

# Geriatric Nutrition & role of nutrition in Sarcopenia

Shashi Tripathi<sup>1</sup>, Dr. Kirti Joshi<sup>2</sup>

\*<sup>1</sup>Research Scholar, Jayoti Vidyapeeth Women's University, Jaipur, shashitripathi486@gmail.com

<sup>2</sup>Assistant Professor, Jayoti Vidyapeeth Women's University, Jaipur, drkirtijoshi@jvwu.ac.in

## ABSTRACT

Old age is considered as ignored stage in our society. It is because of their lesser physical abilities resulted lesser contribution in family and society. Proper nutrition and cooperation may provide them a healthy and social life. Considering all above factors, geriatric nutrition may retard the process of different kind of changes in old age people by providing them proper nutrition and physical care. The cornerstone of geriatric nutrition is a well-balanced diet.

Early aging as well as geriatric disease foreshorten life, but both can be prevented to some extent by diet and exercise or by just diet itself. In this order sarcopenia is an age-related condition that can make activities like walking more difficult. To prevent muscle loss, change lifestyle can manage of sarcopenia.

After taking advice from a doctor, older adults can start an exercise program. Disease control and prevention centers provide activities like muscle strengthening minimum of two days a week for older adults.

So we can say proper diet and strength training can help people's to fight against sarcopenia. Healthy sources of nutrients especially enough protein, such as fish, nuts, lentils etc. are an important dietary consideration in preventing sarcopenia.

Considering all above facts, we can prevent or retard different changes (physical as well as psychological) by providing proper nutrition and physical care through geriatric nutrition.

**KEYWORDS:** Geriatric nutrition, sarcopenia, nutrition, balance diet

*Article Received: 10 August 2020, Revised: 25 October 2020, Accepted: 18 November 2020*

## I. GERIATRICS NUTRITION

The world population is growing older rapidly, while fertility rates are decreasing and people are living for longer periods due to socioeconomic changes and health initiatives. For an example global population of 65 years old is estimated to be 1.6 billion [1]. Geriatric nutrition applies nutrition principles to delay effects of aging and disease, to aid in the management of the physical, psychological, and psychosocial changes commonly associated with growing old. Functional foods provide not only daily required nutrients but also other secondary metabolites with biological activities and physiological benefits to protect from infections and diseases. Nearly 2500 years ago, the familiar phrase "Let food be thy medicine and medicine be thy food" was coined by Hippocrates. Due to aging effect, the metabolic activity progressively decreases in elderly population of over 65 years. Hence, they should provide balance medication with healthy food habits as well as regular exercise to maintain good health and longevity. Selective functional foods help the elderly to cut down and/or eliminate the medicinal intake by improving their physiological functions. In such cases, functional foods should become an integral part of daily diet [2]. Functional foods are extremely beneficial components which found naturally in foods or added to the regular diet which include secondary metabolites, prebiotics, probiotics, synbiotics in addition

to the usual vitamins, minerals and amino acids. These contain biologically beneficial carotenoids, fatty acids, flavonoids, betalains, phenols, phenolic acids, phytosterols, alkaloids, phytoestrogens and dietary fiber. Some functional components of these foods play a major role in health improvement in the elderly. Medical professional as well as nutritionist, practicing geriatric care should be well informed about functional food intake in the elderly. To avoid the allergies and synergic side effects with the prescription drugs, Foods like oats, soy and Psyllium husk which are rich in fiber, low in saturated fat, cholesterol reduce the risk of cardiovascular diseases [3]. In addition, foods containing at least 0.65 grams of phytosterols consumed twice a day with meal might reduce the risk of heart disease. These health claims were approved by Food and Drug Administration (FDA) [4].

A well-adjusted eating routine is the foundation of Geriatric nutrition, which gives an ideal nourishment for the protection against coronary illness, stroke and cancer. All elderly people need counsel on the changing requirements for dietary assortment with maturing to look after wellbeing. Diseases that can be healthfully prevented, giving us a more well-known opportunity of accomplishing our genetically determined life expectancies, include continuous eating practice related infections, for example, non-insulin-dependent diabetes, hypertension, coronary heart disease and cancer & incapacities coming about because of these

ailments and from degenerative joint pain are additionally subject to adjustment by eating habit. Older people usually need less calories and comparative supplement admissions contrasted and those of younger individuals [5, 6]. Malnutrition plays a key role in the pathogenesis of both weakness and sarcopenia. Old are especially in danger for minor insufficiency of nutrients and follow components.

#### *A. DIETARY GUIDELINES AND NUTRITIONAL REQUIREMENT IN AGING*

Physical illnesses and poverty were significantly correlated with geriatric depression [7]. Social isolation becomes a big problem among elderly due to declining income, health problems and loss of spouse or friends. These all may affect appetite and thus resulting in poor nutritional status. Decrease in all the senses, particularly in the taste buds that affect appetite. Constipation is the major problem faced by elderly. Denture wearers chew less efficiently than those with natural teeth. Insulin secretion usually decreases, which can lead to carbohydrate intolerance, and renal function deteriorates in the 40s for some people [8]. The relationship between poverty, social isolation, physical health and mental health is very complex in nature [9].

A diet consisting of foods from various food groups provides all the required nutrients in proper amounts. They help in prevention of micronutrient malnutrition and certain chronic diseases such as cardiovascular diseases, cataract and cancer. Fresh fruits are nutritionally superior to fruit juices. Overweight and obese individuals are at an enhanced risk of comorbidities including type 2 diabetes, fatty liver disease, gallstones, high blood cholesterol and triglycerides, orthopedic disorders (Osteoarthritis), hypertension and other cardiovascular diseases, certain cancers and psycho-social problems. Eat variety of foods to ensure a balanced diet. Processed foods being rich in fats, salt, sugar and preservatives may pose a health risk if consumed regularly. Water is the most important nutrient of all and helps in the upkeep of our health. Healthy and positive food concepts along with cooking practices are foundation for good health. Senior citizens need more of vitamins and minerals to remain healthy and active.

Elderly people should try to incorporate variety of nutrient-rich foods. They should counter balance of food intake with physical activity. Food consumption should be divided in many portions in a day. Food with more oil and spices should be avoided. Body movements are essential in elderly in the form of exercises like walk, yoga etc regularly. This will control the body weight and composition, reduces risk of chronic diseases, such as Type 2 diabetes, hypertension, heart disease, osteoporosis, arthritis and certain types of

cancers. It also helps in building strong muscles, bones and joints, improves flexibility [10]. For proper nutrition, consumption of a wide variety of foods across all food groups and a wide selection within each of these groups is very necessary, which include nutrient dense foods like fruits, vegetables, whole grain, cereals and pulses, low-fat milk and dairy products, nuts, soybean products, fish etc. Emphasize healthy traditional dishes like dal palak, dal methi, sprouts chat, vegetable raita, missi roti, carrot halwa with nuts to name a few. Encourage consumption of available protective foods (fish, nuts, garlic, onion, cruciferous and leafy vegetables, tomatoes, soy, other pulses, citrus fruits, grapes, berries, herbs, spices and green tea etc) followed by limiting traditional dishes/foods like mithai, cream, pastries, balushahi, achars heavily preserved/pickled in salt, or fried bhaturas, mathi, kachodi, dalmoth, patties etc. Consume mono-unsaturated and poly-unsaturated dietary visible fats obtained from mustard, rice bran, soybean, safflower, groundnut, sunflower, til, and limit fatty spreads in cooking or on bread containing saturated fats and trans fats. Minimize or combine foods containing hidden animal fats (fatty meat, full-fat dairy products, some fast/processed food, and hydrogenated plant fats (some fast/processed food, commercial cakes/biscuits). Limit visible oil consumption to about 20g/day. Added oils may assist in the absorption of fat-soluble nutrients and phytochemicals from plant foods. Consume a variety of fats for cooking which have been minimally processed [11].

#### *B. ANALYSIS OF NUTRITIONAL NEEDS OF ELDERLY PERSON*

Analysis of nutritional needs can be made by following

1. Thorough medical history of elderly person
2. Physical examination
3. Dietary history
4. Pathological results
5. Weight evaluation (BMI of 21 to 27)
6. Dehydration evaluation (which includes physical assessment of skin, assessment of fluid intake, High level of Blood Urea Nitrogen (BUN), albumin, serum sodium and serum osmolality indicate dehydration)

#### *C. FULFILLMENT OF NUTRITIONAL REQUIREMENTS*

Fulfillment of nutritional requirements can be made by following steps

1. Encourage healthier food options
2. Snacking on healthy foods to get extra nutrients and calories
3. Encouraging exercise
4. Make food taste good again
5. Plan social activities

6. Consider adding supplements to your loved one's diet.

## II. SARCOPENIA

Muscle loss associated with age or sarcopenia, was formulated for the first time by Rosenberg in 1997. The definitions of sarcopenia were based solely on muscle mass initially. As muscle strength and physical performance cannot be explained completely by muscle mass as well as muscle mass alone does not predict disability or other outcomes. The current consensus definitions of sarcopenia include measurements of muscle strength and physical performance. It is the loss of muscle mass due to the natural aging process of a person. This decrease in muscle leads to a reduction in a person's strength. As a result, their balance and walk are also affected.

Sarcopenia can have an impact on person's ability to perform day to day activities including climbing stairs, lifting objects and walking. Sarcopenia is an age-related condition that can make every day normal activities, such as walking, more difficult. According to the International Osteoporosis Foundation (IOF), muscle mass starts to decline around the age of 40. The loss of muscle tissue may progress more rapidly when a person reaches their 60s and 70s [12]. Diet and nutrition optimization status during the life may be an important strategy to preventing sarcopenia and enhancing physical ability in older age [13]. To help elder's make good eating choices, HNRCA (Human Nutrition Research Center on Aging) scientists released an updated version of My Plate for Older Adults, an infographic which provides a simple, pictorial guide to a healthy diet. A recent survey conducted by the AARP Foundation, which sponsored and partnered with the HNRCA on the MyPlate project, found that while interest in eating nutritious foods increases with age, understanding of what's on a nutrition label decline. "There is a real need to fill that gap and ensure older adults have the knowledge and resources they need when they are choosing what to eat," said Alex Lewin-Zwerdling, a senior advisor for the AARP Foundation. To generalize it, HNRCA researchers recently helped the Harvard Pilgrim Health Care Foundation create a booklet, "Healthy, Delicious Food at Every Age," which highlights how seniors can shop for, cook and even grow nutritious food; the publication describes some of the most common food and drug interactions as well. Researchers in the HNRCA's Nutrition, Exercise Physiology and Sarcopenia Laboratory also worked with three Boston senior centers to create the Fit-4-Life program, which combines nutrition education with instruction on aerobic and mobility exercises [14].

## A. INFLUENCE OF DIET ON SARCOPENIA

There are two consequences of declining food intakes in older age that could be important for muscle mass and strength. Firstly, lower energy intakes, if not matched by lower levels of energy expenditure, lead to weight loss, including a loss of muscle mass [15]. Secondly, as older people consume smaller amounts of food, it may become more challenging for them to meet their nutrient needs—particularly for micronutrients. For older people with low food intakes, this highlights the importance of having diets of adequate quality. Although the importance of adequate nutrition has been recognized for a long time, its contribution to muscle mass and strength has not been studied extensively and much of the research in this area is relatively new [16]. A number of interventions have been studied, ranging from provision of nutritional support [17], to supplementation with specific nutrients [18, 19]. The nutrients that have been most consistently linked to sarcopenia and frailty in older adults are vitamin D, protein, and a number of antioxidant nutrients, that include carotenoids, selenium, and vitamins E and C. However, there is also some evidence that variations in long-chain polyunsaturated fatty acid status may have important effects on muscle strength in older people [19].

### 1) PROTEIN

Among all nutrients, Protein is considered a key nutrient in older age [20]. Dietary protein provides amino acids that are needed for the synthesis of muscle protein, and importantly, absorbed amino acids have a stimulatory effect on muscle protein synthesis after feeding [21]. There is some evidence that the synthetic response to amino acid intake may be weakened in older people, particularly at low intakes [20], and when protein is consumed together with carbohydrate [22]. Recommended protein intakes may, therefore, need to be raised in older people in order to maintain nitrogen balance and to protect them from sarcopenic muscle loss [20]. If sarcopenia resulted from inadequate protein intakes, this would mean that anabolic resistance could be overcome by higher protein intakes. In fact, most studies indicate that protein intakes and sarcopenia are unrelated with only very limited evidence indicating a relationship. As for longitudinal studies of muscle mass and protein intake, few have been reported. An analysis of the 1993 and 1997 China Health and Nutrition Surveys of older adults ( $n = 608$ , 50–70 years) reported that in those who lost muscle over the 4 years during surveys, muscle-mass change was not associated with protein intakes [23]. The differences were significant, such that the participants with protein intakes in the top fifth of the distribution lost 40% less lean mass over the follow-up period when compared with those in bottom

fifth. Protein and/or amino acid supplementation should, therefore, have the potential to slow sarcopenic muscle loss. However, whilst amino acid supplementation has been shown to increase lean mass and improve physical function, other trials have not been successful [22]. Further work, including longer-term trials, is needed to define optimal protein intakes in older age [22].

## 2) VITAMIN D

An association between vitamin-D-deficient osteomalacia and myopathy has been recognised for many years [24], but the role of vitamin D, and the extent to which it has direct effects on normal muscle strength and physical function remains controversial [25]. The potential mechanisms that link vitamin D status to muscle function are complex and include both genomic and nongenomic roles [24, 26]. The vitamin D receptor (VDR) has been isolated from skeletal muscle, indicating that it is a target organ [24], and polymorphisms of the VDR have been shown to be related to differences in muscle strength [27]. At the genomic level, binding of the biologically active form of the vitamin (1,25-dihydroxyvitamin D) results in enhanced transcription of a range of proteins, including those involved in calcium metabolism [24]. The nongenomic actions of vitamin D are currently less well understood [26].

Much of the epidemiological literature is consistent with the possibility that there are direct effects of vitamin D on muscle strength. For example, among men and women aged 60 years and older in NHANES III, low vitamin D status (serum 25-hydroxyvitamin D < 15 ng mL<sup>-1</sup>) was associated with a fourfold increase in risk of frailty [28], and in a meta-analysis of supplementation studies of older adults, Bischoff-Ferrari et al. [18] showed that supplemental vitamin D (700–1000 IU per day) reduced the risk of falling by 19%. However, the evidence is not always consistent as some observational studies find no association between vitamin D status and physical function, and supplementation studies have not always resulted in measurable improvements in function [25]. In a review of published studies, Annweiler and colleagues [25] discuss the reasons for the divergence in study findings, some of which may be due to methodological differences, including a lack of consideration of confounding influences in some studies. Further evidence is needed, particularly as vitamin D insufficiency is common among older adults [28].

## 3) ANTIOXIDANT NUTRIENTS

There is increasing interest in the role of oxidative stress in aetiology of sarcopenia, and markers of

oxidative damage have been shown to predict impairments in physical function in older adults [29]. Damage to biomolecules such as DNA, lipid, and proteins may occur when reactive oxygen species (ROS) are present in cells in excess. The actions of ROS are normally counterbalanced by antioxidant defence mechanisms that include the enzymes superoxide dismutase and glutathione peroxidase, as well as exogenous antioxidants derived from the diet, such as selenium, carotenoids, tocopherols, flavonoids, and other plant polyphenols [21, 29]. In older age, an accumulation of ROS may lead to oxidative damage and contribute to losses of muscle mass and strength [21].

Lot of observational studies have shown positive associations between higher antioxidant status and measures of physical function [16]. It is remarkable that these associations are seen both in cross-sectional analyses and in longitudinal studies, such that poor status is predictive of decline in function. The observed effects are striking. For example, among older men and women in the InCHIANTI study (a representative population-based study of older persons living in the Chianti geographic area in Tuscany, Italy), higher plasma carotenoid concentrations were associated with a lower risk of developing a severe walking disability over a follow-up period of 6 years; after taking account of confounders that included level of physical activity and other morbidity, the odds ratio was 0.44 (95% CI 0.27–0.74) [30]. Inverse associations have also been described for vitamin E and selenium status and risk of impaired physical function [16]. There have been few studies of older adults to determine how antioxidant supplementation affects muscle strength, and the benefits of supplementation remain uncertain [31]. Since ROS have both physiological and pathological roles, interventions based on simple suppression of their activities may be unlikely to improve age-related declines in muscle mass and function [32]. However, low antioxidant intakes and status are common [33], and this remains an important question to be addressed.

## III. CONCLUSION

To develop strategies to prevent or delay sarcopenia, a better understanding is needed of the lifestyle factors that influence the rate of decline of muscle mass and strength in older age, and the mechanisms involved. Existing evidence indicates the potential importance of diets of adequate quantity and quality, to ensure sufficient intakes of protein, vitamin D, and antioxidant nutrients. Although much of this evidence is observational and the mechanisms are not fully understood, the high prevalence of low nutrient intakes and poor status among older adults make this a current



concern. However, muscle mass and strength achieved in later life are not only determined by the rate of muscle loss, but also reflect the peak attained earlier in life, and efforts to prevent sarcopenia also need to recognise the potential effectiveness of interventions earlier in the life course. Optimising diet and nutrition throughout life may be key to preventing sarcopenia and promoting physical capability in older age.

#### IV. REFERENCES

1. He W, Goodkind D, Kowal P (2016) *An aging world (2015) International Population Reports. United States Census Bureau, US Department of Health and Human Services, National Institute of Health, Washington, DC, USA.* .
2. Institute of Food Technologists, Expert Report (2005) *Functional foods: opportunities and challenge.*
3. Motohashi, N., Gallagher, R., Anuradha, V., & Gollapudi, R. (2017). *Functional foods and their importance in geriatric nutrition. J Clin Nutr Metab* 1, 1, 2.
4. Hasler CM (2002) *Functional foods: benefits, concerns and challenges-A position paper from the American Council on Science Health. J Nutr* 132: 3772-37819 (5,6) Walston J, Hadley E, Ferrucci L et al (2006) *Research agenda for frailty in older adults: toward a better understanding of physiology and etiology: summary from the American Geriatrics Society/National Institute on Aging Research Conference on Frailty in Older Adults. J Am Geriatr Soc* 54:991-1001. doi:10.1111/j.1532-5415.2006.00745.x9
6. Walston JD (2012) *Sarcopenia in older adults. Curr Opin Rheumatol* 24:623-627. doi:10.1097/BOR.0b013e328358d59b
7. Jain, R.K. and Aras, R.Y. (2007). *Depression in geriatric population in urban slums of Mumbai. Indian Journal of Public Health*, 51: 112-113
8. Martin, P., Poon, L.W., and Hagberg, B. (2011). *Editorial - Behavioral factors of longevity. Journal of Aging Research*, 2011, 1-2. doi: 10.4061/2011/197590
9. Kuruvilla, A. and Jacob, K.S. (2007). *Poverty, Social stress & Mental Health. Indian Journal of medical Research*, 126:273-278.
10. Bates, C.J., Benton, D., Biesalski, H.K., Staehelin, H.B., Staveren, W., Stehle, P., Suter, P.M. and Wolfram, G. (2002). *Nutrition and Aging: A Consensus Statement. Journal of Natural Health Aging*, 6:103-160
11. Joshi, S. A. (2010). *Nutrition and Dietetics. Introduction to Nutrition and Dietetics*, pp 5
12. Rosenberg IH (2011) *Sarcopenia: origins and clinical relevance. Clin Geriatr Med* 27:337-339. doi: 10.1016/j.cger.2011.03.003
13. Abiri, Behnaz, and Mohammadreza Vafa. "Nutrition and sarcopenia: A review of the evidence of nutritional influences." *Critical reviews in food science and nutrition* 59.9 (2019): 1456-1466.
14. Gershoff Stanley & Meydani Simin, Nutritional challenges as we age. [https://now.tufts.edu\(2020\).Nutritional challenges as we age](https://now.tufts.edu(2020).Nutritional challenges as we age). URL
15. W. F. Nieuwenhuizen, H. Weenen, P. Rigby, and M. M. Hetherington, "Older adults and patients in need of nutritional support: review of current treatment options and factors influencing nutritional intake," *Clinical Nutrition*, vol. 29, no. 2, pp. 160-169, 2010. View at: [Publisher Site](#) | [Google Scholar](#)
16. M. Kaiser, S. Bandinelli, and B. Lunenfeld, "Frailty and the role of nutrition in older people. A review of the current literature," *Acta Biomedica*, vol. 81, supplement 1, pp. 37-45, 2010. View at: [Google Scholar](#)
17. L. Ha, T. Hauge, A. B. Spinning, and P. O. Iversen, "Individual, nutritional support prevents undernutrition, increases muscle strength and improves QoL among elderly at nutritional risk hospitalized for acute stroke: a randomized, controlled trial," *Clinical Nutrition*, vol. 29, no. 5, pp. 567-573, 2010. View at: [Publisher Site](#) | [Google Scholar](#)
18. H. A. Bischoff-Ferrari, B. Dawson-Hughes, H. B. Staehelin et al., "Fall prevention with supplemental and active forms of vitamin D: a meta-analysis of randomised controlled trials," *British Medical Journal*, vol. 339, Article ID b3692, 2009. View at: [Publisher Site](#) | [Google Scholar](#)
19. P. C. Calder, "n-3 Polyunsaturated fatty acids, inflammation, and inflammatory diseases," *American Journal of Clinical Nutrition*, vol. 83, supplement 6, pp. 1505S-1519S, 2006. View at: [Google Scholar](#)
20. R. R. Wolfe, S. L. Miller, and K. B. Miller, "Optimal protein intake in the elderly," *Clinical Nutrition*, vol. 27, no. 5, pp. 675-684, 2008. View at: [Publisher Site](#) | [Google Scholar](#)

21. J. S. Kim, J. M. Wilson, and S. R. Lee, "Dietary implications on mechanisms of sarcopenia: roles of protein, amino acids and antioxidants," *Journal of Nutritional Biochemistry*, vol. 21, no. 1, pp. 1–13, 2010. View at: [Publisher Site](#) / [Google Scholar](#)
22. D. Paddon-Jones and B. B. Rasmussen, "Dietary protein recommendations and the prevention of sarcopenia," *Current Opinion in Clinical Nutrition and Metabolic Care*, vol. 12, no. 1, pp. 86–90, 2009. View at: [Publisher Site](#) / [Google Scholar](#)
23. Stookey, JD, Adair, L, Stevens, J et al. (2001) Patterns of long-term change in body composition are associated with diet, activity, income and urban residence among older adults in China. *J Nutr* 131, 2433S–2440S. CrossRef / [Google Scholar](#) / [Google Scholar](#)
24. B. Hamilton, "Vitamin D and human skeletal muscle," *Scandinavian Journal of Medicine and Science in Sports*, vol. 20, no. 2, pp. 182–190, 2010. View at: [Publisher Site](#) / [Google Scholar](#)
25. C. Annweiler, A. M. Schott, G. Berrut, B. Fantino, and O. Beauchet, "Vitamin D-related changes in physical performance: a systematic review," *Journal of Nutrition, Health and Aging*, vol. 13, no. 10, pp. 893–898, 2009. View at: [Publisher Site](#) / [Google Scholar](#)
26. L. Ceglia, "Vitamin D and its role in skeletal muscle," *Current Opinion in Clinical Nutrition and Metabolic Care*, vol. 12, no. 6, pp. 628–633, 2009. View at: [Publisher Site](#) / [Google Scholar](#)
27. D. Fusco, G. Colloca, M. R. Lo Monaco, and M. Cesari, "Effects of antioxidant supplementation on the aging process," *Clinical Interventions in Aging*, vol. 2, no. 3, pp. 377–387, 2007. View at: [Google Scholar](#)
28. M. J. Jackson, "Strategies for reducing oxidative damage in ageing skeletal muscle," *Advanced Drug Delivery Reviews*, vol. 61, no. 14, pp. 1363–1368, 2009. View at: [Publisher Site](#) / [Google Scholar](#)
29. R. D. Semba, L. Ferrucci, K. Sun et al., "Oxidative stress and severe walking disability among older women," *The American Journal of Medicine*, vol. 120, no. 12, pp. 1084–1089, 2007. View at: [Publisher Site](#) / [Google Scholar](#)
30. F. Lauretani, R. D. Semba, S. Bandinelli et al., "Carotenoids as protection against disability in older persons," *Rejuvenation Research*, vol. 11, no. 3, pp. 557–563, 2008. View at: [Publisher Site](#) / [Google Scholar](#)
31. D. Fusco, G. Colloca, M. R. Lo Monaco, and M. Cesari, "Effects of antioxidant supplementation on the aging process," *Clinical Interventions in Aging*, vol. 2, no. 3, pp. 377–387, 2007. View at: [Google Scholar](#)
32. M. J. Jackson, "Strategies for reducing oxidative damage in ageing skeletal muscle," *Advanced Drug Delivery Reviews*, vol. 61, no. 14, pp. 1363–1368, 2009. View at: [Publisher Site](#) / [Google Scholar](#)
33. J. P. Stimpson, A. C. Nash, H. Ju, and K. Eschbach, "Neighborhood deprivation is associated with lower levels of serum carotenoids among adults participating in the third national health and nutrition examination survey," *Journal of the American Dietetic Association*, vol. 107, no. 11, pp. 1895–1902, 2007. View at: [Publisher Site](#) / [Google Scholar](#) on a preprint server as soon as possible. We will be providing unlimited waivers of as a reviewer to help

\*\*\*