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Corresponding author:
La correspondance et les demandes de tirés-à-part doivent être adressées à : / Correspondence and requests for offprints should be sent to: Christine Marie Mills, 200 University Avenue West,
Waterloo, ON, Canada N2L 3G1
(Christine.mills@queensu.ca).

Factors Associated with the Development of High Nutrition Risk: Data from the Canadian Longitudinal Study on Aging

Christine Marie Mills[1], Heather H. Keller[2], Vincent Gerard DePaul[3] and Catherine Donnelly[3]

[1]Faculty of Health Sciences, School of Rehabilitation Therapy, Aging and Health Program, Queen's University, Kingston, ON, Canada, [2]Schlegel-UW Research Institute for Aging and Department of Kinesiology & Health Sciences, University of Waterloo, Waterloo, ON, Canada and [3]School of Rehabilitation Therapy and Health Services and Policy Research Institute, Queen's University, Kingston, ON, Canada

Résumé

Cette étude basée sur des données de l'Étude longitudinale canadienne sur le vieillissement visait à déterminer quelles variables liées au réseau social, aux données démographiques et aux indicateurs de santé pouvaient permettre de prédire le développement d'un risque nutritionnel élevé chez les adultes canadiens d'âge mûr et plus âgés. Une régression logistique binomiale multivariée a été utilisée pour examiner les facteurs prédictifs du développement d'un risque nutritionnel élevé lors du suivi, trois ans après le début de l'étude. Au départ, 35,0 % des participants présentaient un risque nutritionnel élevé contre 42,2 % lors du suivi. Des niveaux inférieurs de soutien social, une participation sociale plus faible, la dépression et un niveau médiocre de vieillissement en bonne santé auto-évalué ont été associés au développement d'un risque nutritionnel élevé lors du suivi. Les personnes présentant ces facteurs devraient faire l'objet d'un dépistage proactif de risque nutritionnel.

Abstract

This study aimed to determine which social network, demographic, and health-indicator variables were able to predict the development of high nutrition risk in Canadian adults at midlife and beyond, using data from the Canadian Longitudinal Study on Aging. Multivariable binomial logistic regression was used to examine the predictors of the development of high nutrition risk at follow-up, 3 years after baseline. At baseline, 35.0 per cent of participants were at high nutrition risk and 42.2 per cent were at high risk at follow-up. Lower levels of social support, lower social participation, depression, and poor self-rated healthy aging were associated with the development of high nutrition risk at follow-up. Individuals showing these factors should be screened proactively for nutrition risk.

Introduction

Nutrition throughout the lifespan has an influence on health and well-being (Herman et al., 2014). Diets that provide the appropriate amount of energy and essential nutrients are important for the maintenance of good health and well-being (Herman et al., 2014). Nutrition at midlife and beyond, in particular, can help prevent the development of many chronic diseases or can help in their management (Lambrinoudaki et al., 2013). However, as people enter midlife (ages 45 to 65) and older adulthood (ages 65 and older), physiological, psychological, and social changes can lead to changes in dietary habits and food intake (de Boer, Ter Horst, & Lorist, 2013; Elsner, 2002; Herman et al., 2014). When these changes lead to inadequate intake, nutrition risk and the risk of poor nutritional status can develop (Ramage-Morin & Garriguet, 2013). Nutrition risk lies on a continuum between good nutritional health and malnutrition (Ramage-Morin & Garriguet, 2013). Depending on how nutrition risk is measured, individuals can be at no/low, moderate, or high nutrition risk (Craven, Pelly, Lovell, & Isenring, 2018; de Groot, Beck, Schroll, & van Staveren, 1998; Keller, Goy, & Kane, 2005; Roberts, Wolfson, & Payette, 2007). Moderate to high nutrition risk can lead to several negative outcomes, including decreased quality of life, frailty, hospitalization, institutionalization, and mortality (Keller & Østbye, 2003; Keller, Østbye, & Goy, 2004; Payette, Coulombe, Boutier, & Gray-Donald, 2000; Ramage-Morin, Gilmour, & Rotermann, 2017). High nutrition risk is prevalent in community-dwelling Canadians, with approximately one-third of adults ages 50 and older at high nutrition risk (Morrison, Laur, & Keller, 2019; Ramage-Morin & Garriguet, 2013).

A variety of factors have been associated with high nutrition risk in cross-sectional studies of community-dwelling older adults; however, relatively few studies have examined nutrition risk longitudinally or examined nutrition risk in adults at midlife. A Canadian longitudinal study by Roberts et al. (2007), that lasted 1 year, examined nutrition risk in 839 older adults residing in Montreal, Quebec, Canada. The authors found that for individuals who were at low nutrition risk at baseline, only poor self-rated health was a predictor of elevated risk 12 months later (Roberts et al., 2007). In this study, Roberts et al. (2007) used the Elderly Nutrition Screening tool to determine nutrition risk status and logistic regression to determine the predictors of elevated nutrition risk. Another longitudinal Canadian study, by Keller (2006), that lasted 18 months examined the relationship between meal programs (such as Meals on Wheels and other meal programs that include a social component, such as congregate dining or supportive housing with dining) and nutrition risk scores in older adults living in southwestern Ontario, Canada. She found that meal programs improved nutrition risk scores between baseline and follow-up 18 months later, and that depression at baseline was associated with increased nutrition risk 18 months later (Keller, 2006). Keller (2006) used Seniors in the Community: Risk Evaluation for Eating and Nutrition to determine nutrition risk and self-reported frequency of depression to determine depression status. In a longitudinal study looking at nutrition risk in men only, five trajectories of nutrition risk were identified over the course of 4 years (Lengyel, Jiang, & Tate, 2017). These trajectory groups differed on mental health, physical aging, self-perceived successful aging, and living alone (Lengyel et al., 2017).

Outside of Canada there have also been longitudinal studies examining nutrition risk. A study in the United Kingdom found an association between baseline nutrition risk scores and lower grip strength at follow-up (Bloom et al., 2021). In a study from Taiwan, being at malnutrition risk at baseline was longitudinally associated with an increased risk of depression at two follow-up points, 4 and 6 years after baseline (Tsai, 2013). A study from New Zealand by Wham, Curnow, and Towers (2022) looked at nutrition risk over the course of 4 years. They found that, at baseline, those at high nutrition risk had poorer mental and physical health than those not at high risk, and those at high risk also had higher depression scores (Wham et al., 2022). Those at high nutrition risk also had lower social connection scores than those not at high risk (Wham et al., 2022). Four years later, those who were at high risk improved their mental health scores, whereas their physical health scores deteriorated (Wham et al., 2022). Depression scores increased for those not at high risk and remained stable for those who were at high risk (Wham et al., 2022).

Theoretical Framework

This study uses social network theory, described by Berkman, Glass, Brissette, and Seeman (2000), as its theoretical framework. Using a theoretical framework helps provide structure and support for research (Osanloo & Grant, 2016) and helps guide research questions (Herek, 2011); however, much of the nutrition risk literature does not use a framework. Social network theory describes how social networks influence health outcomes (Berkman et al., 2000) and suggests that social and cultural contexts (the macro level) influence social networks (the mezzo level), which in turn affect psychosocial mechanisms that comprise social and interpersonal behaviours (the micro level) (Berkman et al., 2000). These psychosocial mechanisms then influence health outcomes (Berkman et al., 2000).

In Berkman et al.'s (2000) social network theory, social networks have characteristics that include their size and range. The ties within these networks include frequency of contact with network members and frequency of participation in community activities (Berkman et al., 2000). Social networks then influence behaviour through psychosocial mechanisms that include the provision of social support, social engagement and attachment, and access to resources and material goods (Berkman et al., 2000).

Social networks may also change as people enter midlife and older adulthood (Infurna, Gerstorf, & Lachman, 2020; Luo & Li, 2022). At midlife, individuals may be caring for aging parents, having their relationships with their children change, and may become grandparents (Infurna et al., 2020). These changes may affect their dietary intake (Booth et al., 2009; Chen & Antonelli, 2020). As people continue to age into older adulthood, social networks continue to change (Ayalon & Levkovich, 2019), frequently becoming smaller (Cornwell, Laumann, & Schumm, 2008; English & Carstensen, 2014) while connections within those networks may become closer or more intimate (English & Carstensen, 2014). These changes may lead to social isolation (Luo & Li, 2022), which may lead to a decrease in food intake (Vesnaver & Keller, 2011).

A variety of health outcomes, both physical and psychological, have been associated with social networks in the literature (Berkman, 2000; Berkman et al., 2000; Smith & Christakis, 2008; Tsai & Papachristos, 2015); therefore, it is hypothesized that social networks may also be associated with the development of high nutrition risk. Many of the social network characteristics and psychosocial mechanisms from social network theory (Berkman et al., 2000) have been associated with nutrition risk and food intake in cross-sectional studies of adults ages 65 and older (Vesnaver & Keller, 2011). Several studies have shown that eating with others improves dietary intake and reduces nutrition risk in older adults (Vesnaver & Keller, 2011), whereas eating alone is associated with high nutrition risk (Bloom et al., 2017; Keller & McKenzie, 2003). Social relationships may also improve nutritional risk by encouraging compliance with dietary norms (Vesnaver & Keller, 2011). Eating with others may provide "social cues for when and what to eat" (Vesnaver & Keller, 2011, p. 15). An individual's social support system may also encourage healthy behaviours, such as consuming adequate amounts of nutrient-rich foods (Locher & Sharkey, 2009). Studies have also found that social support helps reduce nutrition risk (Keller, 2005; Vesnaver & Keller, 2011), whereas low levels of social support are associated with increased nutrition risk (Locher & Sharkey, 2009). Individuals with higher levels of social support may have greater assistance with food-related activities, such as meal preparation and grocery shopping (Vesnaver & Keller, 2011).

While the current literature has identified several factors that contribute to changes in nutrition risk in adults over time, what has not been done is to comprehensively explore the social network factors associated with high nutrition risk or the development of high nutrition risk. This study focuses on the mezzo and micro levels of Berkman et al.'s (2000) social network theory, as social network factors at these levels may be direct upstream determinants of nutrition risk. This study also seeks to add to the literature on longitudinal nutrition risk by examining social network factors associated with the development of high nutrition risk, using data from the Canadian Longitudinal Study on Aging (CLSA). By identifying factors that lead to the development of high nutrition risk, this study hopes to provide guidance for identifying people

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who should be proactively screened for nutrition risk and informing programs and policies designed to prevent high nutrition risk.

The goal is to determine which social network characteristics and psychosocial mechanisms, collectively referred to as *social network factors*, predict the development of high nutrition risk in individuals who were not originally at high risk.

Methods

Data Source

This study uses data from baseline and first follow-up of the CLSA. The CLSA is a large, longitudinal study and participants are followed every 3 years for 20 years or until participants' death (Kirkland et al., 2015). CLSA participants were between the ages of 45 and 85 when recruited between 2010 and 2015, and baseline data were gathered at this time (Raina et al., 2009). First follow-up data, referred to as *follow-up*, were gathered 3 years later (Raina et al., 2009).

The detailed CLSA study design is available elsewhere (Raina et al., 2009). There are 21,241 tracking participants who are followed by telephone interview only, and there are 30,097 comprehensive participants who are interviewed in person, undergo physical assessments, and provide urine and blood samples (Raina et al., 2009). The CLSA randomly selected participants in the tracking cohort within sex and age strata in each Canadian province. The proportion of individuals in the tracking cohort from each province is proportional to the province's population to allow CLSA data to be generalized to a given province's population and the Canadian population (Kirkland et al., 2015; Raina et al., 2009). For this reason, this study uses data from the tracking cohort.

The selection and recruitment process for the CLSA is described elsewhere (Raina et al., 2009). Briefly, the CLSA used three sampling frames for the tracking cohort: a subset of participants from Statistics Canada's Canadian Community Health Survey – Healthy Aging (CCHS-HA), registries from provincial health care systems, and random digit dialling (RDD) of landline telephones (Raina et al., 2019). There was an attempt to over-sample certain regions identified from census data to ensure representation of individuals with lower socio-economic status and less education, since they are often underrepresented in population-based studies (Raina et al., 2019). Residents of the Canadian territories and some remote regions, individuals living on First Nation reserves and settlements, regular force members of the Canadian Armed Forces, and individuals living in institutions, including long-term care homes, are not included in the CLSA (Raina et al., 2019). Participants were required to understand English or French and be physically and cognitively able to answer study questions by themselves (Raina et al., 2019).

The core set of questionnaires in the CLSA is common across both cohorts. Questionnaires ask about demographics, social and psychological measures, health and functional status, lifestyle, and behaviour (Raina et al., 2019). To use a theoretically informed model, CLSA measures were mapped onto the social network factors in Berkman et al.'s (2000) social network theory (Table 1), as several of the social measures gathered by the CLSA had a clear and obvious fit with social network theory. These social network variables were the predictor variables in all analyses, with high nutrition risk as the outcome variable and demographic and health-indicator variables as potential covariates.

The complete list of CLSA measures has been reported elsewhere (Raina et al., 2009). Data from baseline were used for the social network, demographic, health-indicator variables, and data from both baseline and follow-up for nutrition risk.

Table 1. Mapping CLSA variables onto social network theory

Social Network Theory Factors	CLSA Measures
Mezzo level (social networks)	
Social network structure Size Range	Number of children, siblings, friends, relatives, and neighbours Number of people known through work and/or school, community activities, and other activities
Characteristics of network ties Frequency of face-to-face contact	Frequency of face-to-face contact with children, siblings, friends, relatives, and neighbours
Micro level (psychosocial mechanisms)	
Social support	MOS Social Support Survey
Social engagement	Participation in social activities
Access to resources and material goods	Self-rated social standing, household income

Source: Berkman et al. (2000).

Social network variables

Social network size. CLSA participants indicated the number of people in each of these groups: children (biological, adopted, step), siblings, close friends, relatives, and neighbours. Participants also reported the number of people known through work or school, through community involvement, and through other activities.

Frequency of contact with network members. CLSA participants reported when they last got together with members of each of the following groups: children, siblings, close friends, relatives, and neighbours. Responses included: *live with me*, *more than one year ago*, *within the past year*, *within the past six months*, *within the past month*, *within the last week or two*, and *within the last day or two*. Like previous studies (Lin et al., 2020; Mills, Keller, DePaul, & Donnelly, 2023), these were collapsed into two categories: "low contact" for *more than one year ago*, *within the past year*, and *within the past six months*; and "high contact" for *within the last month*, *within the last week or two*, *within the last day or two*, and *live with me*.

Social participation. CLSA participants reported how often they participated in eight different types of activities over the past 12 months. These were: family/friend activities, religious activities, sports or physical activities with others, education or cultural activities, clubs or fraternal organizations, association activities, volunteer or charity work, and other recreational activities. Participants could respond, *never*, *at least once a year*, *at least once a month*, *at least once a week*, and *at least once a day*. Like Harasemiw et al. (2018), the responses for each of these categories were summed to create a social participation variable that could range from 0 to 32, with higher numbers indicating increased frequency of participation.

Social support. Social support was measured using the 19-item MOS Social Support Survey. It measures multiple components of social support, including affection, emotional and informational support, tangible social support, and positive social interaction. The MOS has excellent internal consistency (overall and subscale

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Cronbach alphas ranging from 0.91 to 0.97) and test–retest reliability (ICC = 0.78 after 1 year) (Sherbourne & Stewart, 1991).

Self-rated social standing. Participants were asked to think of a ladder with 10 steps as representing where people stand in their communities. At the top of the ladder (or Step 10) are the people who have the highest standing in their community. At the bottom (or Step 1) are the people who have the lowest standing in their community. Participants were asked, "On which step would you place yourself on this ladder?"

Household income. Participants were asked about their household income from all sources, using the following categories: "less than $20,000," "$20,000–$49,999," "$50,000–$99,999," and "$100,000 or more."

Demographic variables

Demographic measures in the CLSA include age, sex assigned at birth, living situation (alone or with others), marital status, education, and income. For marital status, participants could use one of the following options: single (never married), married/common-law, widowed, divorced, and separated. These were collapsed into three categories: "married/common law," "single (including single, divorced, or separated)," and "widowed." Participants were asked about their highest level of education. This study used the level of education (four levels) variable: "less than secondary school graduation," "secondary school graduation (but no post-secondary)," "some post-secondary," and "post-secondary degree/diploma." Participants were asked about the number of people living in their household, other than the participant. Individuals were categorized as living alone if they indicated no other person resided in their household.

Health-indicator variables

Self-rated general health, mental health, healthy aging, and oral health. These were measured by asking participants: Would you say your health/mental health/healthy aging/oral health is excellent, very good, good, fair, or poor? Like previous studies (Mills et al., 2023; Morrison et al., 2019; Wister, Cosco, Mitchell, Menec, & Fyffe, 2019), these were collapsed into three categories: "fair/poor," "good," and "very good/excellent."

Depression. Depression was measured using the short form of the Center for Epidemiologic Studies – Depression (CES-D10) Scale. The CES-D10 has been used in many large studies and has shown good reliability and validity in adult and older adult populations (Andresen, Malmgren, Carter, & Patrick, 1994). The CES-D10 has a positive correlation with poor health status and a negative correlation with positive affectivity (Andresen et al., 1994).

Disability. Basic activities of daily living (ADL) and instrumental activities of daily living (IADL) were measured using modifications of the questions of the Older Americans Resources and Services (OARS) Multidimensional Assessment Questionnaire. The OARS scale is a valid and reliable tool for use in older adult populations (Fillenbaum, 1985, 1988). Participants were classified into one of five categories, ranging from no functional impairment to total impairment. Like the other health-indicator variables, these were collapsed into three categories: "total/severe impairment," "moderate impairment," and "mild/no impairment."

Nutrition risk

Nutrition risk was measured using the abbreviated version of Seniors in the Community: Risk Evaluation for Eating and Nutrition II (rebranded as SCREEN-8) (Keller, n.d.). Eight questions ask about typical daily eating habits and include questions on weight change, meal skipping, appetite, swallowing, servings of fruit and vegetables, fluid intake, eating with others, and meal preparation (Keller, n.d.). Scores range from 0 to 48 (Keller et al., 2005). When compared to registered dietitians' assessment of nutritional risk, SCREEN-8 has good specificity and sensitivity with an AUC ≥ 78 per cent. The test–retest reliability of SCREEN-8 with adults ages 50 and older is good, with ICC = 0.84, as is the inter-rater reliability, with ICC = 0.79. A SCREEN-8 score less than 38 indicates that an individual is at high nutrition risk (Keller et al., 2005). The development of high nutrition risk (SCREEN-8 score < 38) at follow-up was the outcome of interest.

Data Analysis

The primary analytic strategy was hierarchical multivariable binomial regression, as the outcome variable for all analyses was the presence or absence of high nutrition risk at follow-up, thus the outcome variable had two levels (Osborne, 2015). For all analyses, weighting was applied to the data, as recommended by the CLSA (Canadian Longitudinal Study on Aging, 2011). Due to the large sample size, the significance level was set at ? ≤ 0.001, and confidence intervals (CI), odds ratios (OR), and effect sizes were reported (Khalilzadeh & Asli, 2017). Data were analysed using IBM SPSS Statistics, Version 28 (IBM Corp, 2022) and RStudio Version 2022.02.3 (RStudio Team, 2022).

First, univariate analyses were run in SPSS to obtain descriptive statistics for each variable used in the regression analyses. Individuals in the sample were then classified into two groups: those who were at high nutrition risk and those who were not at high nutrition risk at baseline. For the social network, demographic, and health-indicator variables, comparisons were made between those at high risk at baseline and those not at high risk. Independent sample t-tests were used for continuous variables and χ^2 tests for categorical variables. Effect sizes were calculated, using Cohen's d for continuous variables and Cramer's V for categorical variables (Durlak, 2009). The proportion of missing data for all variables and the patterns of missingness were examined in RStudio using the package naniar (Tierney & Cook, 2023). This package and Little's (1988) test were also used to determine whether cases were missing completely at random.

For the logistic regression analyses, the assumption of linearity of the continuous variables with respect to the logit of the dependent variables was tested using the Box-Tidwell procedure (Box & Tidwell, 1962). Two multivariable binomial logistic regression analyses were run for all participants; the first had the presence or absence of high nutrition risk at baseline as the outcome variable, and the second had the presence or absence of high nutrition risk at follow-up as the outcome variable. The social network variables were the predictor variables, and potential covariates included the demographic and health-indicator variables.

Development of High Nutrition Risk at Follow-up In Those Not at High Risk at Baseline

Using data from participants who were not at high nutrition risk at baseline, bivariate odds ratios between the presence of high nutrition risk at follow-up and social network, demographic, and health-indicator variables at baseline were calculated. Hierarchical binomial logistic regression was conducted, to first examine which social network variables were associated with the development of high nutrition risk, then to examine which social network variables were associated with the development of high nutrition risk when demographic variables were added as potential covariates, and,

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finally, to examine which social network variables were associated with the development of high nutrition risk when both demographic and health-indicator variables were added as potential covariates. Therefore, three binomial logistic regression analyses were run with the development of high nutrition risk at follow-up as the outcome variable. The first analysis had the social network variables at baseline as the predictors, the second analysis added demographic variables as potential covariates to the social network variables, and the third analysis added health-indicator variables as potential covariates to the social network and demographic variables. The sensitivity, specificity, and accuracy for each of the analyses were calculated. The McFadden pseudo-R^2 (ρ^2) was used to calculate whether the analyses were a good fit, as McFadden states that a ρ^2 between .4 and .6 indicates an excellent fit (McFadden, 1979). Odds ratios were reported for all the predictor variables and covariates.

Sensitivity Analysis

Multiple imputation of missing data (Rubin, 2004) was performed using RStudio and the package mice (van Buuren & Groothuis-Oudshoorn, 2011) to assess the potential for bias due to missing values (Supplemental Table 4). The mice package uses fully conditional specification (FCS) to conduct multiple imputation. This method is also known as *multivariate imputation by chained equations (MICE)* (van Buuren & Groothuis-Oudshoorn, 2011). MICE is practical and flexible and uses a series of regression models for each variable with missing data (Azur, Stuart, Frangakis, & Leaf, 2011; White, Royston, & Wood, 2011). This method can handle a variety of different variable types, including continuous and categorical variables (Azur et al., 2011; van Buuren & Groothuis-Oudshoorn, 2011; White et al., 2011). All variables included in the regression analyses were included in the imputation model, as recommended (White et al., 2011; Wulff & Ejlskov, 2017). Twenty imputations were used as recommended in the literature (Sterne et al., 2009; White et al., 2011). After multiple imputation, the third analysis (social network, demographic, and health-indicator variables as predictors) was re-run. The package mice (van Buuren & Groothuis-Oudshoorn, 2011) was used to obtain the pooled regression results and odds ratios.

Results

Sample Description

Of the 21,241 participants in the baseline tracking sample, 17,051 provided data at follow-up, and that sample is used here. There were confirmed deaths for 1,165 participants (5.5%). For sex assigned at birth, there were approximately equal percentages of males and females (47.8% males). The mean age of the participants was 59.46 (SD = 9.94). Most participants were married or partnered (76.5%). At baseline, 36.5 per cent of all participants were at nutrition risk and 42.2 per cent were at risk at follow-up. A paired sample t-test found that there was a difference between SCREEN-8 scores at baseline and at follow-up between individuals who were not at high nutrition risk and those who were at high nutrition risk at baseline, and the effect sizes were very large (Table 2). Among those who were not at high nutrition risk at baseline, 27.4 per cent developed high nutrition risk at follow-up. Further details on the social network, demographic, and health-related variables are shown in Table 2. Comparing those who were not at high nutrition risk at baseline to those who were at high risk, individuals who were not at high risk had higher levels of social participation, higher self-rated social standing, greater social support, and better self-rated health and healthy aging, although the effect sizes were small (Cohen, 1992; McHugh, 2018).

The proportion of missing data was examined. For nutrition risk, 13.1 per cent of the sample was missing SCREEN-8 scores at baseline and 19.7 per cent at follow-up (Supplemental Table 1). Out of 17,051 participants for whom there were data, 9,437 (44.4%) participants had complete data on all the variables of interest. Little's Missing Completely at Random test (Little, 1988) was not statistically significant (χ^2 = 29703.91, p = .394), therefore the complete case analysis is reported here.

Logistic Regression Analyses

There was no multicollinearity among the variables used in the analyses for all the analyses conducted, as all variables had a variance inflation factor value below 4 (Harris, 2021). All continuous independent variables were linearly related to the logit of the dependent variables (Osborne, 2015). There were no outliers (no cases with standardized residuals above three standard deviations) (Osborne, 2015).

High Nutrition Risk at Baseline

At baseline, among all participants, 36.5 per cent were at high nutrition risk. The results of the analysis examining the variables at baseline that examined the presence or absence of high nutrition risk at baseline can be found in the supplemental materials (Supplemental Table 3). Among the social network variables, lower levels of social participation, lower self-rated social standing, and lower levels of social support at baseline were associated with increased odds of being at high nutrition risk at baseline.

High Nutrition Risk at Follow-Up

At follow-up, among all participants, 42.2 per cent were at high nutrition risk. The results of the analysis examining the variables at baseline that examined the presence or absence of high nutrition risk at follow-up can be found in the supplemental materials (Supplemental Table 4). Among the social network variables, lower levels of social participation, lower self-rated social standing, and lower levels of social support at baseline were associated with increased odds of being at high nutrition risk at follow-up.

Bivariate Analysis

Among those who were not at high nutrition risk at baseline, 27.4 per cent developed high nutrition risk at follow-up (see Table 2). In the bivariate analyses examining the relationship between the predictor variables at baseline and the development of high nutrition risk at follow-up in those who were not at high nutrition risk at baseline, the SCREEN-8 score at baseline was associated with the development of high nutrition risk at follow-up (Supplemental Table 5). All the social network variables were associated with the development of high nutrition risk, except for the number of children and siblings, and all the frequency of contact variables. Among the demographic variables, all were associated with the development of high nutrition risk at follow-up, except for age and sex assigned at birth. All the health-indicator variables were associated with the development of high nutrition risk at follow-up.

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Table 2. Population characteristics, overall and by nutrition risk

Characteristic	Population Estimates at Baseline[a]			Comparing Those at High Risk and Not at High Risk at Baseline	
	Overall	Not at high nutrition risk (*n* = 11,032)	At high nutrition risk (*n* = 6,019)	Effect size[c]	*p*-value
SCREEN-8 score at baseline, mean (SD)	38.66 (6.40)	42.58 (2.90)	31.85 (4.95)	2.89**	< .0001
SCREEN-8 score at follow-up, mean (SD)	37.87 (6.61)	40.14 (5.30)	33.87 (6.84)	1.06**	< .0001
At nutrition risk at baseline, % (*n*)	36.5 (6019)	0.0	100.0		
At nutrition risk at follow-up, % (*n*)	42.2 (7195)	27.4 (3023)	67.9 (4087)		
Age, mean (SD)	59.88 (10.29)	60.00 (10.18)	59.41 (10.22)	.063	< .0001
Social participation, mean (SD)	10..07 (4.66)	10.70 (4.57)	9.30 (4.60)	.316*	< .0001
Self-rated social standing, mean (SD)	6.01 (1.98)	6.19 (1.88)	5.69 (2.11)	.288*	< .0001
Social support, mean (SD)	83.30 (17.64)	86.06 (15.19)	79.28 (20.10)	.407*	< .0001
Number of living children, mean (SD)	2.31 (1.53)	2.34 (1.48)	2.24 (1.55)	.058	< .0001
Number of living siblings, mean (SD)	3.10 (2.44)	3.06 (2.40)	3.08 (2.42)	-.023	.132
Number of living relatives, mean (SD)	38.44 (30.61)	39.00 (30.52)	38.10 (30.80)	.023	.146
Number of close friends, mean (SD)	5.85 (8.01)	5.99 (7.56)	5.58 (8.47)	.059	< .0001
Number of neighbours, mean (SD)	11.01 (14.21)	11.51 (14.02)	10.13 (13.95)	.099	< .0001
Number of people known through work or school, mean (SD)	50.28 (40.95)	52.37 (40.76)	48.00 (40.91)	.105	< .0001
Number of people known through community involvement, mean (SD)	34.00 (37.83)	36.20 (38.14)	31.90 (37.53)	.128	< .0001
Number of people known through other activities, mean (SD)	22.76 (33.21)	24.19 (33.88)	21.54 (32.65)	.076	< .0001
Frequency of contact with children, % (*n*)				.026	< .0001
High contact	88.6 (15107)	89.8 (9907)	87.9 (5291)		
Low contact	11.4 (1944)	10.2 (1125)	12.1 (728)		
Frequency of contact with siblings, % (*n*)				.011	.138
High contact	55.7 (9497)	56.4 (6222)	55.8 (3359)		
Low contact	44.3 (7554)	43.6 (4810)	44.2 (2660)		
Frequency of contact with relatives, % (*n*)				.024	.001
High contact	55.2 (9412)	56.3 (6211)	54.5 (3280)		
Low contact	44.8 (7639)	43.7 (4821)	45.5 (2739)		
Frequency of contact with friends, % (*n*)				.016	.038
High contact	87.7 (14954)	87.8 (9686)	87.6 (5273)		
Low contact	12.3 (2097)	12.2 (1346)	12.4 (746)		
Frequency of contact with neighbours, % (n)				.008	.277
High contact	63.9 (10913)	63.9 (7049)	63.6 (3828)		
Low contact	36.0 (6138)	36.1 (3983)	36.4 (2191)		
Sex, % (*n*)				.034	< .0001
Female	51.8 (8832)	50.6 (5582)	54.4 (3274)		
Male	48.2 (8219)	49.4 (5450)	45.6 (2745)		
Marital status, % (*n*)				.169	< .0001
Married/partnered	75.0 (12788)	81.8 (9024)	67.5 (4063)		
Single	17.7 (3018)	12.6 (1390)	23.6 (1420)		
Widowed	7.3 (1245)	5.6 (618)	8.9 (536)		
Highest educational level, % (*n*)				.094	< .0001
Post-secondary degree/diploma	56.5 (9634)	61.7 (6807)	51.4 (3094)		
Some post-secondary	8.5 (1449)	8.5 (938)	9.3 (560)		

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Table 2. *Continued*

Characteristic	Population Estimates at Baseline[a]			Comparing Those at High Risk and Not at High Risk at Baseline	
	Overall	Not at high nutrition risk (n = 11,032)	At high nutrition risk (n = 6,019)	Effect size[c]	p-value
Secondary	14.6 (2489)	13.3 (1467)	16.2 (975)		
Less than secondary	20.4 (3479)	16.5 (1820)	23.1 (1390)		
Household income, % (n)				.158	< .0001
$100,000 or more	30.7 (5235)	35.8 (3949)	25.9 (1559)		
$50,000–99,999	35.7 (6087)	37.0 (4082)	34.8 (2095)		
$20,000–49,999	26.8 (4570)	23.4 (2581)	30.2 (1818)		
Less than $20,000	6.8 (1159)	3.8 (419)	9.0 (542)		
Living situation, % (n)				.158	< .0001
Does not live alone	83.8 (14289)	89.2 (9841)	77.4 (4659)		
Lives alone	16.2 (2762)	10.8 (1191)	22.6 (1360)		
Depression, % (n)				.170	< .0001
Screened negative for depression	81.9 (13965)	87.7 (9675)	74.5 (4484)		
Screened positive for depression	18.1 (3086)	12.3 (1357)	25.5 (1535)		
Self-rated general health, % (n)				.231*	< .0001
Very good/excellent	55.9 (9532)	64.5 (7116)	44.4 (2672)		
Good	30.1 (5132)	27.3 (3012)	34.8 (2095)		
Fair/poor	14.0 (2387)	8.2 (905)	20.8 (1252)		
Self-rated mental health, % (n)				.179	< .0001
Very good/excellent	67.8 (11560)	74.3 (8197)	59.7 (3593)		
Good	26.6 (4536)	23.0 (2537)	31.2 (1878)		
Fair/poor	5.6 (955)	2.7 (298)	9.1 (548)		
Self-rated healthy aging, % (n)				.230*	< .0001
Very good/excellent	57.5 (9821)	66.4 (7325)	45.2 (2721)		
Good	31.2 (5320)	27.0 (2979)	38.2 (2299)		
Fair/poor	11.2 (1910)	6.6 (728)	16.6 (999)		
Disability, % (n)				.072	< .0001
Mild/no impairment	98.5 (16795)	99.4 (10966)	97.7 (5881)		
Moderate impairment	1.0 (171)	0.4 (44)	1.7 (102)		
Total/severe impairment	0.5 (85)	0.1 (11)	0.6 (36)		
Self-rated oral health, % (n)				.184	< .0001
Very good/excellent	66.8 (11390)	73.7 (8131)	56.8 (3419)		
Good	24.4 (4161)	20.7 (2284)	29.8 (1794)		
Fair/poor	8.8 (1500)	5.5 (607)	13.4 (807)		
Age group, % (n)				.043	< .0001
45–54	38.1 (6496)	37.3 (4115)	40.7 (2450)		
55–64	31.4 (5354)	32.1 (3541)	31.3 (1884)		
65–74	19.0 (3240)	19.9 (2195)	17.6 (1059)		
75 and over	11.5 (1961)	10.8 (1191)	10.4 (626)		
Status at follow-up[b], % (n)					
Provided follow-up data	80.3 (17051)				
Withdrawn	6.0 (1266)				

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Table 2. *Continued*

Characteristic	Population Estimates at Baseline[a]			Comparing Those at High Risk and Not at High Risk at Baseline	
	Overall	Not at high nutrition risk (n = 11,032)	At high nutrition risk (n = 6,019)	Effect size[c]	p-value
No follow-up data	12.0 (2546)				
Data in preparation	1.8 (379)				
Confirmed death	5.5 (1165)				

Notes:[a]Population estimates calculated using trimmed inflation weights.
[b]Raw data, not weighted.
[c]Effect size for the difference between those at high nutrition risk at baseline and those not at high risk – Cohen's d for continuous variables and Cramer's V for categorical variables.
*Small effect size.
**Very large effect size.

Development of High Nutrition Risk at Follow-Up in Those Not at High Risk at Baseline

The first analysis, which used the social network variables to examine the development of high nutrition risk at follow-up in those not at high risk at baseline, was statistically significant (χ^2 = 5294.7, $p < .0001$). The McFadden pseudo-R^2 was .406, indicating an excellent fit (McFadden, 1979). The accuracy was 77.4 per cent, the sensitivity was 40.9 per cent, and the specificity was 77.5 per cent. Higher levels of social participation, social support, and household income were associated with lower odds of developing high nutrition risk (Table 3).

The second analysis added demographic variables as potential covariates to the social network variables. This analysis examining the development of high nutrition risk was statistically significant (χ^2 = 5344.0, $p < .0001$). The McFadden pseudo-R^2 was .410, indicating an excellent fit (McFadden, 1979). The accuracy was 77.4 per cent, the sensitivity was 46.5 per cent, and the specificity was 77.6 per cent. Higher social participation, self-rated social standing, and social support were associated with lower odds of developing high nutrition risk (see Table 3).

The third analysis added health-indicator variables as potential covariates to the social network variables and demographic covariates. This analysis examining the development of high nutrition risk was statistically significant (χ^2 = 5515.1, $p < .0001$). The McFadden pseudo-R^2 was .423, indicating an excellent fit (McFadden, 1979). The accuracy was 77.4 per cent, the sensitivity was 50.0 per cent, and the specificity was 77.9 per cent.

Among the social network variables, in the analysis that included the social network, as well as the demographic and health-indicator variables as potential covariates, social support was a statistically significant predictor. For every 1-point increase in social support, the odds of developing high nutrition risk decreased by .99. None of the demographic variables were associated with the development of high nutrition risk. Among the health-indicator variables, depression, self-rated healthy aging, and self-rated oral health were associated with the development of high nutrition risk. Those who screened positive for depression had 1.36 odds of developing high nutrition risk, compared to those who screened negative for depression. Those with a self-rated healthy aging of "good" or "fair/poor," compared to those with a self-rated healthy aging of "very good/excellent," had 1.49 and 1.69 odds, respectively, of developing high nutrition risk. Those with a self-rated oral health of "good," compared to "very good/excellent," had 1.27 odds of developing high nutrition risk (see Table 3).

Sensitivity Analysis

Compared to the complete cases, those with missing data differed on all the social network variables, except for the frequency of contact with neighbours; however, the effect sizes were all small or trivial (Cohen, 1992; Ferguson, 2009). Among the demographic variables, age, marital status, living situation, and education attainment differed between the two groups, but again the effect sizes were small or trivial (Ferguson, 2009). SCREEN-8 scores at baseline and at follow-up also differed between the complete cases and those with missing data; however, the effect size was trivial (Ferguson, 2009) (Supplemental Table 2).

Development of High Nutrition Risk in Those Not at Risk at Baseline

After multiple imputation, the logistic regression analysis that included the social network, demographic, and health-indicator variables, that examined the development of high nutrition risk at follow-up in those not at high risk at baseline, had several differences compared to the complete case analysis (Supplemental Table 6). After multiple imputation, social participation, sex assigned at birth, educational attainment, marital status, and self-rated general health became associated with the development of high nutrition risk.

Discussion

This study builds on the literature examining nutrition risk longitudinally by using a theoretical framework to explore factors that contribute to the development of high nutrition risk in individuals who were originally not at high risk, using a nationally representative sample of Canadian adults ages 45 and older. This study found that 36.5 per cent of the sample was at high nutrition risk at baseline, similar to previous Canadian studies that used SCREEN-8 and found that 32.5 per cent of community-dwelling Canadians ages 55 and older (Morrison et al., 2019) and 34.2 per cent of community-dwelling Canadians ages 65 and older (Ramage-Morin & Garriguet, 2013) were at high nutrition risk. Other studies, using SCREEN-14 (which adds six questions to the questions in SCREEN-8), have found a higher prevalence of high nutrition risk in community-dwelling adults ages 65 and older: 61.5 per cent in the Netherlands, 68.2 per cent in New Zealand, and 70.1 per cent in Canada (Borkent, Keller, Wham, Wijers, & de van der schueren,

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Table 3. Logistic regression analyses examining the development of high nutrition risk at follow-up in those not at risk at baseline

	Social Network Variables			Social Network and DemographicVariables			Social Network, Demographic, and Health-indicator Variables		
Characteristic	Odds ratio	95% CI	*p*-value	Odds ratio	95% CI	*p*-value	Odds ratio	95% CI	*p*-value
Social participation	.97**	.95, .98	<.0001	.97**	.95, .98	<.0001	.98	.96, .99	.002
Self-rated social standing	.95	.922, .98	.002	.947*	.918, .98	<.001	.96	.934, .996	.027
Social support	.99**	.98, .99	<.0001	.99**	.98, .99	<.0001	.99*	.99, .997	<.001
Number of living children	1.037	.99, 1.082	.096	1.041	.996, 1.088	.074	1.045	.999, 1.092	.055
Number of living siblings	.97	.947, 1.000	.049	.97	.943, .996	.025	.97	.941, .995	.022
Number of living relatives	1.010	1.003, 1.018	.007	1.011	1.003, 1.018	.007	1.011	1.004, 1.019	.004
Number of close friends	1.001	.999, 1.003	.214	1.001	.999, 1.003	.277	1.001	.999, 1.003	.344
Number of neighbours	1.003	1.000, 1.007	.050	1.003	1.000, 1.007	.058	1.003	1.000, 1.007	.072
Number of people known through work or school	1.000	.998, 1.001	.893	1.000	.998, 1.001	.589	1.000	.998, 1.001	.779
Number of people known through community involvement	1.001	.999, 1.003	.235	1.001	.999, 1.003	.159	1.001	.999, 1.003	.271
Number of people known through other activities	1.000	.998, 1.002	.925	1.000	.998, 1.002	.824	1.000	.998, 1.001	.696
Frequency of contact with children									
High contact	—	—		—	—		—	—	
Low contact	0.99	.824, 1.180	.893	0.98	.818, 1.174	.840	.97	.805, 1.162	.740
Frequency of contact with siblings									
High contact	—	—		—	—		—	—	
Low contact	.99	0.873, 1.113	.823	0.99	0.876, 1.118	.867	.98	.862, 1.105	.704
Frequency of contact with friends									
High contact	—	—		—	—		—	—	
Low contact	.97	0.802, 1.161	.720	0.98	0.814, 1.181	.855	.99	.820, 1.198	.944
Frequency of contact with relatives									
High contact	—	—		—	—		—	—	
Low contact	.99	0.876, 1.116	.858	0.98	0.871, 1.112	.800	.99	.874, 1.120	.872
Frequency of contact with neighbours									
High contact	—	—		—	—		—	—	
Low contact	1.011	0.895, 1.141	.859	1.013	0.896, 1.143	.842	1.025	.905, 1.159	.700
Household income									
$100,000 or more	—	—		—	—		—	—	
$50,000 or more, but less than $100,000	1.100	0.97, 1.253	.153	1.084	0.946, 1.241	.246	1.031	.898, 1.183	.667
$20,000 or more, but less than $50,000	1.337*	1.141, 1.566	<.001	1.233	1.032, 1.471	.021	1.115	.930, 1.335	.238
Less than $20,000	1.844*	1.267, 2.662	.001	1.471	0.98, 2.185	.058	1.169	.772, 1.757	.456
Age				.995	0.99, 1.003	.215	.998	.99, 1.005	.552
Sex									
Male				—	—		—	—	
Female				.864	0.769, 0.97	.014	.892	.792, 1.005	.060
Marital status									
Married				—	—		—	—	
Single (single, divorced, separated)				1.291	1.019, 1.627	.033	1.277	1.005, 1.615	.044

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Table 3. *Continued*

	Social Network Variables			Social Network and DemographicVariables			Social Network, Demographic, and Health-indicator Variables		
Characteristic	Odds ratio	95% CI	*p*-value	Odds ratio	95% CI	*p*-value	Odds ratio	95% CI	*p*-value
Widowed				1.170	0.834, 1.629	.359	1.177	.836, 1.648	.346
Living situation									
Do not live alone				—	—		—	—	
Live alone				1.175	0.879, 1.572	.276	1.240	.923, 1.667	.154
Education									
Post-secondary degree or diploma				—	—		—	—	
Some post-secondary education				1.218	0.98, 1.511	.077	1.196	.96, 1.488	.114
Secondary school graduation, no post-secondary education				1.309	1.101, 1.553	.002	1.294	1.086, 1.539	.004
Less than secondary				1.332	1.022, 1.727	.032	1.242	.947, 1.618	.113
Depression									
Screen negative for depression							—	—	
Screen positive for depression							1.358*	1.130, 1.628	<.001
Self-rated health									
Very good or excellent							—	—	
Good							1.112	.949, 1.301	.186
Poor or fair							1.284	.97, 1.685	.074
Self-rated mental health									
Very good or excellent							—	—	
Good							1.051	.901, 1.225	.523
Poor or fair							1.054	.735, 1.500	.773
Self-rated healthy aging									
Very good or excellent							—	—	
Good							1.488*	1.280, 1.728	<.001
Poor or fair							1.694*	1.271, 2.253	<.001
ADLs and IADLs									
Mild or no impairment							—	—	
Moderate impairment							1.160	.458, 2.813	.745
Total or severe impairment							.450	.033, 2.834	.443
Oral health									
Very good or excellent							—	—	
Good							1.265*	1.098, 1.456	.001
Poor or fair							1.210	.920, 1.582	.168
Sensitivity	40.9%			46.5%			50.0%		
Specificity	77.5%			77.6%			77.9%		
Accuracy	77.4%			77.4%			77.4%		
Cox and Snell pseudo-R^2	.553			.557			.570		
Nagelkerke pseudo-R^2	.641			.646			.660		
McFadden pseudo-R^2	.406			.410			.423		

Notes:$p \leq 0.001$.
**$p \leq 0.0001$.

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2020); and 65 per cent in Sweden (Westergren, Khalaf, & Hagell, 2015) and 67 per cent in the Netherlands (Haakma & Wham, 2015). These studies, using SCREEN-14, all found a higher prevalence of high nutrition risk than the current study did at follow-up (42.2%). A 2023 study that used the CLSA comprehensive cohort (the study presented here used the tracking cohort) found that 29.0 per cent of participants were at high nutrition risk at baseline, 35.6 per cent were at high nutrition risk at follow-up, and 17.3 per cent of those who were not at high risk at baseline developed a high risk at follow-up (Keller & Trinca, 2023). While these percentages are lower than those found for the tracking cohort, participants in the comprehensive cohort are more educated and have higher household incomes compared to the Canadian population, whereas the tracking cohort is representative of each province's population (Raina et al., 2019). Further, participants in the comprehensive CLSA cohort had to be able to visit the urban academic test centres, and thus underrepresent Canadians who live in small urban and rural communities (Raina et al., 2019).

In this study, social support was associated with the development of high nutrition risk at follow-up in individuals who were not at high risk at baseline. Higher levels of social support at baseline were associated with lower odds of developing high nutrition risk at follow-up in all three analyses. Social participation was also a predictor of the development of high nutrition risk at follow-up in the analysis that included only the social network variables and in the analysis that included the social network and demographic variables, but not in the analysis that included the social network, demographic, and health-indicator variables. Greater social participation was associated with lower odds of developing high nutrition risk.

Previous Canadian studies have found that low social support (Johnson, 2005; Ramage-Morin & Garriguet, 2013) and infrequent social participation (Ramage-Morin & Garriguet, 2013) were associated with nutrition risk in adults ages 65 and older. Other studies have also found that having low levels of social support is associated with increased nutrition risk (Locher et al., 2005; Locher & Sharkey, 2009). Social support may affect nutrition risk in several ways. First, healthy behaviours such as consuming adequate amounts of nutrient-rich foods may be encouraged by an individual's social support system (Locher & Sharkey, 2009). Additionally, if an individual requires assistance with food-related activities, such as grocery shopping or meal preparation, adequate social support can ensure these needs are met (Keller, 2005). Higher levels of social support and increased social participation may also provide an individual with more opportunities to eat with others. Eating with others improves food intake (de Castro, 1994), whereas eating alone is a well-known risk factor for poor nutrition and food intake (Bloom et al., 2017; Keller & McKenzie, 2003; Vesnaver & Keller, 2011). Eating with others can reinforce social norms around food and eating, for example, by providing cues for mealtimes and appropriate food intake (Vesnaver & Keller, 2011). Even after adjusting for demographic and health-related variables that have been shown to influence nutrition risk, social support remained a significant predictor of the development of high nutrition risk, lending further support to the idea that social relationships play a key role in food and eating behaviours.

Social participation may also be associated with health status and therefore affect nutrition risk. As adequate nutrition is important for the maintenance of good health and well-being (Herman et al., 2014), individuals who are not at high nutrition risk may have better health than those at risk (see Table 2). Here, those who were not at high nutrition risk at baseline had higher self-rated general health than those who were at high risk. Therefore, individuals who are not at high nutrition risk may have better health and may therefore be able to participate in a greater number of community activities.

This study found that screening positive for depression was associated with higher odds of developing high nutrition risk in the analysis that included the social network, demographic, and health-indicator variables. Previous longitudinal studies have found an association between depression and increased nutrition risk (Keller, 2006; Tsai, 2013). Other studies have also found this association (Wham et al., 2015; Wham et al., 2022; Wham, Carr, & Heller, 2011). Depression may lead to a loss of appetite and reduced food intake (Ávila-Funes, Gray-Donald, & Payette, 2008; de Boer et al., 2013), resulting in weight loss and nutrition risk. Those with fewer social connections and lower social support may also be at increased risk for developing depression (Courtin & Knapp, 2017; Gariépy, Honkaniemi, & Quesnel-Vallée, 2016). Similarly, those who are depressed may engage in fewer social activities, and thus have fewer opportunities to eat with others. There is therefore a complex relationship between social support, social participation, and depression, and these can all affect nutrition risk.

Self-rated healthy aging was associated with the development of high nutrition risk at follow-up in the analysis that included the social network, demographic, and health-indicator variables. Those who rated their self-rated healthy aging lower had higher odds of developing high nutrition risk at follow-up. A previous Canadian study also found an association between increased nutrition risk and lower self-rated successful aging (Lengyel, Tate, & Bayomi, 2014). Individuals with higher self-rated healthy aging may find it easier to complete food-related tasks, such as meal preparation and grocery shopping. The consumption of a healthy diet, and therefore the absence of high nutrition risk, could also lead an individual to rate their healthy aging as higher. Not being at high nutrition risk may be both a cause and a consequence of healthy aging.

There were many more social network, demographic, and health-indicator variables associated with the development of high nutrition risk in the bivariate analyses. It is possible that some of these variables are consequences of nutrition risk, as opposed to potential causes. It is also possible that there are additional factors affecting these social network, demographic, and health-related variables, and nutrition risk. Other factors have been associated with high nutrition risk in cross-sectional studies, such as driving status, number of medications used daily, type of housing, satisfaction with income, and satisfaction with social support (Ramage-Morin et al., 2017; Roberts et al., 2007). These variables were not included in the analyses presented here as they either were not available in the CLSA data or not part of Berkman et al.'s (2000) theoretical framework. It is likely that some of these additional variables could also be predictors of high nutrition risk.

Strengths and Limitations

One strength of this study is the use of CLSA data, which is a large, representative sample of the Canadian population ages 45 and older (Raina et al., 2009). As there are currently two waves of CLSA data available, nutrition risk was able to be examined longitudinally. As CLSA will follow participants every 3 years for 20 years or until participants' death, additional longitudinal analyses can be completed in the future. This longitudinal data will also allow trajectories of nutrition risk to be explored in future research.

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Another strength is that the CLSA measures were chosen in collaboration with expert working groups (Kirkland et al., 2015; Raina et al., 2009; Raina et al., 2019). The measures were chosen based on many factors, including feasibility, practicality, and availability of tools in English and French (Raina et al., 2009, Raina et al., 2019). Other considerations included relevance across the age groups included in the CLSA (45 to 85) and the psychometric properties of the measures, including sensitivity, specificity, and responsiveness (Raina et al., 2009, Raina et al., 2019). The CLSA used validated questionnaires when available in both English and French (Raina et al., 2009, Raina et al., 2019). When there was no validated questionnaire available, the CLSA used established questionnaires from national surveys such as Statistics Canada's CCHS (Raina et al., 2009, Raina et al., 2019). Thus, the measures used in the research presented here all have good validity and reliability or have been used in national Canadian surveys.

Despite these strengths, there are some limitations to the CLSA data. For example, not all social activities were captured in the CLSA data set. Similarly, the CLSA only captured frequency of face-to-face contact and not other forms of contact such as telephone calls, e-mails, or connecting through social media sites or other Internet programs. This may affect the generalizability of the results to other populations.

While the CLSA is representative of Canadian provincial residents, several groups were excluded. Full-time members of the Canadian Armed Forces, those living in the territories and in some remote areas, and those living on First Nation reserves and settlements (Raina et al., 2019) were not included in the CLSA. Additionally, only those who can speak English or French and those with the capability to answer the questions themselves were included in the CLSA (Raina et al., 2019). The tracking cohort also consists primarily of Canadians who indicated that their cultural/racial background is white (97.40%) (Canadian Longitudinal Study on Aging, n.d.).

While several CLSA measures mapped onto the factors in Berkman et al.'s social network theory (Berkman et al., 2000), there are other social network factors that were not captured in the CLSA. Inclusion of additional mezzo and micro level factors may have resulted in better models and should be explored in future research. Factors at the macro level could also affect nutrition risk, and these should be explored in future research, as should additional factors that have been associated with nutrition risk in other studies.

It should be noted this study included adults ages 45 and older, whereas most other studies included only adults ages 65 and older – although a previous study using CLSA data included adults ages 55 and older (Morrison et al., 2019). This younger age group was purposely included so future research can explore how their nutrition risk continues to change, particularly as they enter older adulthood. Future research will explore how the development of high nutrition risk varies for different age groups.

Conclusions

This study examined factors that were associated with the development of high nutrition risk in Canadian adults ages 45 and older, using data from the CLSA. The analyses, based on Berkman et al.'s social network theory (Berkman et al., 2000), found that low social participation and social support were associated with the development of high nutrition risk in the analysis that looked at only social network variables and in the analysis that looked at social network and demographic variables, that low social support was associated with the development of high nutrition risk in all three analyses (social network; social network and demographic; and social network, demographic, and health-indicator variables), and that depression and fair/poor self-rated healthy aging were associated with the development of high nutrition in the analysis that included social network, demographic, and health-indicator variables. Designing programs and policies that encourage social participation, provide social support, address depression, and encourage healthy aging may therefore help prevent the development of high nutrition risk. Canada's Food Guide (Health Canada, 2019), for example, recognizes the importance of eating with others. The Canadian Malnutrition Task Force (Keller, Donnelly, Laur, Goharian, & Nasser, 2021) also recommends referral to meal-based programs or shopping and meal preparation assistance when an individual is at high nutrition risk. Congregate meal programs have been shown to improve nutritional status (Keller, 2006) and provide opportunities for socialization. Further research should evaluate additional interventions designed to prevent high nutrition risk.

As high nutrition risk is associated with increased morbidity and mortality (Keller & Østbye, 2003; Ramage-Morin et al., 2017), it is important to help individuals who are not at high nutrition risk to remain not at risk. Individuals with low social participation, low social support, depression, and low self-rated healthy aging should also be screened proactively for high nutrition risk. Future research should examine additional factors associated with the development of high nutrition risk and should use future waves of CLSA data to continue to explore predictors of nutrition risk longitudinally.

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The AB SCREEN™ II, rebranded as SCREEN-8, assessment tool is owned by Dr. Heather Keller. Use of the AB SCREEN™ II assessment tool was made under license from the University of Guelph.

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