages consistent with national recommendations and considered the cultural verities in food consumption, was also necessary. Older adult nutrition and eating behaviours are a priority for the EU public health agenda due to significant potential health and economic effects of malnutrition [28]; adapting Nutri-eSCREEN® for other regions, such as the EU is possible.



Specific efforts are needed to get older adults to realize that their nutrition behaviour is important to their health [28–30]. The time has come for inclusion of preventive practices, such as screening for nutrition risk and self-management, into the routine care of older adults [31] and Nutri-eSCREEN® can be part of an integrated process. The gender, age and risk factor associations found in this study are consistent with prior work, further demonstrating the utility of Nutri-eSCREEN®. For example, prior work has found associations between poorer diet quality and inadequate dentition, increasing age, male gender, and fewer meals per day [32–35]. Persons at risk for chronic conditions such as those with pre-diabetes [29] could be key targets for Nutri-eSCREEN®. Nutri-eSCREEN® and other internet based applications cannot meet all audiences and nutrition education needs, but may be able to provide greater reach for stimulating awareness of eating habits and potentially leading to intentions to change behaviours. The practicality of how these up-stream self-management platforms can be used in conjunction with other forms of education and treatment requires further study, but shows promise [27]. Certainly, this study has demonstrated a significant interest among older adults for use of this technology for this purpose. Finally, public health and decision makers could also benefit from self-management sites such as Nutri-eSCREEN®; access to large amounts of data on older adult nutrition behaviours to examine trends is necessary to understand their needs when planning programs and policies to support their nutrition.

## Conclusions

Nutri-eSCREEN® is a reliable internet platform for the identification of nutrition risk in older adults. Self-management is needed to address upstream risk factors amenable to change in this segment of the population and this platform provides a viable mechanism for reaching a large proportion of older adults. Future work needs to include the evaluation of this tool to determine how older adults use the information and if knowledge, attitudes and intention to change behaviour occur. As well, providers should consider how Nutri-eSCREEN® can be integrated into primary health care systems.

## Abbreviation

SCREENII: Seniors in the Community Risk Evaluation for Eating and Nutrition, Version II.

## Competing interests

HK is the originator of SCREENII and in partnership with Dietitians of Canada and EatRight Ontario, developed Nutri-eSCREEN®.

## Authors' contribution

HK conceived and conducted the analysis and wrote the full manuscript.

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