THE EFFECT OF A FRESH FRUIT AND VEGETABLE DELIVERY ON THE HEALTH AND INDEPENDENCE OF SENIORS

Miryem Salah[1]
Moisson Montréal, Canada

George Grimble[2]
University College London, (UCL), UK

Abstract

Purpose: The purpose of this study was to determine the effect of a fresh fruit and vegetable delivery on the health and independence of seniors. The habitual consumption of fruits and vegetables (F&V) in accordance with recommendations has shown to have a protective effect on the onset of non- communicable diseases. However, little literature is available that reports on the effect of such interventions on the health and well being of seniors.

Design/methodology/approach: The paper reports on 72 participants, aged over 50 years, who received a nutrition intervention consisting of weekly deliveries of F&V for 12 weeks; this was complemented by cooking sessions in a community kitchen. In this study, health benefits as well as the impact on independence were set to be extrapolated from change in Likert scale scores, for both dietary intakes and the perception of well-being and independence.

Findings: A notable increase in F&V intakes were found for both genders receiving the intervention while no change was noted in the control group.

Research limitations/implications – Future research should assess the changes in biological markers such as cholesterol levels, etc., of subjects receiving the

International Journal
of Food, Nutrition and
Public Health (IJFNPH)
Vol. 6 No. 2, 2013

[1]Miryem Salah BSc, MSc, Community Development Coordinator, Moisson Montréal, 1000 de la commune est Montreal #511, Montréal (Québec) H2L5C1, poste 257 | 514 703-7561, Email: smiryem@hotmail.com

[2]Dr George Grimble, Principal Teaching Fellow, UCL, Centre for Gastroenterology and Nutrition, Rockefeller Building, Gower Street, London WC1E 6BT UK, Email: g.grimble@ucl.ac.uk

intervention. A longer duration would also be more representative of health changes.

Practical implications: Such interventions, if implemented nationally, can have a great economical impact on the NHS, as they play a preventive role by delaying the onset of non-communicable diseases.

Social implications: Reports that subjects felt more independent and part of the community after attending the cooking sessions can help tackle problems related to social isolation common to the ageing population.

Originality/value: No similar research was available in the literature; this will benefit not only the nutrition community but also public health policy makers.

Keywords: Fruits and vegetables, Elderly, Non-communicable diseases, Health, Well-being.

INTRODUCTION

Worldwide, the population aged over 60 years is the fastest growing (WHO, 2002). In the United Kingdom, there has been an increase in the proportion of the population over 65 years; with a greater increase in those over 85 years of age (Office for National Statistics, 2009). These demographic changes highlight the importance of understanding the ageing process in relation to formulating public health strategies to provide better prevention and treatment services.

Unhealthy diets are well established as crucial determinants when addressing chronic disease, ageing and mortality (Kalache *et al.*, 2002). Improving nutritional status of older adults not only facilitates the prevention and delays the onset of chronic diseases but also improves quality of life. These are key objectives in public health campaigns targeting older adults (Chernoff, 2001). Of particular relevance is the inverse relationship found in the National Health And Nutrition Examination Survey (NHANES) between fruit and vegetable intakes, and both cardiovascular disease and all-cause mortality (Bazzano *et al.*, 2002). Moreover, a meta analysis of the literature concluded that increased dietary intake of vegetables could significantly reduce risks of type 2 Diabetes Mellitus (Carter *et al.*, 2010). It is such evidence that provided the rationale to investigate the effect of increased fruit and vegetable intakes on health status indicators for the elderly.

In a recent systematic review, a positive association was reported between fruit and vegetable intake and living in an advantaged area (Kamphuis *et al.*, 2006). Hackney council remains the second most deprived borough in the country with high levels of unemployment. Even with a fall in their incidence, CVD, cancer and other chronic disease rates are higher compared to other parts of the country (City and Hackney teaching primary trust, 2008). With lower income and less access to services and support, the elderly are at higher risk of isolation, malnutrition and consequent health problems (Cade, 2008); health benefits are certainly achievable from interventions such as the Seniors' Healthy Eating Programme (SHEP). Through a regular delivery of fresh fruits and vegetables combined with locally held cooking sessions, SHEP aimed at promoting better health and independence for participants. The cooking sessions aimed at influencing the normative beliefs to eat more fruits and vegetables by enhancing their knowledge on how to incorporate more fruits and vegetables to their diets (Sjoberg, 2004).

A final feedback conducted at the end of the intervention was used to verify the sustainability of such programmes.

Aim (primary objective)

- To assess the impact of the SHEP on the health, well-being and independence of free-living elderly in Hackney

Research methodology/investigative plan

- Design a cross-sectional health and nutrition questionnaire
- Design feedback forms to assess the sustainability of the SHEP
- Recruit and carry out interviews of participants taking part in the SHEP and a control group not receiving the intervention.

METHODS

Design and delivery of the SHEP

The most important barriers to consuming fresh produce remain local availability, ill health, and economic factors (Kamphuis *et al.*, 2006). East London Food Access (ELFA) supports community health and well-being through the promotion and delivery of fresh produce to residents on housing estates across Hackney. Moreover, it operates six fresh food co-ops in disadvantaged areas; many of which cater to elderly individuals suffering from poor access to shops that stock fresh produce, due to lack of mobility.

Hypothesis

- There should be a significant increase in fruit and vegetable intake for all participants receiving the intervention. No significant change should be noted for the control group
- There should be an improvement in the participants' perception of their health status, wellbeing and independence following the intervention. No significant change should be noted for the control group

METHODS AND MONITORING STANDARDS

A total of 108 individuals received the fruit and vegetable deliveries; those who did not match the inclusion criteria of the research (e.g. could not commit for 12 weeks), were not included. The deliveries were

planned according to the participants' preferences and food allergies and medical aversions were taken into consideration. The participants receiving the deliveries also attended weekly cooking sessions in a community kitchen.

Seventy two participants were recruited; all were over 50 years of age; 42 were interviewed face to face, 8 of which were assigned to the control group the remaining 30 enrolled were interviewed only at the end of the intervention. Leaflets were distributed in north east Hackney. SHEP was also promoted in community events, such as Age Concern's coffee morning. Participants were interviewed before and at the end of the 12 week intervention. This was a blind experimental study, where participants were randomly (probability sample) assigned to either the intervention or control group. The control group was interviewed similarly to the intervention group but participants did not receive deliveries and did not attend cooking sessions.

A 24-hour dietary recall questionnaire was chosen as the best suited assessment method for SHEP given the constraints of this pilot study (Bingham, 2003) . It was used to assess fruit and vegetable intake and was complemented by a 7-day fruit and vegetable prospective record to increase the reliability of the estimates. Compliance to the 7 day diary was very low and estimates were therefore not analysed. Guidance was available to standardise the interview's protocol to all subjects and the Food Standards Agency (FSA)'s portion size leaflet was handed to participants to help estimate their daily portions. Mean fruit and vegetable intake was calculated before and after the delivery, based on the self-reported diaries. Combining knowledge from the nutrition screening initiative (Posner *et al.*, 1993) and the malnutrition universal screening tool (MUST), an appropriate multi-dimensional Likert questionnaire was designed to ascertain the impact of SHEP on the test group/participants. The rationale behind using different assessment methods was to gain perspective from different angles and obtain more precise, accurate and reliable results. A study into self-reported multidimensional questionnaires found that when compared to interviewing, the self-reported style was less reliable and problematic. Therefore, in order to increase the reliability of the collected data, questionnaires were carried out during an interview performed by a researcher. The Likert questionnaire aimed at assessing the respondent's change in their perception of barriers to healthy eating, physical health and independence.

STATISTICAL ANALYSES

All data were first input then reviewed by the principal researcher; statistical analyses were then conducted in both Microsoft Excel® and SPPS 17.0®. Descriptive statistics provide details of the participants recruited and interviewed at the beginning of the programme.

Inferential statistics were used to draw conclusions about the population using sample data. At the end of the intervention, full data were collected from 28 of the 42 initially interviewed participants. T-testing compared intakes before and after for both test and control groups using 24-hour dietary recall data. A factorial Anova testing 2 within (time) by 2 between (groups) was conducted to assess the changes in the scores overtime between the intervention and the control group. Further Ancova testing looking for differences at post-SHEP between intervention and control taking into consideration the pre-SHEP scores was also conducted. All factorial Anovas and Ancovas were conducted for each question provided in the questionnaire and for groups of related questions. Further analysis by comparing the sum of scores for both participants and control group was conducted using paired t tests when appropriate.

RESULTS

Table 1 represents descriptive statistics for the participants interviewed before the launch of the intervention; also reported are the subjects' barriers to healthy eating and health conditions affecting their diets.

There was no significant difference in fruit and vegetable consumption by gender pre-SHEP (P=0.59) nor post-SHEP (P=0.83). Participants reported a significant increase in fruit and vegetable intake after the intervention; the mean increased from 2.45 portions a day pre-SHEP to 3.27 post-SHEP (P=0.001). Similarly, there was a strong statistical difference for intake before and after the intervention by gender; males (P=0.01) and females (P=0.03). No significant difference in F&V intake was found for the control group; with a mean of 2.43 pre-SHEP and 2.68 post-SHEP (P=0.17).

Figure 1 represents the scores for each of the Likert questions before and after the intervention for both groups. When accounting for the initial scores, a significant difference (P=0.002) was found for scores over time in the intervention group; none was found for the control group (P=0.907).

	Intervention (n=34)	Control (n=8)
Gender (n)		
Male	15	3
Female	19	5
Age (years)		
50-65	18%	25%
Over 65	82%	25%
Ethnicity		
White	50%	62.5%
Mixed		
Asian/Asian British		12.5%
Black/Black British	50%	
Other		25%
Disability		
None	44%	37.5%
Hearing	3%	12.5%
Vision		
Mobility	18%	50%
Long-term illness	3%	
More than 1	29%	
Household cook		
Yourself	62%	62.5%
More than 1	8%	25%
Other	30%	12.5%
Do you have any health conditions		
None	21%	
Diabetes	9%	12.5%
Hypertension	11%	37.5%
High cholesterol	3%	
More than 1	47%	25%
Other	9%	25%
Barriers to cooking fresh, healthy fruits and vegetables		
None		76%
Illness		
Medications	3%	
Mouth, chewing problems	9%	12.5%
Gastrointestinal problems	12%	
I eat mainly tinned foods	6%	37.5%
I don't enjoy/ know how to cook	9%	
I eat out more than I eat at home		12.5%

Table I.
Descriptive statistics for participants before the interventio

Intervention		N	Minimum	Maximum	Mean	Std. Deviation
control	PRE_Q1_Mean	8	3.33	4.67	3.8750	.43416
	POST_Q1_Mean	8	3.00	4.67	3.8750	.50198
	PRE_Q2_Mean	8	2.00	5.00	3.1667	1.09834
	POST_Q2_Mean	8	2.00	5.00	3.1250	1.14000
	PRE_Q3_Mean	8	3.00	5.00	4.1667	.75593
	POST_Q3_Mean	8	3.33	5.00	4.2083	.68863
	PRE_Q4_Mean	8	2.00	5.00	3.3750	.98299
	POST_Q4_Mean	8	2.00	5.00	3.3333	.97590
	PRE_Total_Mean	8	2.75	4.33	3.6458	.58715
	POST_Total_Mean	8	2.75	4.42	3.6354	.55979
	Valid N (listwise)	8				
intervention	PRE_Q1_Mean	20	2.67	5.00	3.9667	.62032
	POST_Q1_Mean	20	2.67	5.00	4.3250	.57855
	PRE_Q2_Mean	20	1.67	4.33	3.0167	.81273
	POST_Q2_Mean	20	2.00	4.33	2.9167	.74829
	PRE_Q3_Mean	20	1.33	4.33	3.4000	.85567
	POST_Q3_Mean	20	2.00	5.00	3.6500	.90143
	PRE_Q4_Mean	20	2.33	5.00	3.5000	.81291
	POST_Q4_Mean	20	2.67	4.67	3.7500	.52843
	PRE_Total_Mean	20	2.83	4.08	3.4708	.33907
	POST_Total_Mean	20	2.92	4.33	3.6604	.38003
	Valid N (listwise)	20				

Figure 1. Descriptive statistics for Likert scores

Correlation test for the median Likert scores pre and post SHEP showed a mild positive correlation (r=0.38) while for the control group it showed a strong, almost perfect, correlation (r=0.99).

Likert score, sum of all questions before and after the intervention, showed an increase in the mean score 41.65 pre-SHEP to 43.92 post-SHEP (*P*=0.006). Likert score, sum of all questions before and after the intervention for the control group showed a mean decrease from 43.75 pre-SHEP to 43.62 post-SHEP (*P*=0.85). The mean Likert scores were also analysed using paired t tests; the participants group showed a mean increased from 3.2 pre-SHEP to 3.4 post-SHEP (*P*=0.11) while the control group showed a mean decrease from 3.45 to 3.41 with (*P*=0.39).

LIMITATIONS

Duration, sample size and use of questionnaires instead of biological markers remain design limitations that could be accounted for in future research. For example, serological markers for cholesterol and fasting

glucose should be included; these are more representative but expensive and complicated tests.

The lack of statistical power, in this case less than the 0.8 minimum, explains that statistical significance was not found in some tests; sample size is accountable for this low statistical power.

DISCUSSION

This is the first study, surprisingly, to investigate the effect of a fruit and vegetable delivery combined with healthy cooking sessions on the health and independence of free-living elderly. The most important findings were that the participants:

1. Consumed more fruit and vegetable at the end of the intervention
2. Scored higher in the Likert questionnaire, even if not statistically significant in all cases of analysis
3. Expressed the positive effect they felt on their independence
4. Expressed their interest in continuing to receive the intervention.

FRUIT AND VEGETABLE INTAKE

It was reported that less than half the elderly population did not achieve the "5 a day" recommendations (Johnson, 1998); findings from SHEP agree with this; it was shown that the mean intake for all participants at the beginning was 2.45 portions a day, well below these recommendations. The difference found between usual fruit and vegetable intakes by gender is however different from that reported in the literature. It is expected that males have lower intakes based on previous study; in our study males reported a higher mean daily intake (2.62) at baseline when compared to their female counterparts (2.31). This difference in mean intakes decreased post SHEP with males (3.33) and females (3.22). Lower physical disability and mobility problems reported by male participants could explain this gender difference, which remains of great importance given that malnutrition impacts on quality of life (Vetta *et al.*, 1999). However, it is hard to define which is the cause and which the effect: malnutrition or disability. The lack of interest in healthy cooking reported by male participants did, however, correlate with previous findings (Baker and Wardle, 2003).

Overall, a significant increase in fruit and vegetable consumption was noted (P=0.001); these findings are well strengthened by the lack of statistical difference in the control group's intakes following the intervention.

In the literature, it is agreed that diets low in fruit and vegetables double the risks of some cancers, heart disease and cataracts (Block *et al.*, 1992). Substantial evidence is also available for the preventive effect fruits and vegetables hold on some cancers (Ames *et al.*, 1993; Van Duyn and Pivonka, 2000). It was suggested by Liu that health benefits of high intakes of fruits and vegetables are attributable to the complex mixture of phytochemicals, the active non-organic compounds such as flavonoids (Liu, 2003). Moreover, phenolic compounds, terpenoids, pigments and other natural anti-oxidants (vitamins A, C, E) are present in abundance in fruits and vegetables (Craig, 1997) and thought to have a potent antioxidant effect (Liu, 2003). High F&V intakes are also associated with greater bone mass density, thus decreased risks of osteoporosis (Tucker *et al.*, 1999). It was reported in the European EPIC study that fruit and vegetable consumption is inversely proportional to glycosylated haemoglobin, hence a decreased risk of diabetes mellitus (Bender, 1998). Fruits and vegetables are high in fibres; dietary fibres have tremendous health benefits, playing a role in the prevention of hypertension, obesity, gastrointestinal disorders and diabetes. Nonetheless, confounding factors remain and it is yet to be demonstrated whether these effects are attributable to lower intakes of saturated fats and other dietary components once fibre is increased (Anderson *et al.*, 1994).

Although the biochemical action of different vitamins, minerals, phytochemicals and other components of fruits and vegetables are yet to be fully understood, data from studies prove their numerous health benefits. These benefits are of great importance to the elderly population more likely to suffer chronic diseases. Given that the effect of SHEP on health was set to be extrapolated from changes in F&V intake, it can be concluded that SHEP was shown to be statistically significant at increasing the F&V intakes of free-living elderly in Hackney Council. By doing so, SHEP helped participants get closer to achieving their "5 a day" target and increased the consequent health benefits associated with such dietary change. Results are strengthened by the findings that no significant change was noted for the control group; hence these changes are less likely to be attributable to confounding factors.

LIKERT SCORES (CORRELATION TESTING)

It can be deduced from the results of the present study that a change has occurred in the scores for all participants before and after the intervention. This positive correlation is interpreted as an increase in Likert scores when comparing pre and post SHEP; however no causative association can be assumed. As for the control group, the perfect positive correlation (r=0.99) noted for the Likert scores suggests that the results are very similar, that no significant change occurred and therefore the control group's attitudes towards their health, well-being and independence did not differ.

LIKERT SCORES (T TESTING)

No significant difference between the mean of the sum of Likert scores for all participants before and after the intervention was found. However, there was an increase in the mean score from 41.65 to 43.92. The control group showed no significant difference between the mean from 43.65 to 43.62 of the sum of Likert scores for all participants before and after the intervention. This lack of statistical difference is understandable given that the control group did not receive any intervention capable of affecting their attitudes towards the questionnaire. More importantly, when accounting for initial scores a significant difference (P=0.002) was found over time for the intervention group; none was found for the control group (P=0.907).

These results suggest that SHEP had a positive effect on the health, well-being and independence of the free elderly in the council of hackney. They also agree with the findings that recreational services decrease stress, consequently enhancing the quality of life of beneficiaries (Fitzpatrick, 1994). The importance of the lack of difference in the control group' scores pertain to decreasing confounding factors that could affect the significance of the collected results.

THE PARTICIPANTS' REPORT (A CLOSED-ENDED QUESTIONNAIRE)

Reports from a recent Cochrane systematic review showed that dietary advice is efficacious at beneficially changing the diet over approximately 10 months (Brunner *et al.*, 2005). Similarly, 80 per cent of the participants reported that their intake of fruits and vegetables has increased; a further 54 per cent reported that they consumed less unhealthy snacks given

that they had more fruits and vegetables handy from the delivery. These results further strengthen the reliability of the estimates from the 24hr dietary recall and Likert questionnaires discussed earlier in this paper.

SHEP assessed conditions that can be ameliorated by an increase in fruit and vegetable intake such as gastrointestinal health; such conditions were strictly chosen to have shown significant changes in previous studies. In fact, a higher intake of a non-absorbable disaccharide (naturally found in fruits) showed a positive impact on constipation after 6 weeks. However, no notable change can be reported for cardiovascular disease or cancer incidence in such a short-term study. Mozzafarian *et al.* (2003) reported a notable decrease in the incidence of cardiovascular disease but this was a prospective study that lasted 8.9 years. Reports from the nurses' health study agree with these reports, emphasizing the benefits as primarily for cardiovascular disease (Hung *et al.*, 2004). Therefore, it was expected that an intervention such as SHEP, with its twelve week duration, might impact gastrointestinal health rather than cardiovascular. Indeed, 54 per cent of the participants reported better gastrointestinal health.

37 per cent felt that they had more energy for daily activities; this measure is at greater risk of being affected by confounders such as weather, but more likely was not affected given the short duration of the intervention.

28 per cent of the participants reported better social interaction and more importantly, 55 per cent reported better access to community services since adhering to SHEP. As for the independence, the reports were unanimous and 94 per cent of the participants felt relieved that they did not have to carry their fruits and vegetables. This agrees perfectly with the reports from the Elderly nutrition programme, where participants reported better diets and greater socialisation (Millen *et al.*, 2002). Moreover, 67 per cent of these expressed their interest in continuing to receive deliveries; those who did not confirmed that the only issue was the extra charge applicable as the programme was no longer funded.

Food accessibility is an important environmental determinant of one's diet (Kamphuis *et al.*, 2006); participants benefited from the higher availability and accessibility of fruit and vegetables from the delivery. Through nutritional status, food insecurity can negatively affect the

health and quality of life of the elderly population (Lee and Fongillo, 2004); by increasing food access, SHEP lessened the detrimental impact of food insecurity in the elderly participants.

CONCLUSION

Based on the current study's findings, it has become clear that the present intervention had a notable impact on the diet of the beneficiaries; increasing their fruit and vegetable consumption had positive impacts on their health and independence. Results from this brief research are optimistic and support claims for the beneficial effects of programmes such as SHEP for the well-being and independence of free-living elderly. The results of this study are modest and a clearer understanding of the health benefits should be further researched using a larger study with a longer duration, and serological and anthropometric measures to assess health. Finally, it is of great importance to appreciate the extent of the benefits in the event that SHEP is prolonged and implemented in different areas of the United Kingdom and other countries suffering from the cost burden on their healthcare service of non-communicable diseases.

REFERENCES

Alipanah, N., Varadhan, R., Sun, K., Ferrucci, L., Fried, L.P. and Semba, R.D. (2009), "Low serum carotenoids are associated with a decline in walking speed in older women", *Journal of Nutrition Health & Aging*, Vol. 13, pp. 170-175.

Ames, B.N., Shigenaga, M.K. and Hagen, T.M. (1993), "Oxidants, antioxidants and the degenerative diseases of ageing", *Proceedings of the National academy of Science*, Vol. 90, pp. 7915-7922.

Anderson, J.W., Smith, B.M. and Gustafson, N.J. (1994), "Health benefits and practical aspects of high fiber diets", *The American Journal of Clinical Nutrition*, Vol. 59, pp. 1242-1247.

Appleton, K.M., McGill, R. and Woodside, J.V. (2009), "Fruit and vegetable consumption in older individuals in Northern Ireland: levels and patterns", *British Journal of Nutrition* Vol. 102, pp. 949-953.

Baker, A.H. and Wardle, J. (2003), "Sex differences in fruits and vegetables intake in older adults", *Appetite*, Vol. 40, pp. 269-275.

Bazzano, L.A., He, J., Ogden, L.G., Loria, C.M., Vupputuri, S., Myers, L. and Whelton, P.K. (2002), "Fruit and vegetable intake and risk of cardiovascular disease in US adults; the first national health and nutrition examination survey epidemiologic follow-up study," *The American Journal of Clinical Nutrition*, Vol. 76, pp. 93-99.

Bender, A.E. (1998), "Fruits and vegetables", *Encycopedia of Human Nutrition*, Elsevier, Oxford, UK, pp. 356-360.

Bingham, S.A. (2003), "Biomarkers of nutritional exposure and nutritional status. Urine nitrogen as a biomarker for the validation of dietary protein intake," *Journal of Nutrition Supplement*, Vol. 133, pp. 921-924.

Block, G., Patterson, B. and Subar, A. (1992), "Fruit, vegetables and cancer prevention: A review of the epidemiological evidence", *Nutrition and Cancer*, Vol. 18, pp. 1-29.

Brunner, E.J., Rees, K, Ward, K., Burke, M. and Thorogood, M. (2005), "Dietary advice for reducing cardiovascular risk", *Cochrane Database of Systematic Reviews*,CD002128.

Cade, J. (2008), "The low income diet and nutrition survey: implications for relationships between diet and disease", *Proceedings of the Nutrition Society*, Vol. 67, E89.

Carresi, C., Cruciani. F., Paolucci. T., Curto, L., Mazzeo, G., Cuozzo, A., Moramarco, M. And Gharbiya, G. (2009), "Montelparo study: risk factors for age-related macular degeneration in a little rural community in Italy", *Clinica Terapeutica*, Vol. 160, e43-e51.

Carter, P., Gray, L.J., Troughton, J., Khunti, K. and Davies, M.J. (2010), "Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta analysis", *British Medical Journal*, Vol. 341, pp. 4229.

City and Hackney Teaching Primary Care Trust, (2008), City and Hackney Joint Strategic Needs Assessment.

Chernoff, R. (2001), "Nutrition and health promotion in older adults", *Journal of Gerontology*, Vol. 56A (Special Issue II), pp. 47-53.

Cowan, D.T., Roberts, J.D., Fitzpatrick, J. M., While, A.E. and Baldwin, J. (2004), "Nutritional status of older people in long term care setting: current status and future directions", *International Journal of Nursing Studies*, Vol. 41 No. 3, pp. 225-237.

Craig, W.J. (1997). "Phytochemicals: guardians of our health", *Journal of the American Dietetics Association*, Vol. 97 No. 10, supplement 2, pp. 199-204.

Dauchet, L., Amouyel, P., Hercberg, S. and Dallongeville, J. (2006), "Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies", *Journal of Nutrition*, Vol. 136, pp. 2588-2593.

Delavar, M.A., Lye, M.S., Khor, G.L., Hassan, S.T. and Hanachi, P. (2009), "Dietary patterns and the metabolic syndrome in middle aged women, Babol, Iran", *Asia Pacific Journal of Clinical Nutrition*, Vol. 18, pp. 285-292.

Dixon, H., Mollins, R., Wakefield, M. and Hill, D. (2004), "Encouraging the consumption of fruits and vegetables by older Australians: an experiential study", *The Journal of Nutrition, Education and Behaviour*, Vol. 36, pp. 245-249.

Finkel, T. and Holbrook, N.J. (2000), "Oxidants, oxidative stress and the biology of ageing", *Nature*, Vol. 408, pp. 239-247.

Fitzpatrick, T.R, (1994), "Stress and well-being among the elderly: the effect of social and recreational services", Boston College Graduate School of Social Work, Ohio State University, available at: http://handle.net/1811/36809

Fitzpatrick, T.R. Spiro, A., Kressin, N., Greene, E. and Boss, R. (2001), "Leisure activities, stress and health among bereaved and non-bereaved elderly men: the normative aging study", *The Journal of Death and Dying*, Vol. 43 No. 3, pp. 217-245.

Fries, J.F. (1980), "Ageing, natural death and the compression of morbidity", *New England Journal of Medicine*, Vol. 303 No. 3, pp. 131-135.

House, J.F., Kessler, R.C. and Herzog, R. (1990), "Age, socioeconomic status and health", *The Milkbank Quarterly*, Vol. 68 No. 3, pp. 383-413

Hung, H.C., Joshipura, K.J. and Jiang, R. (2004), "Fruit and vegetable intake and risk of major chronic disease", *Journal of the National Cancer Institute*, Vol. 96, No. 21, pp. 1577-1585.

Johnson, A.E., Donkin, J.M.A., Morgan, K., Neale, R.J., Page, R.M. and Silburn, R.M. (1998), "Fruit and vegetable consumption in later life", *Age and Ageing*, Vol. 27, pp. 723-728.

Kalache, A., Aboderin, I. and Hoskins, I. (2002), "Compression of morbidity and active ageing", *Bulletin of the World Health Organization*, Vol. 80 No. 3, pp. 243-244.

Kamphuis, C.B.M., Giskes, K., de Bruijn, G.J., Wendel-vos, W., Brug, J. and van Lenthe, F.J. (2006), "Environmental determinants of fruit and vegetable consumption among adults: a systematic review", *British Journal of Nutrition*, Vol. 96, pp. 620-635.

Kaur, C., Kapoor, H.C. (2001), "Antioxidants in fruits and vegetables-the millenium's health", *International Journal of Food Science and Technology*, Vol. 36, pp. 703-725.

Kirkwood, T.B.L. and Ritter, M.A. (1997), "The interface between ageing and health in man", *Age and Ageing*, Vol. 26, pp. 9-14.

Koutsari, C., Asem, H. Ali, K. Sreekumaran, N., Rizza, R.A. O'Brien, P., Khosla, S. and Jensen, M.D. (2009), "Fatty acid metabolism in the elderly", *Journal of Clinical Endocrinology and Metabolism*, Vol. 94 No. 9, pp. 3414-3423.

Lee, J.S., Weyant, R.J., Corby, P., Kritchevsky, S.B., Harris, T.B., Rooks, R., Rubin, S.M. and Newman, A.B. (2004), "Edentulism and nutritional status in biracial sample of well functioning community dwelling elderly: the health, ageing and body composition study", *American Journal of Clinical Nutrition*, Vol. 79, pp. 295-302.

Liu, R.H. (2003), "Health benefits of fruits and vegetables are from additive and synergistic combinations of phytochemicals", *American Journal of Clinical Nutrition*, Vol. 78, pp. 517-520.

Marmot, M.G., Bosma, H., Hemingway, H., Brunner, E. and Stansfeld, S. (1997), "Contribution of job control and other risk factor to risk variations in coronary heart disease incidence", *The Lancet*, Vol. 350, pp. 235-239.

Mathews, R.J., Smith, L.K., Hancock, R.M., Jagger, C. and Spiers, N.A. (2005), "Socioeconomic factors associated with the onset of disability in older age: a longitudinal study of people aged 75 years and older", *Social Science and Medicine*, Vol. 61, pp. 1567-1575.

Millen, B.E., Fada, PH., Ohls, J.C., Ponza, M.P. and McCool, A.C. (2002), "The Elderly Nutrition Programme: An effective national framework for preventive nutrition interventions", *Journal of the American Dietetic Association*, Vol. 102, pp. 234-240.

Mozzafarian, D., Kumanyika, S.K., Lemaitre, R.N., Olson, J.L. Burke,G.L. and Siscovick, D.S. (2003), "Cereal, Fruit, and Vegetable Fiber Intake and the Risk of Cardiovascular Disease in Elderly Individuals" *JAMA*, Vol. 289 No. 13, pp. 1659-1666.

Office for National Statistics, (2009), Population Estimates for UK, England and Wales, Scotland and Northern Ireland. Accessed via {http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=601}

Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948.

Posner, B.M., Jette, A.M., Smith, K.W. and Miller, D.R. (1993), "Nutrition and health risks in the elderly: the nutrition screening initiative", *The American Journal of Public Health*, Vol. 83 No. 7, pp. 972-979.

Pottle, M. (2005), National Institute for health and Clinical Excellence (NICE), measuring impact: improving the health and wellbeing of people in mid-life and beyond.

Resnicow, K., Jackson, A., Wang, T., De, A.K., McCarty, F. (2001), "A motivational interviewing intervention to increase fruit and vegetable intake through black churches: results of the Eat for Life trial", *American Journal of Public Health*, Vol. 91 No. 10, pp. 1686-1694.

Ross, A. (1999), "Atherosclerosis: an inflammatory disease", *New England Journal of Medicine*, Vol. 340 No. 2, pp. 115-126.

Sjoberg, S., Kim, K., Reicks, M. (2004), "Applying the theory of planned behaviour to fruit and vegetable consumption by older adults", *Journal of Nutrition for the Elderly*, Vol. 24 No. 4, pp. 35-48.

Smith, G.D., Hart, C., Blaine, D. and Gillis, C. (1997), "Lifetime socioeconomic position and mortality: prospective observational study" *British Medical Journal*, Vol. 314, p. 547.

Sohal, R.S. (1982), "Oxygen consumption and life span in the adult male housefly, *Mucosa domestica*", *Age*, Vol. 5, pp. 21-24.

Stein, C. and Moritz, I. (1999), "A lifecourse perspective of maintaining independence in older age", *World Health Organisation*, Geneva.

Tucker, K.L., Hannan, M.T., Chen, H., Cupples, A.L., Wilson, P.W.F. and Kiel, D.P. (1999), "Potassium, magnesium and fruit and vegetable intakes are associated with greater bone mineral density in elderly men and women", *American Journal of Clinical Nutrition*, Vol. 69, pp. 727-736.

Van Duyn, M.A. and Pivonka, E. (2000), "Overview of the health benefits of fruit and vegetable consumption for the dietetics professional: selected literature", *Journal of the American Dietetic Association*, Vol. 100, pp. 1511-1521.

Vertuani, S., Angusti, A. and Manfredini, S. (2004), "The antioxidants and prooxidants network: an overview", *Current Pharmaceutical Design*, Vol. 10, pp. 1677-1694.

Vetta, F., Ronzoni, S., Taglieri, G. and Bollea, M.R. (1999), "The impact of malnutrition in the quality of life in the elderly", *Clinical Nutrition*, Vol. 18 No. 5, pp. 259-267.

World Health Organisation (WHO). (2002), "Active ageing: a policy framework", *Ageing and Lifecourse*. Available at: http://whqlibdoc.who.int/hq/2002/who_nmh_nph_02.8.pdf

ABOUT THE AUTHORS

Miryem Salah has extensive academic and professional public health experience; she currently works in community development in the biggest food bank in Canada, Moisson Montreal. Previously, she worked as a nutritionist at Age Concern UK and was involved in educating the elderly on various aspects of healthy eating. Before this, she was involved in an anti-obesity programme, run by Social Action for Health. She also worked as a researcher at East London Food Access, designing and delivering an intervention that aimed at assessing the impact of nutrition on health and independence. Miryem graduated with a first class honours for her BSc in Human Nutrition. She then pursued her Master of Science at the prestigious medical school of University College London (UCL), UK. Her passion is in public health, focusing on the impact of nutrition and physical activity on health; she believes in the importance of prevention campaigns to lower the impact of major public health concerns such as obesity, cardiovascular disease, as well as communicable diseases.

Dr George Grimble has been working in the area of Clinical Nutrition since 1980 with a special emphasis on clinical gastroenterology research,

intensive care medicine and nutrition in older people. He is currently Principal Teaching Fellow at UCL in the Centre for Gastroenterology & Nutrition in the Division of Medicine. From 2007, he ran RECOMMEND (Reading Community Medical Nutrition Data) which investigated the attitudes of Family doctors towards nutrition and weight management. From 2008, he held concurrent appointments at Reading and UCL, running MSc programmes in both universities. Dr Grimble is a very active teacher in graduate programmes and has published extensively. He is currently preparing his 7th book and has more than 250 scientific publications, which include 74 reviews and book chapters and two patents. He has acted as consultant for many companies active in clinical nutrition support.