Examining the effectiveness of a holistic nutrition programme among community-dwelling elderly in Singapore

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Abstract
Background: Singapore faces challenges in providing efficient health-care services for the ageing population. Objectives: We evaluated the effectiveness of a novel holistic nutrition programme among the elderly who were staying in several senior activity centres in Singapore. Methods: A total of 83 elderly participants (>55 years old) took part in a mixed-methods experimental study. Participants were assigned to the control group (CG), the intervention group without health talks (IGH–) or the intervention group with health talks (IGH+). Demographics, perceived satisfaction score of the administered programme and pre–post measurement on nutritional knowledge and perceived competence were measured. Subsequently, in-depth interviews were also carried out with some participants. Results: One-way analysis of variance revealed significantly higher scores for the IGH– and IGH+ groups compared to the CG in terms of perceived satisfaction of the programme (p=0.009 and p=0.005, respectively). There was also a significant difference in terms of the change in nutritional knowledge before and after the programme between the IGH– and IGH+ groups (p=0.002) but not for perceived competence (p=0.26). Several determinants of dietary behaviours in the elderly such as living arrangements, attitudes and finances were identified from thematic analyses of the interviews. Conclusions: The findings from the study demonstrate the effectiveness of an holistic programme in effecting changes in nutritional knowledge but not perceived competence.

Keywords
Nutrition literacy, ageing, healthy eating, elderly, holistic programme

Introduction
Singapore faces challenges in providing efficient health-care services to its ageing population. Chronic conditions such as diabetes and cardiovascular diseases found in the elderly population are often linked to poor diet and lifestyle. As nutrition is a key predictor of healthy ageing, public-health campaigns in Singapore strive to promote a healthy nutritional diet amongst the elderly. Over the years, researchers have evaluated holistic health interventions that focus on the individual as the agent for achieving optimal health and well-being, considering the individual’s mind, body, spirit and environment. Psychosomatic factors can influence one’s motivation to eat, regardless of the individual’s physiological state of hunger. Excessive eating might occur to cope with negative emotions. Social relationships such as friends and family also play a critical role in eating behaviour. It is therefore imperative to assess the effectiveness of implementing holistic approaches to health promotion.

Self-efficacy, defined as an individual’s perceived competence and capacity to attain goals by executing relevant behaviours, was highlighted as an important factor in adopting and maintaining healthy behaviours. Previous work on nutrition

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interventions indicated the importance of improving self-efficacy in order to adopt and improve positive health behaviours effectively. Furthermore, health behaviours are more likely to be attained and maintained when individuals are responsible for making their own plans for achieving health goals.

Moreover, education is important in health-promotion interventions, as it equips individuals with skills and knowledge to adopt and maintain healthy behaviours successfully. Likewise, imparting nutrition knowledge has proven effective in the promotion of healthy eating behaviours. One study showed the effectiveness of a six-month active programme followed by a three-month maintenance programme in changing elderly participants’ eating behaviours, recommending future programmes to measure the self-efficacy of participants.

Building on previous work on holistic health-promotion approaches, the current study aimed to implement a holistic approach in empowering Singapore’s community-dwelling elderly’s competence towards adopting and maintaining a healthy diet by administering an individual-centred intervention in empowering Singapore’s community-dwelling elderly’s competence in maintaining or adopting a healthy diet?

This study addressed three research questions (RQs):

RQ1: Would perceived satisfaction towards the administered programme differ significantly among (a) the intervention group with health talks (IGH+), (b) the intervention group without health talks (IGH–) and (c) the control group (CG)?

RQ2: Would there be a significant change in (a) nutritional knowledge and (b) perceived competence towards the maintenance of a healthy diet between the IGH+ and IGH– groups before and after the intervention?

RQ3: What are the underlying factors behind the elderly’s competence in maintaining or adopting a healthy diet?

Methods

This study involved three different groups. One served as control group, while the other two served as intervention groups.

Participant recruitment

Participants were recruited from three senior activity centres (SACs) in Singapore and were assigned to one of the three groups: IGH+, IGH– or CG. A total of 83 elderly participants, aged 55 years and older and residing across the three centres, were randomly recruited. Specifically, 40 participants were recruited to the CG, 25 to the IGH– group and 18 to the IGH+ group. Eight participants from the IGH– group and 13 from the IGH+ group provided deeper insights through interviews.

Holistic intervention programme

Aiming to educate the elderly on the importance of a healthy diet, a certified nutritionist spearheaded four weekly three-hour sessions with the following themes: (a) foundations of a good diet, (b) reading food labels, (c) preparing healthy meals and (d) bringing back the joy of eating. Participants were given educational materials such as healthy recipes and a food pyramid with recommended servings. Cooking demonstrations and training on social-emotional regulatory skills were included to ensure the programme was tailored to the specific demographic group.

To engrain healthy eating habits further, IGH+ and IGH– participants underwent meal-planning sessions, where they were able to apply their current and/or newly acquired health knowledge. During the pre-intervention phase, we observed relationships between health behaviours and perceptions of healthy food being inaccessible, bland and expensive. Thus, a strong emphasis was placed on the delivery of healthy meals to allow these assumptions to be adjusted.

We engaged participants through a fortnightly healthy food bazaar and games where intergenerational interactions were promoted to encourage healthy eating. Likewise, healthy food items were distributed to promote the convenience of a healthy diet in their everyday life.

As seen in Figure 1, the intervention, which catered for 43 elderly participants, consisted of four health talk sessions, eight healthy meal-planning sessions, 16 healthy meal deliveries and four healthy food bazaars across the two-month period.

Volunteers were engaged in all activities during the intervention period. They assisted the nutritionist during the health talks and meal-planning sessions, facilitated activities and games at the food bazaars and conducted meal deliveries. For the control group, the elderly received educational pamphlets on a healthy diet. The centre manager continued to provide general dietary advice to them.

Meal-planning system

The meal-planning sessions were conducted using the HOMecare and CAregiving Model for Optimising Services for the Elderly (HOCAMOSE) system. HOCAMOSE is a web-based health-care management system developed by the research team as part of a funded project.

It comprises eldercare services such as general health checks, medication delivery, supporting medication adherence, encouraging exercise through exergames, providing smart home sensors, meal planning and meal delivery services. The current study focused on the meal planning and delivery service of the HOCAMOSE system, whereby the creation of individualised meal plans was based on health condition, food preferences and dietary requirements. The system, as seen in Figure 2, has an array of food items presented in local colloquial terms from different food providers. The unique component of the HOCAMOSE system is the interactive food pyramid, shown in Figure 3, where the tallying of food choices with recommended daily servings can be done simply and swiftly. During the intervention, all 43 participants planned their meals every Tuesday, at which point they were planning for the upcoming Wednesdays and Thursdays of the same week. Equally, for that same Wednesday and Thursday, a healthy meal was delivered to them in accordance with their created meal plan. The prepacked healthy meals were distributed free of charge to all IGH+ and IGH– participants who took part in the intervention. The meals were delivered to
the SACs wherein volunteers helped to distribute the meals to the elderly’s homes.

Data collection

Pre- and post-intervention questionnaires were conducted across the two groups (IGH+ and IGH–) using the Perceived Competence Scale (PCS) and the Nutrition and Wellness Questionnaire (NWQ). The PCS is a four-item scale based on self-determination theory. The NWQ is a self-developed 10-item scale, based on a typical Singaporean diet, aimed to assess participants’ nutritional knowledge. Participants rated their competence towards adoption or maintenance of a healthy diet using a seven-point Likert scale ranging from 1=’not true at all’ to 7=’very true’. Subsequently, the Client Satisfaction Scale (CSQ-8) was completed by all three groups (CG, IGH+ and IGH–) to assess the satisfaction level of the programmes. The CSQ-8 is an eight-item scale rating participants’ satisfaction with the programme using a four-point Likert scale, ranging from 1=’poor’ to 4=’excellent’. All questionnaires were available in English, Mandarin and Malay. Demographic information included age, sex, ethnicity/race, educational level, living arrangement, perceived health status and availability of social support from family members.

For qualitative data, selected participants were interviewed after the intervention. Participants were sampled purposively using criteria to select who had (a) completed all meal-planning sessions, (b) received all healthy meals and/or (c) attended all health talk sessions. Equally, participants’ willingness to participate and ability to articulate their experiences in a reflective manner were also considered during sampling.

To ensure data accuracy, interviews were conducted in the participants’ comfortable setting and in their spoken language. Face-to-face interviews were steered with the help of a semi-structured questionnaire. Whenever there was uncertainty in the participants’ answers, the interviewers probed for clarification, often in their colloquial language. Conversations were audio-recorded, with permission, and after each interview, the research team discussed any salient opinions to probe further in subsequent interviews.

Data analysis

Cross-tabulation analyses were used to compare the three groups’ demographics. One-way analysis of variance (ANOVA) was conducted to investigate differences in satisfaction scores between the three groups. Changes in survey
scores in participants’ pre and post intervention were computed (change in score=post intervention score–baseline score). As we were interested in the comparison between the two intervention groups (IGH+ and IGH–), an independent samples t-test was used. No participants from any of the three groups completely withdrew from the study during the eight-week intervention period. However, one participant from the IGH+ group and one participant from the IGH– group were hospitalised after the intervention period and were unable to complete sections of the entire post-test.
questionnaire. After accounting for missing data points between all participants’ pre- and post-test surveys, the remaining data were analysed using IBM SPSS Statistics for Windows v25 (IBM Corp., Armonk, NY).

Audio files from the interviews were transcribed by adopting naturalism, noting every enunciation. The inclusion of respondents’ mannerisms and personality supplemented the content of the discourse. The coding process rendered words and sentences into themes and sub-themes. We used Grounded Theory, where the data drive the analysis.26 With no preconceived theories to reject or support, the data were analysed through constant comparison, initially between data, and later progressed to the evaluation of interpreted themes. Researcher flexibility was adopted to minimise any possible impact of the researcher’s role throughout the data analysis.27 To ensure anonymity, respondents were each assigned a unique combination of number and alphabet in the transcript, and any other names during the conversation were replaced with pseudonyms.

### Table 1. Demographics and chi-squared test for all participants.

| Measurement               | CG (n=40) | IGH+ (n=18) | IGH– (n=25) | χ² |
|---------------------------|-----------|-------------|-------------|----|
| Age, M (SD)               | 70.50 (5.81) | 70.44 (7.89) | 71.32 (6.69) | χ²=3.66; p=0.16 |
| Sex                       |           |             |             | |
| Male                      | 9 (22.5%) | 7 (38.9%) | 11 (44.0%) | |
| Female                    | 31 (77.5%) | 11 (61.1%) | 14 (56.0%) | |
| Race/ethnicity            |           |             |             | χ²=18.78; p<0.001 |
| Chinese                   | 100 (100.0%) | 12 (66.7%) | 24 (96.0%) | |
| Malay                     | 0 (0%) | 6 (33.3%) | 1 (4.0%) | χ²=3.66; p=0.33 |
| Education level           |           |             |             | |
| No formal education       | 6 (15.0%) | 5 (27.8%) | 4 (16.0%) | |
| Primary                   | 19 (47.5%) | 6 (33.3%) | 12 (48.0%) | |
| Secondary                 | 15 (37.5%) | 5 (27.8%) | 6 (24.0%) | |
| Pre-university             | 0 (0%) | 2 (11.1%) | 2 (8.0%) | |
| University and above      | 0 (0%) | 0 (0%) | 1 (4.0%) | |
| Living arrangement        |           |             |             | χ²=8.31; p=0.08 |
| Alone                     | 8 (20.0%) | 4 (22.2%) | 11 (44.0%) | |
| With family               | 32 (80.0%) | 13 (72.2%) | 14 (56.0%) | |
| Others                    | 0 (0%) | 1 (5.6%) | 0 (0%) | |
| Family support            |           |             |             | χ²=2.24; p=0.33 |
| With support              | 26 (65.0%) | 27 (62.8%) | 18 (72.0%) | |
| No support                | 14 (35.0%) | 16 (37.2%) | 7 (28.0%) | |
| Health status             |           |             |             | |
| Below average             | 3 (7.5%) | 4 (9.3%) | 3 (12.0%) | |
| Average                   | 14 (35.0%) | 14 (32.6%) | 7 (28.0%) | |
| Above average             | 23 (57.5%) | 25 (58.2%) | 15 (60.0%) | |

### Table 2. Overview of results

| Measurements                      | CG | IGH+ | IGH– | p-Value |
|-----------------------------------|----|------|------|---------|
| Participants’ satisfaction score   | n=40, 25.28 (3.89) | n=18, 28.50 (3.35) | n=25, 27.96 (2.82) | IGH+’s p=0.005 w.r.t. control; IGH–’s p=0.009 w.r.t. control |
| Change in nutritional knowledge   | NA | n=17, 4.53 (4.23) | n=20, 0.15 (3.67) | p=0.002 |
| Change in perceived competence    | NA | n=15, 0.80 (6.66) | n=19, 2.95 (4.20) | p=0.26 (n.s.) |

*Missing data point.

NA: not applicable; n.s.: not significant; w.r.t: with respect to

### Results

#### Quantitative findings

Basic demographics, tabulated in Table 1, show no significant differences between the three groups in terms of sex, education level, living arrangement, family support and health status. However, there was a significant difference with regard to ethnicity/race, with each of the three groups having more Chinese participants ($\chi^2=18.78$, $p<0.001$). Table 2 shows the means and standard deviations (SD) of the participants’ satisfaction with the programme between the three groups. A one-way ANOVA showed a main effect on the satisfaction score ($F(2, 80)=7.36$, $p=0.001$, $\eta^2_p=.16$). Post hoc analyses using Tukey’s HSD indicated that satisfaction scores were lower for the CG compared to the IGH+ (p=0.005) and the IGH– groups (p=0.009). However, there were no significant differences between the IGH+ and IGH– groups (p=0.87). An independent-samples t-test indicated that changes in the
scores for nutritional knowledge and wellness were significantly higher for the IGH+ group (M=4.53, SD=4.23) compared to the IGH− group (M=0.15, SD=3.67; t(35)=3.37, p=0.002, d=1.10). There were no significant differences for the change in perceived competence between the IGH+ group (M=0.80, SD=6.66) and the IGH− group (M=2.95, SD=4.20; t(32)=−1.15, p=0.26).

**Qualitative results**

As seen in Table 3, 21 participants from the IGH+ and IGH− groups were aged between 62 and 87 years, with the majority in their 60s. Of the 21 participants, 15 were female, and about 67% were living with their spouse and/or family members. Comparing the two SACs, there were no Malay participants in the IGH− group, as the centre is largely occupied by Chinese. Equally, 19% of the respondents had no formal education. Most (14/21) had attained a minimum of primary education. Most (14/21) had attained a minimum of primary education, with only eight proceeding to secondary level. Learning English was compulsory in primary and secondary school in the 1960s, when the aforementioned 14 participants were of school age.28 However, despite being exposed to English, only six respondents were able to converse fluently in English.

We noted certain social demographics as possible contributing factors influencing the elderly’s dietary habits, health knowledge and perception of healthy eating: (a) associating mood with dietary habits, (b) determinants motivating and discouraging healthy eating habits and decisions. Most agreed that often being tired and lazy, largely driven by their mood, affect their eating and cooking behaviour. Equally, individuals who stay alone due to loss or separation are prone to experience food apathy, where they show an absence of interest and curiosity to cook or eat. Equally, they are not motivated to cook simply for one person, since it requires similar time and effort as when cooking for more than one. On that basis, there tends to be a certain discrepancy between one’s intention and one’s actual behaviour. When individuals are provoked emotionally, especially when they are exposed to food cravings, their initial well-thought-out eating plans are often compromised. As such, they try to justify their unhealthy habits as somewhat uncommon, largely functioned to keep their life moving rather than as a routine behaviour.

Determinants motivating and discouraging healthy eating behaviour. Eating behaviours are often influenced by multiple coexisting social determinants, which eventually lead to undesirable eating habits and health conditions. With regard to the 21 older adults, their financial situation, educational qualifications, living arrangements and attitude were predominantly salient in motivating and discouraging their participation in healthy eating habits. Unquestionably, their finances were constrained, since the majority were not earning a salary, largely but not exclusively due to their age. As such, food items that were cheaper or even free of charge were often their choice of everyday food. Equally, those who were less educated were more likely to steer their dietary choices based on their income and savings. As explicated by some of the elderly, their level of formal education impeded their opportunity to gain the knowledge needed and the health routine, which ultimately influenced their eating choices.

The elderly who resided with their spouses and/or family members frequently indicated their counterpart as an influence on their eating habits. This persuasive behaviour is often understood as socially normative, which eventually encourages the consumption of convenience and/or pleasure-seeking foods. Moreover, the elderly’s intentions were often seen to be motivated by their attitude and willingness to be open minded to external intermediation, which in turn motivated or discouraged their participation. Their attitudes towards the intervention were also encouraged through them witnessing the efforts dedicated to accomplish the health intervention. However, for some, coming from a recipient perspective, their sentiment ambiguously overlaps with a sense of obligation to be content with the complimentary intervention. Instead of being interested due to their personal health accountability, some accepted the health intervention without reflecting on their health needs.
Importance of a holistic approach. The daily state of the elderly, along with the determinants motivating and discouraging them, steer the need for a holistic approach when introducing problem-solving interventions. Findings suggest interventions related to eating behaviours and knowledge that consider everyday routines while incorporating social and nutritional components were effective in introducing and incorporating both new and existing health knowledge and habits among the elderly. However, any multifaceted health programme that disregards the frequency and length of the programme would ultimately limit the change in health behaviour; as time is substantial in influencing health habits and routines in the long term, especially post intervention. Likewise, the delivery of health knowledge should be mutual rather than a one-way sharing session, as the notion of interaction and social engagement appealed to the social demographic of the participants. Some of the elderly also highlighted the importance of socialising and being emotionally content when partaking in the intervention. Fundamentally, the holistic approach allowed the elderly to understand that healthy eating habits do not stand alone, but rather each component supplements the other, resulting in positive and improved health behaviour. The combination of health knowledge, the delivery of healthy meals and exposure to the notion of meal planning successfully attuned some respondents’ health habits and behaviours. Some were inspired to sustain the eating habits in their everyday routines while incorporating social and nutritional related to eating behaviours and knowledge that consider one’s perceived competence in having a healthy diet.

Discussion
The results show that the intervention was successful in improving nutritional knowledge in the IGH+ group, indicating the effectiveness of the health talks.

Additionally, our findings suggest that acquiring adequate knowledge on nutrition could be a prerequisite to improving one’s perceived competence in having a healthy diet. Furthermore, for an individual to obtain a certain level of knowledge, they would need to be equipped with the required language skills and educational background in order to be capable of receiving and reflecting on the content taught. As demonstrated in other studies, individuals who are financially stable, independent and able to comprehend more complex nutritional knowledge are more likely to be aware and informed on the different types of nutritional food and its availability. However, almost 30% of those in the IGH+ group in this study did not have any formal education. Despite having the health talks translated into multiple languages (English to Mandarin and Malay), there was still the chance that the content could be misinterpreted. The limitations of their social circumstances possibly explain why participants in the IGH+ group increased their nutritional knowledge but showed little change in their perceived competence.

Ultimately, this study aimed to assess participants’ satisfaction towards the holistic intervention and to identify salient factors that might influence participants’ motivation to adopt and maintain a healthy diet. Our current findings show that there were greater levels of satisfaction towards the holistic intervention in both the IGH+ and IGH– groups compared to the community support programme received by the CG. To build on this, the interviews revealed that IGH+ participants were motivated to learn about nutrition and were aware of the importance of having a healthy diet. They understood the value of the health talks and appreciated the interactive and conducive learning environment. Furthermore, the meal-planning sessions encouraged them to plan strategies proactively towards the attainment of a healthy diet.

Likewise, we explored and identified salient factors that might influence elderly participants’ competence to adopt and maintain a healthy diet. Key factors included financial stability, educational level, living arrangements and attitude. In terms of finances, participants tended to have the misconception that healthy foods are more costly than processed and ready-made meals, which consist of higher salt and fat content. We also found that participants with lower educational levels were more likely to make poorer food choices, therefore underscoring the importance of having a health education component to improve health literacy. Additionally, the living arrangements of participants tended to influence their attitudes towards the adoption of a healthy diet. Having meals together with family members was often perceived as a social activity, and this might have an impact on the way the elderly eat in groups. Environmental stressors such as having a busy schedule might also impede one’s motivation to prepare healthy meals at home. In other words, not having sufficient time to prepare healthier meals might lead the elderly to consume more convenience foods and ready-made meals.

Therefore, our results revealed that individual differences in attitudes and expectations of achieving positive health behaviours might differentially impact their attitudes and reception of the holistic health intervention.

All in all, the findings of our study have shown the effectiveness of having a holistic approach in improving nutritional knowledge amongst elderly participants. Our study used a mixed-method design to gain a comprehensive understanding of the elderly’s perception towards the intervention and provided recommended guidelines in the implementation of a holistic intervention for dietary behaviours.

Limitations and future work
Nevertheless, our study is not without limitations. Randomly assigning participants to the intervention and control groups proved to be difficult due to logistical issues at hand. Instead, we randomly assigned the SACs to either the intervention or control groups. Therefore, there might be inherent participant characteristics from the different centres that might differentially impact outcome measures. To mitigate this issue, we computed the chi-square test across groups and found no significant differences with the exception of race/ethnicity. As Singapore is a multicultural country, with Chinese making up 76.1% of the entire population, it is not surprising that many of the participants were of Chinese ethnicity.

In addition, the holistic programme could not establish significant changes to the participants’ perceived competence. The duration of the intervention could be a determining factor on the participants’ perceived competence, considering that building one’s confidence to maintain a healthy diet would
require more time and effort. Future studies should adopt a longer intervention period. Recommendations are to have interventions lasting for more than five months and with a larger sample size.18

Conclusion
Our study’s findings revealed that a holistic approach to nutrition interventions, which encompasses different elements of nutrition education, social interaction and active participation, was regarded as more meaningful and engaging to participants. We identified prominent factors that differentially impact one’s motivation to attain positive health behaviours.

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Authors’ contributions
All authors conceptualised the study. M.E. and Y.L. verified the integrity of the work and gained ethical approval from the institutional review board. J.L., C.R. and N.H. were involved in the study operations, data collection and data analysis. H.V. and M.E. were involved in the data management of the participants’ information on the HOCA MOSE system. J.L., C.R., N.H. and H.V. were involved in the writing of the first draft of the manuscript. M.E. and Y.L. reviewed and edited the manuscript. All authors reviewed and edited the final manuscript and approved the final version of the manuscript.

Availability of data and materials
The data set and all other relevant videos cited in the manuscript have been published to Dataverse NTU. It can be accessed through the following link as shown: https://researchdata.ntu.edu.sg/dataset.xhtml?persistentId=doi:10.21979/N9/CRRGMH

Ethical approval
Ethical approval for this study was approved by the Institutional Review Board of Nanyang Technological University (IRB-2018-01-002).

Informed consent
All participants were duly informed regarding the nature of the study, procedures, confidentiality of their data and their rights as participants. Written informed consent was obtained from all participants before the study.

Conflict of interest
The authors declare that there is no conflict of interest.

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