

# Malnutrition in older adults on financial assistance in an urban Asian country: a mixed methods study

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Submitted 8 February 2013: Final revision received 20 June 2013: Accepted 5 August 2013: First published online 6 September 2013

## Abstract

**Objective:** The objectives of the present study were to assess the nutritional status, identify factors for malnutrition risk and evaluate barriers to adequate nutrition among recipients of the Public Assistance (PA) scheme for socio-economically disadvantaged Singaporeans.

**Design:** Using a cross-sectional study design, we assessed PA recipients' malnutrition risk using the DETERMINE Nutritional Health checklist and the full Mini-Nutritional Assessment (MNA), as well as their nutritional knowledge, co-morbidity burden, depression risk, instrumental and basic activities of daily living (IADL and BADL), and awareness and utilization of available food services. In-depth interviews were also conducted on malnourished individuals (MNA score < 17) to understand barriers to adequate nutrition.

**Setting:** Homes of community-living older adults and nursing homes of institutionalized older adults.

**Subjects:** All PA recipients aged  $\geq 55$  years in Central Singapore District.

**Results:** Four hundred and sixty-five of 511 (91.0%) eligible PA recipients participated in the study. The prevalence of malnutrition in the study population was 2.8%. However, 50.3% were at risk of malnutrition. Among community-dwelling respondents, the risk of malnutrition was independently associated with age >75 years, currently unmarried, BADL impairment, depression risk and BMI < 19.0 kg/m<sup>2</sup>. Qualitative analysis revealed that financial, social and physical barriers and lack of knowledge were the main contributors to poor nutritional status. Only half were aware of subsidized food services and education increased interest in utilizing food services. Among nursing home respondents, those who were BADL impaired were more likely to be at risk of malnutrition.

**Conclusions:** Among PA recipients, the prevalence of malnutrition is low but the risk of malnutrition is high. Education on adequate nutrition and food services are recommended.

## Keywords

Malnutrition  
Nutrition  
Nutritional assessment  
Geriatric assessment  
Geriatric nursing

Singapore is an urbanized Asian country with a widening income gap that has resulted in pockets of poverty in the country. The Public Assistance (PA) scheme was started in 1946 for socio-economically disadvantaged citizens and permanent residents who are unable to work due to old age, illness or unfavourable circumstances, and have no means of subsistence or minimal family support<sup>(1)</sup>. PA recipients receive up to \$S 400 (\$US 267) per month and free treatment at public primary care clinics and hospitals. Malnutrition is a cause for concern in the elderly, especially in those of lower socio-economic status. A local study by Yap *et al.* showed that 30.1% of local community-dwelling Chinese aged above 55 years

were at risk of malnutrition, as defined by a DETERMINE Your Nutritional Health checklist score of  $\geq 3$ <sup>(2)</sup>. Chan *et al.* found that 39% of residents of a local voluntary welfare nursing home were malnourished as defined by a score of <17 using the Mini Nutritional Assessment (MNA), and 52% were found to be underweight as defined by a BMI of 18.5 kg/m<sup>2</sup> or lower<sup>(3)</sup>. In impoverished individuals like PA recipients, however, the prevalence of malnutrition may be even higher than that in the general population due to factors such as greater economic hardship, lack of resources and limited education<sup>(4)</sup>. No previous study has been done on PA recipients to determine their nutritional status. Some of the subsidized

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food services available to PA recipients include meal delivery schemes, meal vouchers to purchase cooked food from establishments and grocery vouchers to purchase food items from grocery stores, all of which have been shown to improve or maintain nutritional risk in older American adults<sup>(5)</sup>. However, the awareness and utilization rate of these services among poor individuals in an urban Asian country have not been previously reported. Hence, we assessed PA recipients' malnutrition risk, nutritional knowledge, co-morbidity burden, depression risk, functional status, and awareness and utilization of available food services. Among malnourished individuals, in-depth interviews were conducted to understand barriers to adequate nutrition.

## Materials and methods

### Study population

Central Singapore District provided the investigators with a master list of all PA recipients under their care ( $n$  711) and sent each household an official letter inviting them to participate prior to the start of the study. The eligibility criteria for study participation were recipients currently receiving PA and aged 55 years or older. The minimum age of 55 years was chosen so our results could be compared with those by Yap *et al.*<sup>(2)</sup>. The residents of the selected nursing home were included to provide comparison with a similar study done in a local nursing home by Chan *et al.*<sup>(3)</sup>. Individuals who were non-communicative (e.g. dementia or dysphasic stroke) were excluded from the study. Eighteen pairs of trained medical student interviewers conducted face-to-face interviews with PA recipients from 5 to 21 January 2010 as the study was part of a community health project within the medical school curriculum of Yong Loo Lin School of Medicine, National University of Singapore. Non-responders were defined as those who were not contactable after three visits on three separate days. Refusals were defined as eligible individuals who refused or failed to complete the survey. A structured quantitative questionnaire was used to record data on the participants' sociodemographic profile, nutritional knowledge, nutritional status, depression risk, co-morbidity burden, functional status, and awareness and utilization of available food services. Individuals identified as malnourished were subsequently invited to participate in a qualitative interview using a guide designed to explore their difficulties in obtaining adequate nutrition.

### Assessment tools

#### Malnutrition

Two nutritional assessment tools were used: the DETERMINE Your Nutritional Health checklist and the full MNA. These were chosen to provide a baseline of comparison with previous local studies by Yap *et al.* and Chan *et al.*<sup>(2,3)</sup>.

The DETERMINE checklist is a well-used screening tool that detects nutritional risk where a score of  $\geq 3$  suggests that the individual is at increased risk of being malnourished<sup>(6)</sup>. The DETERMINE checklist comprises ten questions formulated to identify those with inadequate dietary nutrition according to RDA standards or individuals with underlying medical conditions that affect their health. Questions focus on pre-existing medical issues and difficulties the elderly face which may prevent them from having access to nutrition (e.g. teeth problems or lack of resources to prepare a balanced diet)<sup>(6)</sup>.

The MNA is a nutritional risk assessment tool that has been validated for use on elderly people in both community and nursing home settings<sup>(7)</sup>. The MNA was designed to identify individuals at risk of malnutrition so that nutritional intervention could be administered promptly<sup>(7)</sup>. It comprises four categories: (i) anthropometric measurements; (ii) assessment of an individual's lifestyle, medications and mobility; (iii) dietary questionnaire relating to number of meals, food intake and feeding issues; and (iv) self-perception of nutritional health<sup>(7)</sup>. A score of  $< 17$  suggests malnutrition, a score of 17–23.5 suggests risk of malnutrition and a score  $\geq 24$  is considered normal. Weight and height were measured using portable weighing machines and measuring tapes respectively. The variation between all weighing machines used was calibrated to within 1 kg using a standard weight as reference. Respondents with impaired mobility were weighed using a portable seated weighing scale which was transported into their homes. Mid-arm circumference and calf circumference were measured to the nearest centimetre. The MNA score of  $< 17$  was used to define malnourished individuals who were subsequently invited to participate in the qualitative phase of the study.

#### Risk factors for malnutrition

A simple nutritional knowledge screening questionnaire based on the guidelines for healthy eating by the Health Promotion Board of Singapore was developed for the purposes of the present study to assess awareness of nutritional requirements<sup>(8)</sup>. Participants were asked to select the correct number of servings recommended for each of the four food groups (rice and alternatives, fruits, vegetables, and meat and alternatives) out of five given choices (see Appendix 1). One point was awarded for each correct answer. The maximum score was 4 and the minimum was 0. A score of zero was arbitrarily chosen to indicate poor nutritional knowledge. We opted to use this simple but unvalidated test to assess nutritional knowledge because existing validated measures were lengthy and we wanted to minimize interviewee burden<sup>(9)</sup>. The Charlson Co-morbidity Index was used to assess the co-morbidity burden in the sample population<sup>(10)</sup>. It is recognized as a valid and reliable clinical research tool with high construct validity and is predictive of mortality, disability, readmissions and length of stay. Its test-retest

reliability is good and inter-rater reliability is moderate to good<sup>(11)</sup>. The fifteen-item Geriatric Depression Scale – Short Form (GDS-SF) was used to screen for risk of depression<sup>(12)</sup>. The GDS-SF is a validated questionnaire to screen for depression in the general population and in the elderly Chinese population in Singapore<sup>(13,14)</sup>. The GDS-SF has a minimum score of 0 and a maximum of 15, and a score of 4 and above denotes risk of depression. Functional status was assessed using the Lawton–Brody Scale and the Barthel Index, which are validated research tools to measure instrumental activities of daily living (IADL) and basic activities of daily living (BADL), respectively. Both scales have been previously validated for use in elderly populations and are widely used in research<sup>(15–18)</sup>.

Community-dwelling participants were also surveyed on their awareness and utilization rate of the three subsidized or free food services available locally (i.e. meal delivery services, meal vouchers and grocery vouchers) currently provided by various voluntary welfare organizations. They were also asked about their interest in applying for food services before and after education on these services. Nursing home participants were not interviewed regarding these free food services because all their meals were provided by the residence.

#### *Barriers to adequate nutrition*

In-depth interviews were conducted with respondents identified as malnourished; open-ended prompting questions were asked and participants were allowed to freely express their opinions on the obstacles they faced when obtaining adequate nutrition (see Appendix 2 for the qualitative interview guide). Interviews were conducted in the language and dialect (e.g. Hokkien, Cantonese, etc.) which the participants were conversant with. The interviews were audio-taped and subsequently transcribed into English.

#### **Ethics**

Approval was obtained from the National University of Singapore Institutional Review Board prior to the study. Written consent was obtained before the interview and participants were offered grocery vouchers as tokens of appreciation at the end of the interview.

#### **Data analysis**

Quantitative data analysis was done using PASW Statistics Version 18. Data were entered at the end of each day of field work by each pair of interviewers. The data from each interviewer were manually checked for errors and then collated into a master database. Multiple rounds of manual data cleaning were performed and a final data fidelity check of a random sample of 5% of data collection forms had an accuracy of 99.8%. To determine the factors associated with risk of malnutrition, the full MNA was chosen over the DETERMINE as the main outcome measure, as the latter has not been validated for use in a nursing home setting and the former was found to

be superior to the latter in predicting mortality from malnutrition<sup>(19)</sup>. When determining the factors associated with malnutrition, we subsumed malnutrition under risk of malnutrition because the prevalence of malnutrition was very low in our study population. The  $\chi^2$  test and Fisher's exact test (if  $n < 5$  in any cell) were used to analyse bivariate associations between categorical variables and the McNemar test was used to compare changes in the proportions interested in food services before and after education. The Pearson correlation coefficient ( $r$ ) was used to test for collinearity between MNA and BMI scores because BMI is part of the MNA. The cut-off of  $P < 0.10$  was used to decide which factors associated with the risk of malnutrition in community-dwelling respondents would be included in the multivariate logistic regression model. Backward stepwise regression was used to determine the most parsimonious model of factors independently associated with risk of malnutrition. These steps were not performed for nursing home respondents because risk of malnutrition was only associated with one factor in this population.

We used a phenomenological approach involving immersion and crystallization for thematic analysis of the qualitative data<sup>(20)</sup>. Immersion allowed researchers to surround themselves with the qualitative data in order to sensitize them to the tone, mood, range and content of participants' experience. Crystallization reflected the gradual development and clarification of important themes offered by participants. Each interviewer read the transcripts independently first, initially looking for keywords and emerging themes. Subsequently, all interviewers met together to compare, discuss and combine their independent analyses. The final stage of analysis involved examining all interviews with all interviewers until agreement on the key themes and sub-themes was achieved. Although all thirteen malnourished respondents were interviewed, the team felt that data saturation was achieved by the tenth respondent interviewed.

## **Results**

#### **Quantitative findings**

Among the 711 PA recipients on the master list provided, 551 (77.5%) were contactable and the remaining 160 were non-contactable (i.e. non-responders). Of the 551 contactable individuals, forty respondents were not eligible and forty-six refused to participate, resulting in a final sample of 465 individuals (participation rate =  $465 / (551 - 40) = 91.0\%$ ).

#### *Participant characteristics*

The sociodemographic profile of PA recipients dwelling in the community differed greatly from the sociodemographic profile of those living in nursing homes (Table 1). As the profile of community-dwelling and nursing home

**Table 1** Sociodemographic characteristics\* of the sample population by community dwelling and nursing home status; recipients of the Public Assistance scheme for socio-economically disadvantaged Singaporeans, Central Singapore District, January 2010

Characteristic	All ( <i>n</i> 465)		Community ( <i>n</i> 399)		Nursing home ( <i>n</i> 66)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Age (years)						
55–64	25	5.4	23	5.8	2	3.0
65–74	189	40.6	175	43.9	14	21.2
75–84	189	40.6	176	44.1	13	19.7
85–94	54	11.6	22	5.5	32	48.5
94–104	8	1.7	3	0.8	5	7.6
Mean	76.0		74.7		83.5	
SD	7.8		6.6		9.8	
Years on public assistance						
Mean	6.0		6.0		6.0	
SD	4.4		4.6		3.5	
Gender						
Male	283	60.9	283	70.9	0	0.0
Female	182	39.1	116	29.1	66	100.0
Ethnicity						
Chinese	432	92.9	336	91.7	66	100.0
Malay	14	3.0	14	3.5	0	0.0
Indian	16	3.4	16	4.0	0	0.0
Others	3	0.6	3	0.8	0	0.0
Education level						
No formal qualifications	339	72.9	284	71.2	55	83.3
Primary school	94	20.2	86	21.6	8	12.1
Secondary school	24	5.2	21	5.3	3	4.5
Above secondary school	8	1.7	8	2.0	0	0.0
Type of housing						
One-room apartment	336	72.3	326	84.2	0	0.0
Two-room apartment	54	11.6	52	13.5	0	0.0
Three-room apartment and above	9	1.9	9	2.3	0	0.0
Nursing home	66	14.2	–	–	66	100.0
Ownership of house						
Rented	362	77.8	362	90.7	0	0.0
Owned	37	8.0	37	9.6	0	0.0
Nursing home	66	14.2	–	–	66	100.0
Marital status						
Currently married	46	9.9	45	11.3	1	1.5
Not married	419	90.1	354	88.7	65	98.5
Living arrangement						
Alone	208	52.1	208	52.1	0	0.0
Not alone	191	47.9	191	47.9	66	100.0
With family	88	46.1	88	46.1	0	0.0
With non-family	103	53.9	103	53.9	66	100.0
Preparation of home-cooked meals						
Self	264	63.8	264	63.8	0	0.0
Someone else	29	7.0	29	7.0	66	100.0
None	121	30.3	121	30.3	0	0.0
Nutrition knowledge						
0	139	29.9	121	30.3	18	27.3
≥1	326	71.1	278	69.7	48	72.7
Instrumental activities of daily living (IADL)						
Impaired	225	48.4	168	42.1	57	86.4
Independent	240	51.6	231	57.9	9	13.6
Basic activities of daily living (BADL)						
Impaired	158	34.0	111	27.8	47	71.2
Independent	307	66.0	288	72.2	19	28.8
Risk of depression						
No	379	81.5	324	81.2	55	83.3
Yes	86	18.5	75	18.8	11	16.7
Charlson co-morbidity score						
0	218	46.9	190	47.6	28	42.4
≥1	247	53.1	209	52.4	38	57.6
BMI (kg/m <sup>2</sup> )						
<19.0	119	25.6	115	28.8	4	6.1
≥19.0	346	74.4	284	71.2	62	93.9

\*Values are presented as *n* and % of the total population reported, unless otherwise stated.

participants was very different, we have stratified our results by these two groups.

For the community-dwelling group, the mean respondent age was 74.7 (SD 6.6) years and their mean duration on PA was 6.0 (SD 4.6) years. The majority were male (70.9%), Chinese (91.7%), received no formal education (71.2%), were not currently married (i.e. were divorced, separated or widowed; 88.7%), lived alone in one-room apartments (84.2%) that were mainly rented (90.7%), and were able to cook their own food (63.8%). Almost a third (30.3%) scored zero on the knowledge test, 27.8% were BADL impaired, 42.1% were IADL impaired, 18.8% were at risk of depression, 52.4% had a Charlson co-morbidity score  $\geq 1$  and 28.8% had a BMI  $< 19.0 \text{ kg/m}^2$ .

Compared with the community-dwelling group, the nursing home participants were older at 83.5 (SD 9.8) years but the mean duration on PA was similar at 6.0 (SD 3.5) years; all were female (because of the policy of the nursing home) and of Chinese ethnicity, most had no formal education (83.3%) and most were not currently married (98.5%); a similar proportion scored zero on the knowledge test (27.3%) and were at risk of depression (16.7%), but the nursing home population were more impaired in their BADL (71.2%) and IADL (86.4%), and more had a Charlson co-morbidity score  $\geq 1$  (57.6%). Of note, the nursing home population had a much smaller proportion who had a BMI  $< 19 \text{ kg/m}^2$  (6.1%).

#### *Nutritional status*

Using the MNA, the prevalence of malnutrition was 2.8% ( $n = 13$ ) in the community-dwelling population and 1.5% ( $n = 1$ ) in the nursing home population (OR = 1.84; 95% CI 0.30, 11.24;  $P = 0.703$ ). However, the risk of malnutrition was higher in the nursing home compared with the community-dwelling respondents (68.2% *v.* 50.4%,  $P = 0.007$ ). Using the DETERMINE checklist, the prevalence of risk of malnutrition was 67.7% for the community-dwelling population and 45.5% in the nursing home population.

#### *Risk factors for malnutrition*

There was little collinearity between BMI and MNA scores as the correlation between the two scores was weak ( $r = -0.406$ ). Cronbach's  $\alpha$  for the nutritional knowledge test based on all study respondents was low at 0.34.

For the community-dwelling group, advanced age ( $> 75$  years), currently unmarried, poor nutritional knowledge, BADL impairment, risk of depression and BMI  $< 19.0 \text{ kg/m}^2$  were associated with risk of malnutrition on bivariate analysis (Table 2). For the nursing home group, only BADL impairment was associated with risk of malnutrition on bivariate analysis (Table 2).

For the community-dwelling group, multivariate analysis identified the independent factors for risk of malnutrition as age  $> 75$  years (adjusted OR = 1.64; 95% CI 1.04, 2.60;  $P = 0.034$ ), currently unmarried (adjusted OR = 2.43;

95% CI 1.17, 5.01;  $P = 0.017$ ), BADL impairment (adjusted OR = 2.20; 95% CI 1.30, 3.70;  $P = 0.003$ ), risk of depression (adjusted OR = 2.66; 95% CI 1.46, 4.85;  $P = 0.001$ ) and BMI  $< 19 \text{ kg/m}^2$  (adjusted OR = 9.71; 95% CI 5.46, 17.2;  $P < 0.001$ ). Poor nutritional knowledge was not found to be significant factor for risk of malnutrition on multivariate analysis.

#### *Food services*

The majority of respondents were aware of the food services available to them: 65.8%, 57.4% and 54.8% of the study population were aware of meal delivery, meal voucher and grocery voucher services, respectively. However, only 20.8%, 31.6% and 38.3% were receiving meal delivery services, meal vouchers and grocery vouchers, respectively. After education on the availability and details of these services, interest in applying increased for meal delivery from 25.2% to 28.2% ( $P = 0.041$ ); for meal vouchers from 46.8% to 57.7% ( $P < 0.001$ ); and for grocery vouchers from 67.8% to 79.9% ( $P < 0.001$ ; Table 3).

#### *Qualitative findings*

Thirteen community-dwelling malnourished respondents were interviewed and the main barriers to adequate nutrition identified were financial, social and physical barriers, and lack of knowledge.

#### *Financial barriers*

Due to their tight financial situation, malnourished PA recipients were primarily concerned with the quantity of food they could obtain from their fixed allowance rather than food quality or achieving a balanced diet (Quote 1, Table 4). For example, they would prefer to buy canned and preserved vegetables and condensed milk instead of fresh vegetables and milk because the latter are more expensive and perishable. Even if they were moved to consider nutrition as a factor in their purchases, fiscal constraints prevented them from doing so (Quote 2, Table 4).

#### *Social barriers*

Malnourished PA recipients faced many social issues such as depression and loneliness (Quote 3, Table 4) which contributed to lack of appetite, mealtimes no longer being a social activity and decreased attention to the meals. Moreover, their isolation and hence poor support network further exacerbated the situation, especially for those with impaired mobility who had no caregiver available to shop or cook for them (Quote 4, Table 4).

#### *Physical barriers*

Respondents who had issues with mobility or IADL (as defined by the Lawton–Brody Scale) found it difficult to utilize meal or food vouchers as this entailed reaching nearby food establishments or grocery outlets to purchase

**Table 2** Bivariate comparisons of demographic characteristics of participants who are healthy against those at risk of malnutrition or malnourished, as measured by Mini-Nutritional Assessment score, by community dwelling and nursing home status; recipients of the Public Assistance scheme for socio-economically disadvantaged Singaporeans, Central Singapore District, January 2010

Characteristic	Community (n 399)							Nursing home (n 66)						
	At risk or malnourished		Healthy		Unadjusted OR	95% CI	P value	At risk or malnourished		Healthy		Unadjusted OR	95% CI	P value
	n	%	n	%				n	%	n	%			
Total	201	50.4	198	49.6	–	–	–	45	68.2	21	31.8	–	–	–
Age														
>75 years	109	59.2	75	40.8	1.38	1.14, 1.68	<b>0.001</b>	36	73.5	13	26.5	1.39	0.86, 2.24	0.117
≤75 years	92	42.8	123	57.2	1.00	Ref.		9	52.9	8	47.1	1.00	Ref.	
Gender														
Male	137	48.4	146	51.6	0.88	0.72, 1.08	0.220	0	0.0	0	0.0	–	–	–
Female	64	55.2	52	44.8	1.00	Ref.		45	68.2	21	31.8	–	–	
Ethnicity														
Chinese	181	49.5	185	50.5	0.82	0.61, 1.10	0.220	45	68.2	21	31.8	–	–	–
Others	20	60.6	13	39.4	1.00	Ref.		0	0.0	0	0.0	–	–	
Education level														
No formal qualifications	142	50.0	142	50.0	0.98	0.79, 1.21	0.813	35	63.6	20	36.4	0.70	0.53, 0.92	0.153
Primary school and above	59	51.3	56	48.7	1.00	Ref.		10	90.9	1	9.1	1.00	Ref.	
Type of housing														
One-room apartment	171	50.9	165	49.1	1.07	0.81, 1.41	0.633	45	68.2	21	31.8	–	–	–
Two-room apartment and above	30	47.6	33	52.4	1.00	Ref.		–	–	–	–	–	–	
Ownership of house														
Rented	181	50.0	181	50.0	0.93	0.68, 1.27	0.639	45	68.2	21	31.8	–	–	–
Owned	20	54.1	17	45.9	1.00	Ref.		–	–	–	–	–	–	
Marital status														
Currently married	16	35.6	29	64.4	0.68	0.45, 1.02	<b>0.035</b>	0	0.0	0	0.0	–	–	–
Not married	185	52.3	169	47.7	1.00	Ref.		45	68.2	21	31.8	–	–	
Currently living														
Alone	104	50.0	104	50.0	0.99	0.81, 1.20	0.875	45	68.2	21	31.8	–	–	–
Not alone	97	50.8	94	49.2	1.00	Ref.		0	0.0	0	0.0	–	–	
Prepares home-cooked meals														
Yes	144	49.1	149	50.9	0.91	0.74, 1.13	0.414	–	–	–	–	–	–	–
No	57	53.8	49	46.2	1.00	Ref.		45	68.2	21	31.8	–	–	
Duration on public assistance														
≤7 years	137	47.7	150	52.3	0.84	0.68, 1.02	0.091	32	65.3	17	34.7	0.85	0.61, 1.19	0.548
>7 years	64	57.1	48	42.9	1.00	Ref.		13	76.5	4	23.5	1.00	Ref.	
Nutrition knowledge														
0	71	58.7	50	41.3	1.26	1.03, 1.53	<b>0.029</b>	12	66.7	6	33.3	0.97	0.66, 1.42	0.871
>0	130	46.8	148	53.2	1.00	Ref.		33	68.8	15	31.3	1.00	Ref.	
Instrumental activities of daily living (IADL)														
Impaired	93	55.4	75	44.6	1.18	0.98, 1.44	0.090	40	70.2	17	29.8	1.26	0.69, 2.32	0.450
Independent	108	46.8	123	53.2	1.00	Ref.		5	55.6	4	44.4	1.00	Ref.	



**Table 3** Effect of education on interest in applying for food services among recipients of the Public Assistance scheme for socio-economically disadvantaged Singaporeans, Central Singapore District, January 2010

Pre-education	Total		Post-education				P value
	n	%	Yes		No		
Interest in meal delivery services							
No	225	74.8	14	4.7	211	70.1	<b>0.041</b>
Yes	76	<b>25.2</b>	71	23.6	5	1.7	
Total	301	100.0	85	<b>28.2</b>	216	71.8	
Interest in meal vouchers							
No	141	53.2	33	12.5	108	40.8	< <b>0.001</b>
Yes	124	<b>46.8</b>	120	45.3	4	1.5	
Total	265	100.0	153	<b>57.7</b>	112	42.3	
Interest in grocery vouchers							
No	77	32.2	30	12.6	47	19.7	< <b>0.001</b>
Yes	162	<b>67.8</b>	161	67.4	1	0.4	
Total	239	100.0	191	<b>79.9</b>	48	20.1	

Significant P values for the change in the percentage interested, pre-education v. post-education (bold values), are indicated in bold font.

**Table 4** Quotations from malnourished individuals in receipt of the Public Assistance scheme for socio-economically disadvantaged Singaporeans, Central Singapore District, January 2010

Quote no.	Respondent profile	Quotation
Financial difficulties		
1.	75-year-old Chinese man living alone (R1)	'I rarely take any fruits and milk products... What is important is that I can have three meals a day.'
2.	68-year-old Chinese man living alone (R2)	'Money! Money is the problem. I don't have enough money, how do I buy the kind of food I want?'
Social issues		
3.	82-year-old Chinese lady living alone (R3)	'I feel sad ... not satisfied ... very bored... I feel I have very few friends ... I almost never feel happy.'
4.	73-year-old Chinese lady living alone (R4)	'No [I'm not interested in meal voucher schemes]. I can't walk, and I don't have friends who are willing to help me [to buy food] that often.'
Physical barriers		
5.	73-year-old Chinese lady living alone (R4)	'I can't get out to buy food. If I could go out myself, I could buy food with vitamins and better nutrients, then I would be healthier.'
6.	82-year-old Chinese lady living alone with dense bilateral cataracts (R3)	'Sometimes I can't see what I'm doing. So I can't fry vegetables, but I still can boil noodles.'
7.	82-year-old edentulous Chinese lady living alone who cannot afford dentures (R3)	'The vegetables they [meal delivery service] give are very hard. Because I no longer have teeth, I can't chew them. I have to re-cook them to make them softer.'
8.	82-year-old Chinese lady living alone (R3)	'Sometimes I don't have [any] appetite because I'm not feeling well.'
Lack of knowledge		
9.	68-year-old Chinese man living alone (R2)	'I have no problems with nutrition ... there is nothing wrong with me.'

R, respondent.

score as determined by Yap *et al.* (30.1%)<sup>(2)</sup>, the prevalence of risk of malnutrition in our community-dwelling PA population was two times higher at 67.7% using the same tool. When compared with a similar socio-economically disadvantaged population in Taiwan where the prevalence of risk of malnutrition was 37.9% using the MNA<sup>(24)</sup>, the prevalence of risk of malnutrition in our community-dwelling PA population was higher at 68.2%.

The factors identified to be independent factors associated with risk of malnutrition were similar to those from previous studies. Advanced age is associated with risk of malnutrition due to physiological changes related to

senescence and higher incidence of chronic illnesses which impair appetite, increase nutritional needs and contribute to functional dependence. Moreover, older individuals have lower financial and social resources to obtain adequate nutrition. Social factors such as being unmarried have also been shown to contribute to malnutrition risk<sup>(21)</sup>. The lack of a spouse not only deprives people of companionship at meals which are usually communal social events, but may also discourage domestic food preparation and promote greater reliance on less nutritious pre-processed food options. Functional impairment is commonly associated with risk of malnutrition and



is related to feeding problems and poor mobility, limiting one's ability to cook and shop<sup>(21,24)</sup>. Depression is also a known contributory factor to risk of malnutrition<sup>(24)</sup> and this may be explained by reduced appetite and decreased motivation to self-care in depressed individuals. A low BMI was also associated with malnutrition risk but this is probably a result of chronic malnutrition rather than a causative factor.

The suboptimal awareness of PA recipients about food services available and the increased interest of the respondents in these services after education suggest that much benefit may be derived from better education of PA recipients on the food services provided by voluntary welfare organizations. It may be helpful to tailor the various types of food services to the needs of recipients and this may also contribute to better resource utilization. For example, individuals with poor mobility would more likely benefit more from meal delivery services than food or grocery vouchers as they have problems reaching nearby food establishments and grocery outlets.

The limitations of the study include the lack of objective measures of nutritional status such as biochemical tests and dietary assessments. Our study was a cross-sectional one, so causality cannot be inferred. Our nutrition knowledge test was unvalidated and it had a low Cronbach's  $\alpha$  in our study population, which suggests its internal validity is limited. Participants' answers to the nutritional knowledge test were based on their understanding of the dimension of a serving size. Interviewer's description of a serving size could have been interpreted differently by participants and supplemental visual aids could have been useful in ensuring that the PA recipients had a more uniform understanding of a serving size. As the study was conducted on PA recipients within the central district of Singapore, results should not be generalized to other areas in Singapore or other countries with different socio-economic status or financial assistance programmes. The sample size in the nursing home population was small and this is probably a major reason why only one factor was found to be associated with malnutrition risk. Moreover, as the nursing home population was from only one institution and conducted in an all-female nursing home, our nursing home results cannot be extrapolated beyond our study. Nevertheless, the strength of our study is its use of a mixed method study design to quantify the nutritional status and contextualize the barriers to adequate nutrition faced by socio-economically challenged persons in an urbanized Asian country.

## Conclusion

Although the prevalence of malnutrition among community-dwelling and nursing home Singaporeans on public financial assistance was low, the prevalence of risk of malnutrition was high, with the nursing home population having a higher prevalence. To improve their nutritional

status, we need to focus on addressing functional disability, depression and financial barriers, and better educating these elderly PA recipients on adequate nutrition and on available subsidized food services.

## Acknowledgements

*Sources of funding:* This project was funded by the Central Singapore Community Development Council and Heartware Network, Singapore. The funders had no role in the design, analysis or writing of this article. *Conflicts of interest:* The authors declare no conflict of interest. *Authors' contributions:* X.Y.K. and M.L.K. contributed equally to the study. All authors contributed to the study design, data collection, statistical analysis, discussion and writing of the final manuscript. *Acknowledgements:* The authors thank the Central Singapore Community Development Council for providing the list of PA/SG clients, from which data were obtained. They also thank the students of 2010 Community Health Project Group 1 and the Institute of Technical Education Nursing for assisting in the study.

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2. How many servings of fruits do you think you should consume every day?
    - A. 0 servings
    - B. 0.5–1 servings
    - C. 1.5–2 servings
    - D. 2.5–3 servings
    - E. >3 servings
  3. How many servings of vegetables do you think you should consume every day?
    - A. 0 servings
    - B. 0.5–1 servings
    - C. 1.5–2 servings
    - D. 2.5–3 servings
    - E. >3 servings
  4. How many servings of meat and/or alternatives (e.g. milk products, soya products, pulses, etc.) do you think you should consume every day?
    - A. 0 servings
    - B. 0.5–1 servings
    - C. 1–2 servings
    - D. 2–3 servings
    - E. >3 servings
- (The correct answers for questions 1 to 4 are D, C, C and D, respectively. Cronbach's  $\alpha$  for the nutritional knowledge test based on all study participants was low at 0.34.)

## Appendix 2

### Qualitative interview guide

1. Do you think/feel you are malnourished?
2. What do you think adequate/good nutrition is?
3. How often do you meet this level of nutrition? Please detail.
4. Do you feel your diet is inadequate and how?
5. What do you think are problems/barriers you face in obtaining adequate nutrition? Prompts:
  - a. Do you face financial difficulties in obtaining food?
  - b. Does your environment/people around you/situation pose inconveniences or problems for you to obtain adequate nutrition?
  - c. Do you face any other problems or inconveniences in obtaining adequate nutrition?
  - d. Do you prepare your meals? If not, why? Who does so for you?
6. If you were told that your diet was deficient,
  - e. Would you feel there is a need to correct this?
  - f. Would you know how to correct this/How would you correct this?

## Appendix 1

### Nutritional knowledge test

1. How many servings of rice and/or alternatives (e.g. noodles, potatoes, etc.) do you think you should consume every day?
  - A. 0 servings
  - B. 1–3 servings
  - C. 3–5 servings
  - D. 5–7 servings
  - E. >7 servings