

# Determinants of eating habits among older adults

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**Summary.** Old people suffer from many non-communicable diseases which are mainly consequences of their improper eating habits. Among older adults, eating habits are in turn affected by health status and biological changes shaped by aging which are mediated by a larger pool of factors including familial, social and economic factors. The aim of this article is to review and summarise literature on some key determinants of eating habits of older adults which can be viewed from an individual level, societal and family level as well as economic level which may be useful when designing intervention programs among older adults. Recent developments and updated scientific evidence pertaining to eating habits are critically analysed to gain insight into main factors that influence eating habits of old people. In particular, individual components such as gender, physical activity level (PAL), nutrition knowledge (NK), health and oral status in addition to other determinants such as income, socio-economic status (SES), household composition, marital status and culture that have been documented to influence eating habits of older adults. For example healthier eating habits and better health status have been reported among married older adults and those with high SES, PAL, and NK.

**Key words:** eating habits, socioeconomic status, older adults

## Introduction

The number of adults worldwide aged 60 years and older is expected to more than triple by 2100, increasing from 841 million in 2013 to 2 billion in 2050 and close to 3 billion in 2100 (1, 2). In the past century, the leading causes of death have shifted from infectious diseases to chronic diseases such as cardiovascular disease, diabetes, adult bone loss and cancer and these are well known to have a link with poor eating habits (3, 4). Eating habit is indispensable for population-level health promotion and for chronic disease management. However, as adults age, they tend to eat nutritionally suboptimal diets in terms of reduced variety and fewer vegetables, and thus are unable to meet healthy dietary recommendations (5). As there is a worldwide increase in the number of older adults, so does the need to identify the factors which influence eating habits and consequently how eating habits affect quality of life and survival (3) as well as to develop

public health policy in dealing with chronic disease and in supporting well-being through older age (5).

It is recognised that those who develop healthy eating habits early in life are likely to maintain them into adulthood, and have a reduced risk of chronic diseases such as cardiovascular disease, certain cancers, diabetes and osteoporosis (6). For human subjects the number, size and timing of 'meals' are clearly subject to many acute and chronic social influences and chronological trends (7). Retirement from work is a time when eating habits may change: former employees no longer eat at their place of work, food shopping patterns may change (possibly due to a fall in income), meal times and meal companions could be different (8). Yet retirement can provide better opportunities in terms of time availability as demonstrated in a recent study that retired persons had healthier eating habits as compared to persons reaching retirement age in Mauritius (9). Older people suffering from non-communicable diseases can be prevented as well as control of morbidity and premature mortality if

they know and apply the nutrition principles acknowledged today (10). Above all, these diseases are strongly influenced by individual food choices (11), as a result of developing eating habits during the lifecourse (12).

Research suggests that high level of income may affect older people's eating habits since lower levels of economic resources are associated with greater risk of experiencing hunger and food insufficiency as some studies suggest that healthy eating is costlier; thus low income limits not just quantity but also the nutritional quality of foods purchased (13). Besides income level, there are several other factors which shape eating habits that can lead to an unhealthy nutritional status in older adults as illustrated in Figure 1. These include a decrease in sensitivity to taste; poor dental health and missing teeth; physical difficulties, poor health conditions; poor memory and dementia; lack of transportation, which makes food shopping for older people more difficult; and the financial burden, which may prompt older persons to cut back on food purchased or to buy cheaper and less nutritious foods to stretch their budget, thus affecting their eating habits (14). Marital status and household composition, physical activity and body mass index (BMI) also shape eating habits of older adults (15). According to recent evidence low physical activity level is related to higher consumption rate of fast food and lower intake of fruits and veg-

etables and also married old persons reportedly have healthier eating habits (9, 16).

There has been recent development in the field of obesity as well as nutrition and the aim of this review is to provide novel insights on major determinants of eating habits based on recent scientific evidence which should be taken into account for more appropriate nutrition intervention among older adults.

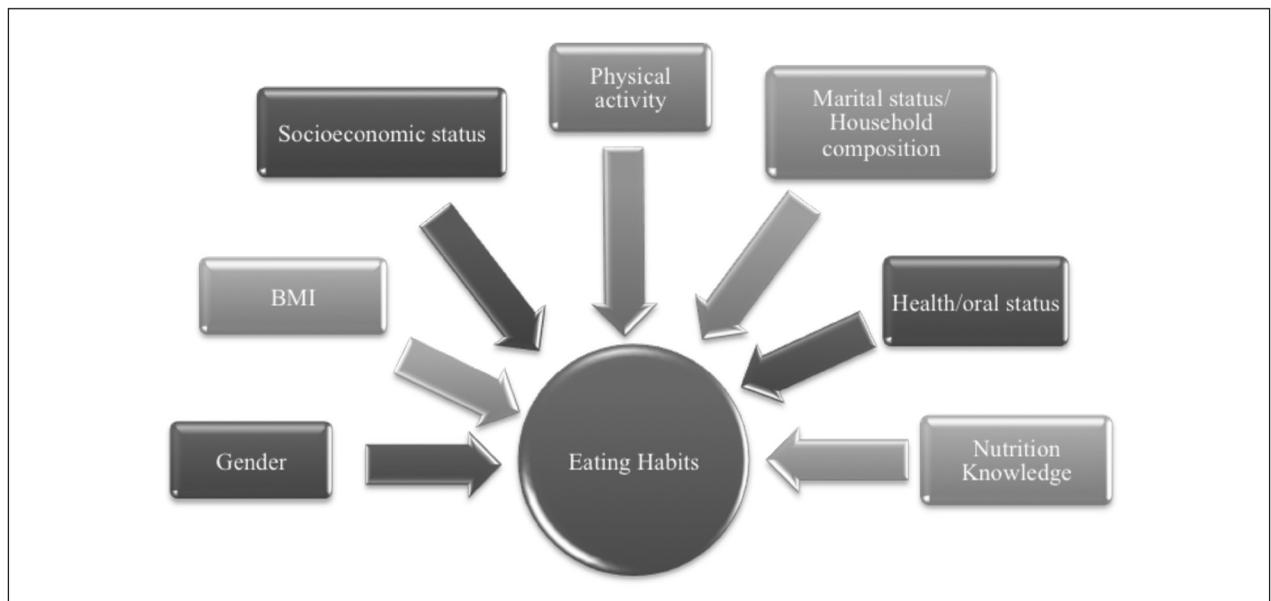
### Factors affecting eating habits

#### *Economic level*

#### *Socioeconomic status*

Socioeconomic status (SES) is one of the most dominant predictors of health status and mortality worldwide (19). A large body of epidemiologic data shows that diet quality follows a socioeconomic gradient (20). As a variable, social class may affect the types and quantity of foods eaten, cooking methods used for food, nutrient intakes and the perceived meanings of foods (21) and in turn determine risk of NCDs such as obesity, hypertension, diabetes and cardiovascular diseases (10).

Studies have identified economic development, as measured with the gross domestic product (GDP) per capita, as a predictor of CVD risk factors (22). In de-



**Figure 1.** Some key determinants of eating habits among older adults (14, 15, 17, 18).

veloping countries, the level of obesity is greater in the higher SES segments of society (23) and this is quite common in Brazil, Cameroon, India, Jordan and Madagascar. The proposed rationale for the increased risk for obesity in higher SES groups includes the greater capacity of the elite to obtain food (24). On the other hand, since the early 1960s in industrialised countries, the prevalence of obesity among adults has doubled, increasing from 13.4 to 35.7 percent in U.S. adults age 20 and older due to significant changes in eating patterns with Americans who consume on average 300 calories more per day in 2002 than in 1985 (25, 26). In addition, the increasing number of women who entered the workforce in the waning decades of the 20<sup>th</sup> century has prompted many families both to rely on pre-packaged meals, or "frozen dinners," and to start eating in restaurants more often (26).

Although there are slight disparities in eating habits among different social class, in several studies, food consumption patterns and nutrient intakes have been more consistent with current dietary guidelines among people of high SES (19). Darmon and Drewnowski (20) defined this observed associations between SES variables and diet-quality measures by two potentially causal mechanisms namely:

1. the disparity in energy costs (\$/MJ) between energy-dense and nutrient-dense foods
2. easy physical access to low-cost energy-dense foods

Income level may not just affect the quantity but also the nutritional quality of the food purchased by older adults (13). The economic sensitivity of diet is considered particularly salient for older adults since they are more likely to have a low income due to a drop in income level through retirement and out-living savings. The fact that considerably higher cost of therapeutic diets places an even greater burden on older people, consumers with low income level are more likely to adopt a "tunnel vision" approach to shopping for food, opting for the same familiar foods each time (5, 21). For instance, low SES was associated with lower grocery purchasing scores among adults aged 60-71 years, as research suggests that it costs more to eat healthily (27). Other studies reported healthier eating patterns among people in the higher SES group with higher consumption of food items such as vegetables, dairy products as well as lower

prevalence of breakfast skipping (19, 28, 29). Two recent studies in Mauritius among pre and post-retired adults as well as among post-menopausal women demonstrated that with higher income level and in higher SES had healthy food choices and diet quality more in line with recommended dietary guidelines (9, 30).

Epidemiology and medical surveys have consistently shown that people in lower SES groups experience poorer health and have shorter lives than those in higher status groups due to unfavourable lifestyle factors and other risk factors that are more prevalent in lower SES strata (28). Persons attempting to limit food costs will first select less expensive but more energy dense foods to maintain dietary energy (31). As food costs diminish further, dietary energy density rises, and total energy intakes may actually increase (32). Thus, having an adequate income is likely to be necessary to ensure a more varied and balanced diet for healthy older people (33). It is obviously primordial that public health interventions should cater for older adults lower socioeconomic strata.

Socioeconomic status is further determined by the broader political and economic environment of the country which can play an important role in determining food choice and eating habits of older adults (34). The macro/public policy level factors involve local, state, and federal policies. Policies that influence food pricing also affect individuals' food intake patterns as healthful foods are reportedly more costly than less nutrient-dense foods, thus making price a strong determinant of food choice (35). The high price of certain food items can impede on the restricted food budget of older adults with low income (36). In a study by Vella et al. (37) cost/price ranked fifth as a factor that would promote consumption (48.0%) and participants with an annual household income  $\geq$  \$50,000 were less likely to report that cost of functional foods was a factor compared to those with an annual household income  $<$  \$50,000 ( $p = 0.002$ ) among adults aged  $\geq 60$  years. Locher et al. (38) also reported that good value of money was a key determinant of food selection among a population of homebound older adults. Community and national programs conducted in countries such as Finland, Singapore, and Mauritius which used media and educational campaigns in addition to alterations in physical environments and changes in taxation and subsidies, to support a health-

ful lifestyle (39). Thus, nutrition interventions aiming to change older adults' food and eating behaviours must take into consideration the macro/public policy level as they can influence motivation of people and hence their food choices.

### *Societal and family level*

#### *Culture*

Culture, defined as the knowledge, beliefs, customs, and habits a group of people share is passed on from generation to generation (40, 41). People tend to behave according to their cultural norms especially with food choice and dietary patterns (42). In applying this theory of cultural norms to food consumption, several different behaviours can emerge that symbolize congeniality, security or reward. Culturally determined dietary practices also involve the identification of foods, methods of food preparation, condiment selection, timing and frequency of meals, and the ritual, social, and symbolic use of foods (41). Some ethnic groups have food patterns that, outside their native environment, may result in inadequate intakes (42). Religion is a key aspect of culture that often prescribes or proscribes food patterns (41). Cultural practices have an important impact on food choices and eating practices even in modern, multi-ethnic societies where many different types of cuisines are available since food traditions are generally among the last to be modified through acculturation (43). For example, Guest and O'Dea (44) reported that the main differences in food habits among Australian Aborigines and persons of European descent were associated with ethnicity such that the prevalence of adding salt during cooking and food consumption was higher among Aborigines compared to Europeans.

Older adults tend to abide to their cultural ways of eating since habits and preferences that are formed during childhood and youth are difficult to change in adult life (45). For instance, Banwell et al. (46) has reported that most of the residents in greater Melbourne born in the 1920s and 1930s have retained many of the habits and practices of their youth, although there has been changes in domestic arrangements, aging and health concerns which have impacted on their culinary habits over the second half of the 20<sup>th</sup> century. Similarly among home-living elderly, foundations of norms

and values regarding food culture, traditions and eating habits were laid early and did not change to any great extent throughout life (47). Therefore, if dietary recommendations based on health considerations conflict with family and cultural tradition, the concerned individuals may find themselves having to think about how to integrate their cultural expectations with their concern about their personal health in order to make required dietary changes. All of these considerations influence individuals' willingness and ability to make changes in their diets (43). Therefore, dieticians should be aware of the eating habits, food preference and practices in cultural occasions and holidays so as to provide best nutritional counselling for their clients. Considerations of the cultural impact when giving nutrition advice will also ensure the clients that their values are being appreciated, which will directly impact adherence to dietary regimens and recommendations (48).

#### *Household composition/Marital Status*

Family structure and composition are important social determinants that may also affect health behaviours and outcomes (49). Eating regular meals and having healthy diet have to some extent been found to depend on eating with others while loneliness due to loss of spouse or friends can diminish the social reasons for and pleasure associated with eating (13). Married persons generally enjoy better health, make fewer demands on the health care system and also experience lower death rates than single, widowed and divorced persons (50). Literature has shown strong correlation between all of the various unmarried states (being single never married, being separated/divorced and being widowed) and increased risk of cardiovascular disease mortality due to variations in eating habits as a consequence of social isolation (51, 52). Moreover, widowed and divorced people living alone did not eat as well as single people (21). According to Yannakouli et al. (16), marital status has been previously reported as a noteworthy predictive cause of fruit and vegetable consumption: being married was significantly associated with the acceptance of this healthy eating behaviour and single/never married or divorced/separated individuals were less likely to consume high fruit and vegetable. Married persons are also less likely to skip meals and better able to afford them. On the

other hand, older men who are not married, particularly those who are widowed, are susceptible to poor nutritional health because they often do not know how to shop or cook for themselves and low motivation to change eating habits may constitute barriers to improving energy intake, healthy eating and appetite while when older women no longer have anyone to cook for, they tend to cook less for themselves (53, 54).

### *Individual level*

#### *Gender*

Gender is a key factor shaping eating habits (15). Gender differences in food consumption are associated to social norms and cultural beliefs, like motives and behaviours. Some foods are labelled masculine, some are seen as feminine. As an example, the consumption of meat symbolizes a masculine diet, while the consumption of vegetables and fruits represents a feminine one (55). Several factors have been associated to healthier eating habits among females as compared to males. Body image is an important consideration for healthier eating as many women prefer a slim body shape (56). Preoccupation with body weight remains high in elderly women as well as young girls in developed and developing countries and this leads to frequent dieting and pressure to be thin (57, 58). Furthermore, being traditionally involved in purchasing, preparing and providing food also has an influence on eating habits of females (59). A survey in Europe revealed that “quality/freshness”, “price”, “trying to eat healthy” and “family preferences” mainly influenced food choice among women while “taste” and “habits” generally affected food choice of male respondents (60). Lower considerations about health behaviours among men although they are aware of healthy eating guidelines is because they often showed some scepticism and resistance to nutrition education messages, as they found healthy eating tedious and unsatisfying (61, 62).

However, some men do express interest in food, cooking, and health, and indicate that they are reducing their consumption of red meat and increasing consumption of vegetables (63). According to Arganini et al. (59), these observations are more common among “high educational levels” than by “blue-collar workers”, suggesting that social class may mediate as-

sociations between “masculinity” and food. Fagerli and Wandel (64) reported that responses from men were related to socio-economic variables both concerning opinions on what constitutes a healthy diet, and frequency of consumption of some foods (vegetables, fruits and dairy products) in comparison to females. Lindmark et al. (65) further demonstrated that men in the highest “*sense of coherence*” score quartile (correlation between prevalence of some diseases to dietary habits) reported more “healthy” food choices.

#### *Physical activity*

Physically active people tend to be healthier, presenting better metabolic conditions compared to the sedentary ones (66). The advantages for older people include improved wellness and quality of life, prevention of osteoporosis and a reduction in the risk of falling, and can improve cardiovascular risk profile (67). Furthermore, physical activity along with proper eating habits, that is, adequate intake of calcium and vitamin D rich foods are effective in the prevention of osteoporosis and osteoporosis-related fractures and hence improve the quality of life in the elderly population (68, 69). Unfortunately, the epidemiological picture that has emerged from population surveillance data demonstrate that both in developing and developed countries the level of physical inactivity is quite high especially with increasing age (e.g., no leisure-time physical activity, ranging from 20-30 % of the population or more) (70, 71).

The Transtheoretical Model (TTM) which is based on a series of stages has demonstrated the inter-relationships between various health behaviors increase with age. The TTM has been successfully applied to older adults relative to exercise, and multiple eating behaviors including avoiding fat, eating fiber, and losing weight (72). Although physical activity (PA) does not affect the choice of food group consumption directly, it has been noted that unhealthy lifestyle patterns (e.g. lack of exercise) and less healthful eating patterns tend to coexist among individuals (73). Low PA is an independent risk indicator of inadequate dietary habits due to the more assorted diet consumed by physically and socially active people (74). This disparity could be because of the appetite stimulus of physical activity or because it symbolises continuing engagement in soci-

ety and better morale (21). Serdula et al. (75) reported higher frequency of intake of fresh fruits, fresh vegetables, or salad as the level of PA increased. Moreover in an intervention study, Bock et al. (76) demonstrated a significant positive association between readiness to adopt PA with willingness to reduce high fat foods and to increase consumption of fruits and vegetables. On the other hand, a randomised clinical trial reported no evidence to support the idea that changes in PA are a gateway for changes in dietary factors among older adults (77). Therefore, the conflicting findings point towards the need for more research to clarify the relationship between PA and eating habits.

### *Body Mass Index*

Retirement is an essential point for weight change (78). Occupational retirement is usually accompanied by considerable changes in lifestyle. If retiring persons do not replace their former work-related PA with other physical activities or do not diminish energy intake to a level that harmonises their new energy requirements, they are at risk of gaining weight (79). The prevalence of obesity is highest among subjects aged 50–65 years due to several reasons (e.g. being physically inactive; having less structured meal times; and consuming food in response to losing personal identity, the potential for social interactions, or the sense of accomplishment derived from working), then the rate levels off and subsequently declines due to loss in muscle mass and decrease in energy intake (79, 80).

Body Mass Index (BMI) is another factor that shapes eating habits (15). Ha et al. (81) reported that eating speed and snacking after dinner were found to be significantly and positively correlated with BMI among elderly Koreans (60–75 years). In addition, more than half of the subjects (63.2%) stated that they sometimes overeat, and 49.1% state they always snack after dinner. Kent and Worsley (82) further reported that among women, margarine, soft drink and whole milk consumption were positively associated with BMI while for men, frequency of meat, salad dressings, and egg consumption were positively associated with BMI. Overweight and obese individuals have different eating habits in comparison with normal-weight individuals, including morning anorexia and consumption of larger food amounts in the afternoon and evening as well as a

higher eating frequency (17). Bivariate analysis of diet intake patterns suggested that centenarians with BMI  $\leq 20$  had the highest total food scores and were more likely to eat two or more servings of meat, fish, and poultry per day and three or more total servings of fruit per day as compared with centenarians in the other BMI classifications. On the other hand, those with a BMI  $\geq 25$  were more likely to report eating less than one serving of citrus or non-citrus fruit per day, less than four servings of orange/yellow vegetables per week, or three total servings of fruit and vegetables per day (83).

### *Health and oral status*

Adult chronic disease, reflects cumulative differential lifetime exposures to damaging physical and social environments. Older adults especially have encountered many demographic shifts which have impacted on the eating habits. The continuity of the life course is seen in the way that both undernutrition and overnutrition (as well as a host of other factors) play a role in the development of chronic disease and at the same time, health or disease status can influence eating habits (84). Changes in body functioning occur not just because of the biological impact of ageing but also because old age is associated with the onset of degenerative diseases (21). Age-related changes in body composition result in slight decline in lean body mass which is usually more remarkable after the age of 60. Consequently, basal metabolism or energy requirements for the elderly diminish by about 100 kcal/day per decade. Cardiovascular, pulmonary, and neurological diseases, as well as osteoarthritis and osteoporosis, may also alter energy requirements in the elderly either by increasing energy expenditure or reducing requirements through muscle loss related to inactivity (85). Aging is also associated with alterations in taste and smell which can as well contribute to decreased food intake. Other changes in gastrointestinal system, for example, greater satiation after a meal and a delay in gastric emptying has been shown in older people (80). Appetite after an overnight fast is often lower in the elderly. Oesophageal motility and atrophic gastritis may also impair vitamin B12 and iron adsorption and thus affect nutritional status (85).

Increase use of medication due to chronic conditions impact on the food choice, and eating habits of elderly changes as a precautionary method as well as

due to loss of taste and smell as a consequence of drug use (40, 80). Elderly tend to be more wary concerning food choice and also tend to decrease the amount of salt, sugar, oil and increase consumption of vegetables (40). Ill health among older people can also lead to a lack of interest in food (86). Reduced mobility due to poor health further limit the ability of older adults to access food due to physical limitations such as difficulty in stooping, lifting, reaching, grasping, walking, or difficulty in carrying out activities of daily living (87), and these impair their ability to obtain, prepare and enjoy nutritious foods (13).

Dental status and oral health often come into play when masticatory performance, dietary habits and nutrition intake in the elderly are being investigated, since many older people suffer from mild or extreme tooth loss (88). Root caries have been found to be the major cause of tooth loss in older adults (89). In addition to impaired dentition, other oral contraindications can also affect individuals by obscuring chewing ability, possibly compromising their food choice and thus their nutritional status and wellbeing. This may impact on their consumption of high-fiber foods such as bread, fruit, and vegetables since they are unable to chew and bite properly (90, 91). A recent study demonstrated that compliance to dietary guidelines was lower among older adults with poor oral health and general health status (92).

#### *Nutrition Knowledge, Attitudes and Beliefs*

Nutrition knowledge (NK) is one among many influential factors that influence eating habits and attitudes (18, 93). Although, NK is usually associated with healthier eating habits, however, the literature on the relationship between eating habits and NK is contradictory. While some researchers have reported that NK was highly and positively associated with eating habits, others have demonstrated little correlation between NK and actual food choices (94). For example, Fischer et al. (95) reported that elderly (60 - 70 years) had a high level of knowledge about fat and salt and they also had healthful food selections. Moreover, Lee et al. (96) accounted that number of servings of grains/cereals/ breads/pasta, milk/cheese, fruits, and vegetables was significantly higher among elderly aged 60 and older with high NK. Several studies have also

reported an increase in NK among elderly involved in nutrition education programs (97-99).

On the other hand, a study carried out in England demonstrated that oldest group had poor scores for NK which probably reflect the fact that the current dietary recommendations are relatively recent and older people probably have more established views on food (100). A recent study reported a significant positive correlation between consumption of breakfast cereal, pasta, fresh fruit, dried/canned fruits, vegetables, dairy product, red meat, white fish and oily fish and NK while there was a significant negative correlation between consumption frequency of white bread and rice and NK (9). Thus, dietary behaviour is quite inconsistent with NK for older adults in the sense that even though they have good NK, they are unable to apply technical NK (101). Another plausible explanation for this unsuccessful application of NK could be due to household income related to diet in part via food-cost concern (102) especially among older adults after retirement. There are several factors - classified as intrapersonal and interpersonal which can act as barriers or promote the influence of NK on eating habits (35, 103).

#### **Conclusion**

In general, older adults are at increased risk of malnutrition due to insufficient food intake (amount) and poor selection of food (quality) as well as due to the biological changes associated with aging. Moreover, it is well established that several other factors such as SES, gender, marital status, household composition, culture, PAL, BMI, NK, health and oral status influence eating habits of older adults. Public health strategies and policies should be based on these determinants to promote healthy eating and support behaviour change. Although there is evidence on the factors influencing the eating habits of older adults, controlled longitudinal studies, with different exposures of defined periods and multiple dietary follow-up in various subgroups of the older population should be promoted especially in developing countries. Moreover, the synergies between the various determinants of eating habits for each group of older adults should be considered when planning nutrition interventions.

## References

1. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2012 Revision, Key Findings and Advance Table; 2013.
2. Kikafunda JK, Lukwago FB. Nutritional status and functional ability of the elderly aged 60 to 90 years in the Mpigi district of central Uganda. *Nutrition* 2005; 21: 59-66.
3. Anderson AL, Harris TB, Tyllavsky FA, Perry SE, Houston DK, Hue TF, et al. Dietary patterns and survival of older adults. *J Am Diet Assoc* 2011; 111: 84-91.
4. Kimura M, Moriyasu A, Kumagai S, Furuna T, Akita S, Kimura S, et al. Community-based intervention to improve dietary habits and promote physical activity among older adults: a cluster randomized trial. *BMC Geriatr* 2013; 13: 1-11.
5. Conklin AI, Maguire ER, Monsivais P. Economic determinants of diet in older adults: systematic review. *J Epidemiol Community Health* 2013; 67: 721-7.
6. Darnton-Hill I, Nishida C, James WP. A life course approach to diet, nutrition and the prevention of chronic diseases. *Public Health Nutr* 2004; 7: 101-21.
7. Gatenby S. Eating frequency: methodological and dietary aspects. *Br J Nutr* 1997; 77: 7-20.
8. Holdsworth MD, Davies L. Nutrition at retirement age. *Proc Nutr Soc* 1984; 43: 303-13.
9. Dunneram Y, Ramasawmy D, Pugo-Gunsam P, Jeewon R. Determinants of eating habits among pre-retired and post-retired Mauritians. *IJNFS* 2013; 2: 109-15.
10. Tourlouki E, Matalas AL, Panagiotakos DB. Dietary habits and cardiovascular disease risk in middle-aged and elderly populations: a review of evidence. *Clin Interv Aging* 2009; 4: 319-30.
11. Sizer FS, Whitney E. *Nutrition: Concepts and Controversies*, Wadsworth, Cengage Learning, Belmont, United States of America, 12th edition; 2011.
12. Dugdale D, Zieve D. *Eating habits and behaviours*, Medline Plus, U.S. Department of Health and Human Services National Institutes of Health; 2011.
13. Dean M, Raats MM, Grunert KG, Lumbers M, the food in later life team. Factors influencing eating a varied diet in old age. *Public Health Nutr* 2009; 12: 2421-7.
14. Turconi G, Rossi M, Roggi C, Maccarini L. Nutritional status, dietary habits, nutritional knowledge and self-care assessment in a group of older adults attending community centres in Pavia, Northern Italy. *J Hum Nutr Diet* 2012; 26: 48-55.
15. Helldan A, Lallukka T, Rahkonen O, Lahelma E. Changes in healthy food habits after transition to old age retirement. *Eur J Public Health*; 22: 582-6.
16. Yannakoulia M, Panagiotakos D, Pitsavos C, Skoumas Y, Stafanadis C. Eating patterns may mediate the association between marital status, body mass index, and blood cholesterol levels in apparently healthy men and women from the ATTICA study. *Soc Sci Med* 2008; 66: 2230-9.
17. Holmbäck I, Ericson U, Gullberg B, Wirfält E. A high eating frequency is associated with an overall healthy lifestyle in middle-aged men and women and reduced likelihood of general and central obesity in men. *Br J Nutr* 2010; 104: 1065-73.
18. Shakkour E. *The Relationship between Nutritional Knowledge and Application* Liberty University, Virginia, USA; 2007.
19. Shahar D, Shai I, Vardi H, Shahar A, Fraser D. Diet and eating habits in high and low socioeconomic groups. *Nutrition* 2005; 21: 559-66.
20. Darmon N, Drewnowski A. Does social class predict diet quality? *Am J Clin Nutr* 2008; 87: 1107-17.
21. Herne S. Research on food choice and nutritional status in elderly people: a review. *Brit Food J* 1995; 97: 12-29.
22. Kim D, Kawachi I, Vander Hoorn S, Ezzati M. Is inequality at the heart of it? Cross-country associations of income inequality with cardiovascular diseases and risk factors. *Soc Sci Med* 2008; 66: 1719-1732.
23. Monteiro CA, Conde WL, Lu B and Popkin BM. Obesity and inequities in health in the developing world. *Int J Obes Relat Metab Disord* 2004; 28: 1181-1186.
24. Gearhart Jr. RF, Gruber DM, Vanata DF. Obesity in the Lower Socio-Economic Status Segments of American Society. *Forum on Public Policy* 2008; 1-21. Available from: <http://www.forumonpublicpolicy.com/archivespring08/gearhart.pdf>.
25. Weight-control Information Network. *Overweight and Obesity Statistics*, NIH Publication No. 04-4158, 2012. Available from: <http://www.win.niddk.nih.gov/statistics/#ref5>.
26. Sommers AR. *Obesity Among Older Americans*, CRS Report for Congress. Washington, DC: CRS, 2008. Available from: <http://www.aging.senate.gov/crs/aging3.pdf>.
27. Brennan DS, Singh KA. Grocery purchasing among older adults by chewing ability, dietary knowledge and socio-economic status. *Public Health Nutr* 2010; 14: 1279-84.
28. Hulshof FAM, Brussaard JH, Kruizinga AG, Telman J, Löwik MRH. Socio-economic status, dietary intake and 10 y trends: the Dutch National Food Consumption Survey. *Eur J Clin Nutr* 2003; 57: 128-37.
29. Galobardes B, Morabia A, Bernstein MS. Diet and socio-economic position: does the use of different indicators matter? *Int J Epidemiol* 2001; 30: 334-40.
30. Bhurosy T, Jeewon R. Food habits, socioeconomic status and body mass index among premenopausal and post-menopausal women in Mauritius. *J Hum Nutr Diet* 2013; 26: 114-22.
31. Basiotis PP. Validity of the self-reported food sufficiency status item in the U.S. In: Haldeman VA, ed. *American Council on Consumer Interests 38th Annual Conference*, Columbia, MO. Washington, DC: US Department of Agriculture; 1992.
32. Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. *Am J Clin Nutr* 2004; 79: 6-16.
33. Drewnowski A, Renderson SA, Driscoll A, Rolls BJ. The dietary variety score: assessing diet quality in healthy young and older adults. *J Am Diet Assoc* 1997; 97: 266-71.
34. Delaney M, McCarthy M. Food choice and health across the life course: A qualitative study examining food choice in older Irish adults. HRB Centre for Health & Diet Research

- and Dept. of Food Business & Development, University College Cork; 2009.
35. Fitzgerald N, Spaccarotella K. Barriers to a Healthy Lifestyle: From Individuals to Public Policy—An Ecological Perspective. *JOE* 2009; 47: 1-8.
  36. R. Schumann, and J. Robson, "Older adults living on a low income," Guelph and Wellington task force for poverty elimination; 2012.
  37. Vella MN, Stratton LM, Sheeshka J, Duncan AM. Functional food awareness and perceptions in relation to information sources in older adults. *Nutr J* 2014; 13: 1-12.
  38. Locher JL, Ritchie CS, Roth DL, Sen B, Vickers KS, Vailas LI. Food choice among homebound older adults: motivations and perceived barriers. *J Nutr Health Aging* 2009;13: 659-64.
  39. Mozaffarian D, Afshin A, Benowitz NL, et al. Population approaches to improve diet, physical activity, and smoking habits: a scientific statement from the American Heart Association. *Circulation* 2012; 126:1514-63.
  40. Kulkarni KD. Food, Culture, and Diabetes in the United States. *ADA* 2004; 22: 190-2.
  41. Tripp-Reimer T, Choi E, Skemp Kelley L, Enslein JC. Cultural Barriers to Care: Inverting the Problem. *Diabetes Spectr* 2001; 14: 13-2.
  42. Chandra RK, Imbach A, Moore C, Skelton D, Woolcott D. Nutrition of the Elderly. *CMAJ* 1991; 145: 1445-87.
  43. Contento IR. Nutrition Education: Linking Research, Theory, and Practice. Jones and Bartlett Publishers, USA, 2nd edition; 2011.
  44. Guest CS, O'Dea K. Food habits in Aborigines and persons of European descent of southeastern Australia. *Aust J Public Health* 1993; 17: 321-4.
  45. Fjellström C, Sidenvall B, Nydahl M. Food intake and the elderly: social aspects. *Food, People and Society: A European Perspective of Consumers' Food Choices*, Frewer L, Risvik E, Schifferstein H, Eds., 197-209, Springer, Berlin, Germany; 2001.
  46. Banwell C, Dixon J, Broom D, Davies A. Habits of a lifetime: family dining patterns over the lifecourse of older Australians. *Health Sociol Rev* 2010; 19: 343-55.
  47. Edfors E, Westergren A. Home-Living Elderly People's Views on Food and Meals. *J Aging Res* 2012; 2012: 1-9.
  48. Bawadi H, Al-Hamdan Z, Bawadi H, Ershidat O, Hamad F, Agraib L. Cultural Eating Practices among Jordanians. *FNS* 2012; 3: 790-5.
  49. Turagabeci AR, Nakamura K, Kizuki M, Takano T. Family structure and health, how companionship acts as a buffer against ill health. *Health Qual Life Outcomes* 2007; 5: 1-9.
  50. Goldman N, Korenman S, Weinstein R. Marital status and health among the elderly. *Soc Sci Med* 1995; 40: 1717-30.
  51. Molloy GJ, Stamatakis E, Randall G, Hamer M. Marital status, gender and cardiovascular mortality: Behavioural, psychological distress and metabolic explanations. *Soc Sci Med* 2009; 69: 223-8.
  52. Ikeda A, Iso H, Toyoshima H, Fujino Y, Mizoue T, Yoshimura T. Marital status and mortality among Japanese men and women: the Japan Collaborative Cohort Study. *BMC Public Health* 2007; 7: 73.
  53. Bales CW, Ritchie CS. Handbook of clinical nutrition and aging, Humana Press, New York, 2nd edition; 2009.
  54. Hughes G, Bennett KM, Hetherington MM. Old and alone: barriers to healthy eating in older men living on their own. *Appetite* 2004; 43: 269-76.
  55. Prättälä R, Paalanen L, Grinberga D, Helasoja V, Kasmel A, Petkeviciene J. Gender differences in the consumption of meat, fruit and vegetables are similar in Finland and the Baltic countries. *Eur J Public Health* 2006; 17: 520-5.
  56. Gustafsson K, Sidenvall B. Food-related health perceptions and food habits among older women. *J Adv Nurs* 2002; 9: 164-73.
  57. Fallaz AF, Bernstein M, Van Nes MC, Rouget P, Morabia A. Weight loss preoccupation in aging women: a review. *J Nutr Health Aging* 1999; 3: 177-81.
  58. Bhurtun DD, Jeewon R. Body Weight Perception and Weight Control Practices among Teenagers. *ISRN Nutrition* 2013; 2013: 1-6.
  59. Arganini C, Saba A, Comitato R, Virgili F, Turrini A. Gender Differences in Food Choice and Dietary Intake in Modern Western Societies. *Public Health - Social and Behavioral Health*, Prof. J. Maddock, Ed., 83-102; 2012.
  60. Lennernäs M, Fjellström C, Becker W, Giachetti I, Schmitt A, Remaut de Winter A, et al. Influences on food choice perceived to be important by nationally-representative samples of adults in the European Union. *Eur J Clin Nutr* 1997; 51: S8-15.
  61. Sellaeg K, Chapman GE. Masculinity and food ideals of men who live alone. *Appetite* 2008; 51: 120-8.
  62. Wardle J, Haase AM, Steptoe A, Nillapun M, Jonwutiwes K, Bellisle F. Gender differences in food choice: the contribution of health beliefs and dieting. *Ann Behav Med* 2004; 27: 107-16.
  63. Sobal J. Men, meat, and marriage: models of masculinity. *Food & Foodways* 2005; 13: 135-58.
  64. Fagerli RA, Wandel M. Gender differences in opinions and practices with regard to a "healthy diet". *Appetite* 1999; 32: 171-90.
  65. Lindmark U, Stegmayr B, Nilsson B, Lindahl B, Johansson I. Food selection associated with sense of coherence in adults. *Nutr J* 2005; 4: 1-7.
  66. Entrala-Bueno A, Iglesias C, De Jesús F. Diet and physical activity: a healthful binomial. *Eur J Clin Nutr* 2003; 57: 63-5.
  67. Crombie K, Irvine L, Williams B, McGinnis AR, Slane PW, Alder EM, et al. Why older people do not participate in leisure time physical activity: a survey of activity levels, beliefs and deterrents. *Age Ageing* 2004; 33: 287-92.
  68. Anderson JJ, Rondano P, Holmes A. Roles of Diet and Physical Activity in the Prevention of Osteoporosis. *Scand J Rheumatol* 1996; 103: 65-74.
  69. Nguyen TV, Center JR, Eisman JA. Osteoporosis in Elderly Men and Women: Effects of Dietary Calcium, Physical Activity, and Body Mass Index. *J Bone Miner Res* 2000; 15: 322-31.
  70. King A, King D. Physical Activity for an Aging Population. *Public Health Rev* 2010; 32: 401-426.
  71. Sims J, Hill K, Davidson S, Gunn J, Huang N. A snapshot of the prevalence of physical activity amongst older, community dwelling people in Victoria, Australia: patterns across the 'young-old' and 'old-old'. *BMC Geriatrics* 2007; 7: 1-8.

72. Tucker M, Reicks M. Exercise as a Gateway Behavior for Healthful Eating among Older Adults: An Exploratory Study. *J Nutr Educ Behav* 2002; 34: 14-9.
73. Deshmukh-Taskar P, Nicklas TA, Yang SJ, Berenson GS. Does food group consumption vary by differences in socioeconomic, demographic, and lifestyle factors in young adults? The Bogalusa Heart Study. *J Am Diet Assoc* 2007; 107: 223-34.
74. Kronold M, Lau D, Yurkiw MA, Coleman P. Food use and perceived food meanings of the elderly. *J Am Diet Assoc* 1982; 80: 523-29.
75. Serdula MK, Byers T, Mokdad AH, Simoes E, Mendkin JM, Coates RJ. The Association between Fruit and Vegetable Intake and Chronic Disease Risk Factors. *Epidemiology* 1996; 7: 161-5.
76. Bock BC, Marcus BH, Rossi JS, Redding CA. Motivational Readiness for Change: Diet, Exercise, and Smoking. *Am J Health Behav* 1998; 22: 248-58.
77. Wilcox S, King AC, Castro C, Bortz W. Do changes in physical activity lead to dietary changes in middle and old age? *Am J Prev Med* 2000; 18: 276-83.
78. Gueorguieva R, Sindelar JL, Wu R, Gallo WT. Differential changes in body mass index after retirement by occupation: hierarchical models. *Int J Public Health* 2011; 56: 111-6.
79. Nooyens AC, Visscher TL, Schuit AJ, et al. Effects of retirement on lifestyle in relation to changes in weight and waist circumference in Dutch men: a prospective study. *Public Health Nutr* 2005; 8: 1266-74.
80. Hickson M. Malnutrition and ageing. *Postgrad Med J* 2006; 82: 2-8.
81. Ha AW, Kim JH, Shin DJ, et al. Eating habits, obesity related behaviors, and effects of Danhak exercise in elderly Koreans. *Nutr Res Pract* 2010; 4: 295-302.
82. Kent LM, Worsley A. Trends in BMI, diet and lifestyle between 1976 and 2005 in North Sydney. *Asia Pac J Clin Nutr* 2009; 18: 453-61.
83. Hausman DB, Johnson MA, Davey A, Poon LW. Body mass index is associated with dietary patterns and health conditions in georgia centenarians. *J Aging Res* 2011; 2011: 1-10.
84. World Health Organization and Food and Agriculture Organization of the United Nations. Diet, Nutrition and the Prevention of Chronic Diseases, Geneva, World Health Organization, 2003, (WHO technical report series; 916), <http://www.fao.org/docrep/005/ac911e/ac911e00.htm#Contents>
85. Wells JL, Dumbrell AC. Nutrition and Aging: Assessment and Treatment of Compromised Nutritional Status in Frail Elderly Patients. *Clin Interv Aging* 2006; 1: 67-79.
86. Holmes BA, Roberts CL. Diet quality and the influence of social and physical factors on food consumption and nutrient intake in materially deprived older people. *Eur J Clin Nutr* 2011; 65: 538-45.
87. Huang DL, Rosenberg DE, Simonovich SD, Belza B. Food Access Patterns and Barriers among Midlife and Older Adults with Mobility Disabilities. *J Aging Res* 2012; 2012: 1-8.
88. Kossioni A, Bellou O. Eating habits in older people in Greece: The role of age, dental status and chewing difficulties. *Arch Gerontol Geriatr* 2011; 52: 197-201.
89. Gati D, Vieira AR. Elderly at Greater Risk for Root Caries: A Look at the Multifactorial Risks with Emphasis on Genetics Susceptibility. *Int J Dent* 2011; 2011: 1-6.
90. Marcenes W, Steele JG, Sheiham A, Walls AW. The relationship between dental status, food selection, nutrient intake, nutritional status, and body mass index in older people. *Cad Saude Publica* 2003; 19: 809-16.
91. Sheiham A, Steele JG, Marcenes W, Finch S, Walls AW. The relationship between oral health status and Body Mass Index among older people: a national survey of older people in Great Britain. *Br Dent J* 2002; 192: 703-6.
92. Brennan DS, Singh KA. Dietary, self-reported oral health and socio-demographic predictors of general health status among older adults. *J Nutr Health Aging* 2012; 16: 437-41.
93. Lin W, Lee YW. Nutrition knowledge, attitudes, and dietary restriction behavior of the Taiwanese elderly. *Asia Pac J Clin Nutr* 2005; 14: 221-9.
94. Pirouznia M. The influence of nutrition knowledge on eating behavior – the role of grade level. *NFS* 2001; 31: 62-67.
95. Fischer CA, Crockett SJ, Heller KE, Skaug LH. Nutrition knowledge, attitudes, and practices of older and younger elderly in rural areas. *J Am Diet Assoc* 1991; 91: 1398-1401.
96. Lee CJ, Godwin SL, Tsui J, et al. Association Between Diet Knowledge and Quality of Diets in Southern Rural Elderly. *J Nutr Elder* 1998; 17: 5-17.
97. Taylor-Davis S, Smiciklas-Wright H, Warland R, et al. Responses of older adults to theory-based nutrition newsletters. *J Am Diet Assoc* 2000; 100: 656-64.
98. Sharpe A, Vaca VL, Sargent RG, White C, Gu J, Corwin SJ. A nutrition education program for older adults at congregate nutrition sites. *J Nutr Elder* 1996; 16: 19-31.
99. Hermann R, Kopel BH, McCrory ML, Kulling FA. Effect of a cooperative extension nutrition and exercise program for older adults on nutrition knowledge, dietary intake, anthropometric measurements, and serum lipids. *J Nutr Educ* 1990; 22: 271-4.
100. Parmenter K, Waller J, Wardle J. Demographic variation in nutrition knowledge in England. *Health Educ Res* 2000; 15: 163-74.
101. Hand R, Antrim LR, Crabtree DA. Differences in the technical and applied nutrition knowledge of older adults. *J Nutr Elder* 1990; 9: 23-34.
102. Turrell G, Kavanagh AM. Socio-economic pathways to diet: modelling the association between socio-economic position and food purchasing behaviour. *Public Health Nutr* 2006; 9: 375-83.
103. Worsley A. Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? *Asia Pac J Clin Nutr* 2002; 11: S579-85.

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