

Research

Cite this article: Chua AYJ, Lee ES, Lee PSS, Lew JK, Sim SZ. (2025) Self-perceived nutrition competence of primary care physicians in Singapore: a cross-sectional study. *Primary Health Care Research & Development* 26(e11): 1–7. doi: [10.1017/S1463423624000689](https://doi.org/10.1017/S1463423624000689)

Received: 22 July 2023

Revised: 31 October 2024

Accepted: 11 November 2024

Keywords:

Clinical competence; diet; food and nutrition; education; general practice; nutrition assessment; primary care physicians

Corresponding author:

Andrew Yu Jing Chua;

Email: Andrew_YJ_CHUA@nhgp.com.sg

Self-perceived nutrition competence of primary care physicians in Singapore: a cross-sectional study

Andrew Yu Jing Chua¹ , Eng Sing Lee^{2,3} , Poay Sian Sabrina Lee² , Jeremy Kaiwei Lew²  and Sai Zhen Sim² 

¹National Healthcare Group Polyclinics, Singapore, Singapore; ²Clinical Research Unit, National Healthcare Group Polyclinics, Singapore, Singapore and ³Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore, Singapore

Abstract

Introduction: Poor diet is a major contributing factor to the increasing prevalence of non-communicable diseases. There is a need for effective nutrition care in primary care that manages the bulk of such diseases. This study aimed to describe the self-perceived nutrition competence of primary care physicians (PCPs) in Singapore and to evaluate the associated factors. **Methods:** A cross-sectional study utilizing an anonymous online survey platform was conducted among PCPs from a public primary care institution in Singapore. We collected data on PCPs' sociodemographic information, previous nutrition education and personal dietary habits, and measured self-perceived nutrition competence using the NUTrition COMPetence (NUTCOMP) questionnaire. Multivariable linear regression was conducted to examine the association between PCPs' characteristics with their self-perceived nutrition competence. **Results:** Totally, 153 PCPs (45.9%) completed the survey in full. Among the four NUTCOMP constructs, 'nutrition knowledge' (2.8 ± 0.6) and 'nutrition skills' (2.9 ± 0.6) had the lowest mean scores followed by 'nutrition communication and counselling' (3.1 ± 0.6) and 'attitudes towards providing nutrition care' (4.3 ± 0.5). PCPs with formal nutrition training had significantly higher NUTCOMP scores compared with those without ($\beta = 10.76$, 95% CI:4.57–16.94), and those with 5 to 9 years and more than 10 years of work experience had significantly higher scores than those with less than 5 years ($\beta = 7.62$, 95%CI:0.44–14.81, and $\beta = 9.44$, 95%CI:2.85–16.04, respectively). **Conclusion:** PCPs had lowest self-perceived confidence in nutrition knowledge and skills. Previous formal nutrition education and a longer primary care work experience were associated with better self-perceived nutrition competence. Future research to better integrate nutrition competencies into formal education programmes may be useful to improve PCPs' self-perceived nutrition competence.

Introduction

Unhealthy diets are a major driver of non-communicable diseases and their related healthcare burdens (Benziger *et al.*, 2016). In 2017, dietary risks were responsible for 11 million deaths and 255 million disability-adjusted life-years (DALYs) globally, with cardiovascular disease being the leading cause of diet-related deaths (GBD 2017 Diet Collaborators, 2019). In Singapore, poor dietary habit was the leading risk factor contributing to DALYs accounting for 10.1% of Singapore overall disease burden (Epidemiology & Disease Control Division, Ministry of Health Singapore and Institute for Health Metrics and Evaluation, 2019). Sub-optimal diet is an important preventable risk factor, and this highlights the importance of providing adequate nutrition care.

Nutrition care refers to any practice conducted by a health professional to support a patient to improve their dietary behaviours (Ball and Leveritt, 2015) and includes nutrition assessment, education and counselling, and referral to nutrition-focused healthcare professionals and services. Nutrition care provided by primary care professionals has the potential to improve patients' dietary behaviours (Ball *et al.*, 2015), and a study showed that most patients with diet-related chronic diseases consider primary care physicians (PCPs) as their preferred provider of nutrition care because PCPs were able to provide trustworthy and personalised nutrition care (Ball *et al.*, 2014). Best practice guidelines also regard nutrition care as an important component of effective prevention and management of diet-related chronic diseases (Wharton *et al.*, 2020).

Competency refers to the set of knowledge, skills, communication, and attitudes that facilitate a clinician's ability to perform safe and effective healthcare practices (Verma *et al.*, 2006). Studies have shown that there is a lack of nutrition competence among PCPs (Smith *et al.*, 2015; Dunic *et al.*, 2018; Keaver *et al.*, 2018), resulting in inadequate nutrition care (Crowley *et al.*, 2020a). To our knowledge, no study has been done in Singapore to evaluate the

© National Healthcare Group Polyclinics, 2025. Published by Cambridge University Press. This is an Open Access article, distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike licence (<https://creativecommons.org/licenses/by-nc-sa/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the same Creative Commons licence is used to distribute the re-used or adapted article and the original article is properly cited. The written permission of Cambridge University Press must be obtained prior to any commercial use.

level of nutrition competence among PCPs. In order to better understand how to improve and support the provision of nutrition care to a growing population of patients with diet-related chronic disease, it is important that current nutrition competence among PCPs is measured and understood. This study aims to describe the self-perceived nutrition competence of PCPs in Singapore and to evaluate the factors affecting their self-perceived nutrition competence.

Methods

Study design and setting

This was a cross-sectional study involving PCPs from the National Healthcare Group Polyclinics (NHGP), which is a public primary care institution that delivers highly subsidized care, including outpatient, maternal, and child health services, to the community in Singapore. The study utilized an anonymous online survey platform Research Electronic Data Capture (REDCap[®]) to evaluate the physicians' self-perceived competence in providing nutrition care to patients with chronic disease. Total population sampling was used, and all PCPs who worked in NHGP, excluding locums, were invited to participate in the study. An electronic invitation email with a secure link to the online survey was sent to all eligible participants and participation was voluntary. Weekly email reminders were sent out during the study period from 11 January 2022 to 12 February 2022.

A sample questionnaire for PCPs is available as online supplementary appendix.

NUTrition COMPetence (NUTCOMP) questionnaire

The NUTCOMP questionnaire (Ball and Leveritt 2015) measures the self-perceived competence of healthcare professionals in providing nutrition care to patients with chronic diseases. Self-perceived competence has been shown to be an accepted indicator of actual competence (Davis *et al.*, 2006). NUTCOMP measures PCPs' self-confidence across a few constructs: (1) nutrition knowledge, which refers to their understanding of food influences on the body systems, chronic diseases, and medication use; (2) nutrition skills, which refers to the assessment and management of the dietary needs of an individual; (3) nutrition communication and counselling, which refers to their understanding of the patients' expectations and comprehension during dietary consultations, and their confidence in their ability to work with other healthcare professionals; and (4) attitudes towards nutrition care, which measures the level of agreement of PCPs in providing good nutrition care.

Each item in the questionnaire uses a 5-point Likert scale to rate confidence level (1 = not very confident at all to 5 = extremely confident) or degree of agreement (1 = completely disagree, to 5 = completely agree). To reflect the local context, 'Australian Guide to Healthy Eating (National Health and Medical Research Council, 2013)' found on two items (section 1, item 4 and section 2, item 4) was changed to 'My Healthy Plate (Health Promotion Board, 2021)'. The mean score for each construct was calculated by adding up the scores for all items in that construct and then dividing the sum by the number of items to give a score from one to five. This represents the level of confidence or degree of agreement for that construct enabling comparisons between the different constructs. The NUTCOMP total score was calculated by taking the sum of scores for all the items in the four constructs.

Participant characteristics

Participant characteristics included age, gender, work experience in primary care setting, highest qualification, self-reported body mass index (BMI), previous formal education with nutrition content, and Continuing Medical Education (CME) engagement in nutrition. Participants were also asked on their perceived need for further nutrition education and the type of dietary counselling they were least confident with. PCPs' highest qualification was classified into two categories: (1) basic medical degree such as Bachelor of Medicine and Bachelor of Surgery (MBBS) and/or Graduate Diploma in Family Medicine (GDFM) and (2) advanced training in family medicine, i.e. Master of Medicine in Family Medicine (MMED) and/or Fellow of the College of Family Physicians Singapore (FCFP). The GDFM is a two-year family medicine training programme that helps PCPs practice at an enhanced level, catering to the healthcare needs of the community. The MMED is designed for working doctors wishing to pursue further higher training in family medicine to function as a registrar family physician, and FCFP is designed to help PCPs function as a consultant family physician (College of Family Physicians Singapore, no date).

Personal dietary habits

This study used the NHGP Fat and Fibre questionnaire, which is a brief dietary assessment questionnaire used by dietitians in NHGP to help individuals identify unhealthy dietary habits. Brief dietary assessment tools offer a low-burden alternative for research studies (Reeves *et al.*, 2015) to quickly identify dietary concerns (England *et al.*, 2015). The NHGP Fat and Fibre questionnaire uses the national dietary recommendations to assess the frequencies of food intake and food consumption behaviours for foods high in fat (fat construct) and fibre (fibre construct). The fat construct consists of 12 questions, and the total score ranges from 12 to 48, with a cut-off of '35 or less' indicating undesirable or high-fat intake. The fibre construct consists of five questions, and the total score ranges from 5 to 20, with a cut-off score of '13 or less' indicating undesirable or low fibre intake.

Statistical analysis

Data were extracted from the REDCap[®] database, and complete case analysis was utilized. Descriptive statistics were calculated for all measures. Means and standard deviations (SD) were presented for continuous variables, while frequency and percentage were used for categorical variables. Test for multicollinearity was conducted using variance inflation factors before proceeding to multivariable linear regression. This was used to investigate the association between each NUTCOMP construct and total score (outcome variable) with independent variables – highest qualification, gender, BMI, work experience, previous formal nutrition education, CME engagement in nutrition, fat, and fibre score. Internal consistency was measured using the Cronbach's alpha. R version 4.1.2 was used for the analyses. A p-value of <0.05 was considered statistically significant.

Results

The study invitations were sent to 333 PCPs and 195 PCPs (58.6%) participated in the study, of which 153 PCPs (45.9%) completed the questionnaire in full and their data were included in the study. Table 1 shows the characteristics of the participants. The mean age

Table 1. Characteristics of participating primary care physicians (n = 153)

Age	Mean (SD)
	35.9 (8.1)
Gender	N (%)
Male	77 (50.3)
Female	76 (49.7)
Work experience (years)	N (%)
1 to 4	63 (41.2)
5 to 9	41 (26.8)
≥10	49 (32.0)
mean (SD)	8.0 (7.4)
Highest qualification	N (%)
MBBS ^a /GDFM ^b	82 (53.6)
MMED ^c /FCFP ^d	71 (46.4)
Body mass index (kg/m ²)	N (%)
<23.0	77 (50.3)
23.0 to 27.4	51 (33.3)
≥27.5	25 (16.4)
Mean (SD)	23.3 (3.8)
Previous formal nutrition education	N (%)
No formal education in nutrition content	122 (79.7)
Formal education with some nutrition content	31 (20.3)
Formal education predominantly focused on nutrition	0 (0.0)
CME ^e engagement in nutrition	N (%)
Yes	69 (45.1)
No	84 (54.9)
Need for further nutrition education	N (%)
Disagree	9 (5.9)
Neutral	11 (7.2)
Agree	133 (86.9)
Fat score (score range 12 to 48)	N (%)
Undesirable (≤35)	99 (64.7)
Acceptable/desirable (≥36)	54 (35.3)
Mean (SD)	33.6 (4.9)
Fibre score (score range 5 to 20)	N (%)
Undesirable (≤13)	107 (69.9)
Acceptable/desirable (≥14)	46 (30.1)
Mean (SD)	11.9 (3.2)

^aMBBS: Bachelor of Medicine and Bachelor of Surgery

^bGDFM: Graduate Diploma in Family Medicine

^cMMED: Master of Medicine in Family Medicine

^dFCFP: Fellow of the College of Family Physicians Singapore

^eCME: continuing medical education

was 35.9 ± 8.1 years old, and the proportion of male and female participants was fairly equal (50.3% male and 49.7% female). Only 50.3% of participants had ideal BMI (BMI <23 kg/m²). The majority of participants (79.7%) did not have any formal nutrition

education program, and only 45.1% of participants had attended CME engagement in nutrition. Most participants (87.0%) agreed with the need for further nutrition education. Calorie counting and carbohydrate counting were the types of dietary counselling that most PCPs felt least confident with (54.6% and 53.0%, respectively).

With regards to the personal dietary habits of the participants, 64.7% and 69.9% of PCPs have undesirable fat and fibre scores, respectively.

Table 2 shows the scores for the NUTCOMP constructs and the total score. PCPs had the lowest self-perceived confidence in nutrition knowledge and nutrition skills (mean scores 2.8 ± 0.6 and 2.9 ± 0.6, respectively), followed by self-perceived confidence in nutrition communication and counselling (mean score 3.1 ± 0.6). They scored highest in their attitudes towards nutrition care (mean score 4.3 ± 0.5).

The Cronbach's alpha coefficients for the NUTCOMP questionnaire and its individual constructs were good (knowledge: 0.87, skills: 0.91, communication and counselling: 0.92, attitudes: 0.88, NUTCOMP: 0.95). For NHGP fat and fibre questionnaire, Cronbach's alpha coefficients were 0.77 for fat and 0.71 for fibre.

There was significant collinearity between work experience and age, hence for multivariable regression analysis, we used work experience as an independent variable instead of age, as the former had more clinical significance.

After adjusting for PCPs' characteristics (Table 3), physicians who had completed a formal education program with nutrition content had significantly higher scores in self-perceived nutrition knowledge ($\beta = 2.27$, 95% C.I.: 4.57 to 16.94, p-value <0.01), self-perceived nutrition skills ($\beta = 5.08$, 95% C.I.: 2.64 to 7.53, p-value <0.01), self-perceived nutrition communication and counselling ($\beta = 3.09$, 95% C.I.: 0.91 to 5.27, p-value <0.01), and NUTCOMP score ($\beta = 10.76$, 95% C.I.: 4.57 to 16.94, p-value <0.01).

Compared to PCPs with 'less than 5 years' of work experience in primary care, those with '5 to 9 years', and those with 'more than 10 years' of experience had significantly higher self-perceived nutrition knowledge [($\beta = 1.97$, 95% C.I.: 0.20 to 3.73, p-value 0.03) and ($\beta = 3.39$, 95% C.I.: 1.77 to 5.00, p-value <0.01) respectively], self-perceived nutrition skills [($\beta = 3.63$, 95% C.I.: 0.79 to 6.47, p-value 0.01) and ($\beta = 3.18$, 95% C.I.: 0.57 to 5.78, p-value 0.02) respectively] and NUTCOMP score [($\beta = 7.62$, 95% C.I.: 0.44 to 14.81, p-value 0.04) and ($\beta = 9.44$, 95% C.I.: 2.85 to 16.04, p-value <0.01), respectively]. PCPs' highest qualification, CME engagement in nutrition, BMI, and personal dietary habits were not significantly associated with their self-perceived nutrition competence.

Discussion

With the rise of non-communicable diseases related to poor dietary habits, there is increasing demand for PCPs to provide nutrition care. This is the first study to measure the self-perceived nutrition competence among PCPs in Singapore. Our findings showed that PCPs reported the highest scores in their attitudes towards nutrition care and the lowest scores in their self-perceived confidence in nutrition knowledge and nutrition skills. We also found that physicians with formal nutrition education and those with more work experience reported higher self-perceived nutrition competence.

Table 2. NUTCOMP constructs and total score

	Number of items	Summative score ^a	SD	Mean score ^b	SD	Minimum score	Maximum score
Knowledge	7	19.8	4.1	2.8	0.6	1.3	5.0
Skills	11	32.3	6.7	2.9	0.6	1.6	5.0
Communication and counselling	9	28.1	5.6	3.1	0.6	1.4	5.0
Attitudes	8	34.4	4.1	4.3	0.5	3.0	5.0
NUTCOMP score	35	114.6	16.6	3.3	0.5	2.4	5.0

^aSummative score for construct: summation of all scores for items in each construct

^bMean score for construct: summative scores divided by number of items in each construct (score range one to five)

Comparison of NUTCOMP constructs

Self-perceived nutrition knowledge and nutrition skills were the two constructs that PCPs had the lowest confidence in. This was similar to studies in Ireland (Keaver *et al.*, 2018) and Saudi Arabia (Al-gassimi *et al.*, 2020), which also used the NUTCOMP questionnaire. The findings also correlated with other studies that used quizzes and patient scenarios to objectively measure nutrition knowledge (Crowley *et al.*, 2016b; Dumic *et al.*, 2018). While the self-perceived nutrition knowledge and nutrition skills scores appeared to be low, it is important to acknowledge that the NUTCOMP tool does not provide a benchmark cut-off for what is high and low (Ball and Leveritt, 2015). As such, further work is required to clarify what benchmark is acceptable for effective healthcare practice.

We also found that PCPs' confidence in nutrition communication and counselling was low in comparison with other constructs, in keeping with similar studies (Smith *et al.*, 2015; Al-gassimi *et al.*, 2020). A focus group study on Australian PCPs reported that they needed further information to contextualize their nutrition counselling to patients' cultural, social, and economic backgrounds (Crowley *et al.*, 2016a). Low perceived confidence may be attributed to inadequate nutrition training, lack of time, and lack of compensation (Kolasa and Rickett, 2010). This lack of confidence may hinder PCPs' efforts to improve patients' dietary behaviours.

The PCPs in our study reported positive attitudes towards nutrition care, and this was also reflected in similar studies (Moore and Adamson, 2002; Crowley *et al.*, 2015; Keaver *et al.*, 2018; Al-gassimi *et al.*, 2020) that used either the NUTCOMP questionnaire (Keaver *et al.*, 2018; Al-gassimi *et al.*, 2020) or self-reported questionnaire consisting of varying number of items (Moore and Adamson, 2002; Crowley *et al.*, 2015). It is an encouraging sign that the majority of PCPs recognize the importance of nutrition care and agree that they have an essential role to play in providing nutrition care. Yet despite so, there exists a gap between the positive attitudes displayed by PCPs, and their low self-perceived confidence in knowledge, skills, communication, and counselling in providing nutrition care. This highlights the importance of strategies such as adequate nutrition training to bridge this gap (Crowley *et al.*, 2020a).

PCPs' characteristics and self-perceived nutrition competence

Our study showed that PCPs who completed a formal education program with nutrition content had significantly better self-perceived nutrition competence, but not those with higher qualifications and those with CME engagement in nutrition.

Also, a large majority of PCPs felt that they needed further nutrition education. This may indicate a lack of adequate nutrition education in undergraduate (Danek *et al.*, 2017; Mogre *et al.*, 2018) and postgraduate medical training programmes (Devries *et al.*, 2019) as well as in CME activities (Crowley *et al.*, 2019), which are considered essential educational activities to maintain, develop, or increase the knowledge, skills, and professional performance of a doctor.

Previous studies have highlighted the lack of curriculum time for nutrition education (Adams *et al.*, 2006), inadequate nutrition content coverage (Chung *et al.*, 2014), poor collaboration with nutrition professionals, and poor application of nutrition science to clinical practice (Mogre *et al.*, 2018) as obstacles to the integration of nutrition education into undergraduate and postgraduate medical training programmes worldwide. CME activities are also inconsistent in their delivery methods (Davis, 1995) resulting in varying effectiveness on its learners (Marinopoulos *et al.*, 2007). In order to improve self-perceived nutrition competence among PCPs, there may be a need for more structured, comprehensive, competency-based education programmes. Competencies are key aspects of any educational model for medical training and having a focus on competency-based framework can help to guide medical education (Kris-Etherton *et al.*, 2015).

Another important finding in our study was that PCPs with more work experience had significantly better self-perceived nutrition competence. This is also consistent with a national survey conducted among PCPs in the United States (Bleich *et al.*, 2012b). More experienced PCPs may have gained nutrition knowledge and nutrition skills through other informal methods, such as interactions with patients and other allied healthcare workers, and thus felt more competent in providing nutrition care. Further studies using qualitative methods will be needed to better understand these informal methods, which may be helpful to improve nutrition competence training strategies targeted at our junior doctors.

Our study also showed that a significant number of PCPs had suboptimal BMI and undesirable personal dietary habits. While our study did not find significant associations between PCPs' BMI, personal dietary habits, and self-perceived nutrition competence, the evidence in the literature is conflicting. Some studies suggested that PCPs who had healthy lifestyles (Hung *et al.*, 2013) and normal BMI (Bleich *et al.*, 2012a) displayed greater confidence in nutrition competence and were more likely to provide nutrition care. However, a systematic review showed that physicians' own weight status was not significantly related to their knowledge, skills, or treatment behaviour of overweight or obese patients (Zhu *et al.*, 2011).

Table 3. Regression results between primary care physicians' characteristics with NUTCOMP constructs and total score

	Knowledge			Skills			Communication and counselling			Attitudes			NUTCOMP score		
	β	95% CI	p-value	β	95% CI	p-value	β	95% CI	p-value	β	95% CI	p-value	β	95% CI	p-value
Highest qualification															
MBBS ^a /GDFM ^b	REF			REF			REF			REF			REF		
MMED ^c /FCFP ^d	-0.18	-1.58 to 1.22	0.80	0.73	-1.52 to 2.99	0.52	0.54	-1.47 to 2.55	0.60	-0.79	-2.33 to 0.75	0.32	0.31	-5.40 to 6.01	0.92
Gender															
Male	REF			REF			REF			REF			REF		
Female	-0.69	-2.04 to 0.65	0.31	-0.88	-3.05 to 1.30	0.43	-0.70	-2.64 to 1.24	0.48	0.75	-0.73 to 2.24	0.32	-1.52	-7.01 to 3.98	0.59
BMI^e (kg/m²)															
<23.0	REF			REF			REF			REF			REF		
23.0-27.4	0.08	-1.40 to 1.55	0.92	0.32	-2.06 to 2.69	0.79	0.48	-1.65 to 2.60	0.66	-0.23	-1.85 to 1.39	0.78	0.64	-5.37 to 6.66	0.83
≥27.5	-0.59	-2.52 to 1.34	0.55	-0.81	-3.91 to 2.30	0.61	0.36	-2.42 to 3.14	0.80	-0.08	-2.20 to 2.04	0.94	-1.11	-8.98 to 6.76	0.78
Work experience (years)															
1-4	REF			REF			REF			REF			REF		
5-9	1.97	0.20 to 3.73	0.03	3.63	0.79 to 6.47	0.01	0.82	-1.71 to 3.36	0.52	1.20	-0.73 to 3.14	0.23	7.62	0.44 to 14.81	0.04
≥10	3.39	1.77 to 5.00	<0.01	3.18	0.57 to 5.78	0.02	2.23	-0.10 to 4.55	0.06	0.65	-1.13 to 2.43	0.47	9.44	2.85 to 16.04	<0.01
Previous formal nutrition education															
Did not complete formal education program with nutrition content	REF			REF			REF			REF			REF		
Completed formal education program with some nutrition content	2.27	4.57 to 16.94	<0.01	5.08	2.64 to 7.53	<0.01	3.09	0.91 to 5.27	<0.01	0.32	-1.35 to 1.99	0.71	10.76	4.57 to 16.94	<0.01
CME^f engagement in nutrition															
Yes	REF			REF			REF			REF			REF		
No	-0.53	-1.79 to 0.73	0.41	-0.23	-2.27 to 1.80	0.82	-0.74	-2.55 to 1.08	0.43	-0.46	-1.85 to 0.93	0.52	-1.95	-7.10 to 3.19	0.46
Fat score															
Undesirable	REF			REF			REF			REF			REF		
Acceptable/desirable	1.00	-0.45 to 2.45	0.18	1.60	-0.74 to 3.93	0.18	0.46	-1.62 to 2.54	0.67	1.41	-0.18 to 3.00	0.08	4.47	-1.44 to 10.37	0.14
Fibre score															
Undesirable	REF			REF			REF			REF			REF		
Acceptable/desirable	0.98	-0.45 to 2.41	0.18	2.81	0.51 to 5.11	0.02	0.64	-1.41 to 2.70	0.54	0.48	-1.09 to 2.05	0.55	4.91	-0.92 to 10.73	0.10

^aMBBS: Bachelor of Medicine and Bachelor of Surgery^bGDFM: Graduate Diploma in Family Medicine^cMMED: Master of Medicine in Family Medicine^dFCFP: Fellow of the College of Family Physicians Singapore^eBMI: body mass index^fCME: continuing medical education

Strengths and limitations

To our knowledge, this is the first study conducted in Singapore to evaluate self-perceived nutrition competence among PCPs. We used the NUTCOMP questionnaire that has been validated with good reliability to measure self-perceived nutrition competence. It has also been used among various healthcare professionals in many countries (Barnes *et al.*, 2016; Keaver *et al.*, 2018; Al-gassimi *et al.*, 2020; Crowley *et al.*, 2020b). Additionally, we explored important physician characteristics that could have influenced their self-perceived nutrition competence, such as their work experience, CME engagement in nutrition, personal dietary habits, and previous formal nutrition education.

Our study had a few limitations. First, the self-reported nature of data collection may have led participants to report socially desirable outcomes rather than a true reflection of their self-perceived nutrition competence. We chose to measure self-perceived nutrition competence, which is different from actual nutrition competence and actual provision of nutrition care, as direct measurement of actual competence is challenging and requires considerable resources to examine the care provided to the patient. Moreover, the measurement of self-perceived competence is reasonable as it has been shown to be an acceptable indicator of competence in health professionals (Davis *et al.*, 2006). Notably, studies have shown that PCPs with greater self-perceived nutrition competence were more likely to report providing nutrition care (van Dillen *et al.*, 2013; Al-gassimi *et al.*, 2020).

Second, there may be non-response bias due to the suboptimal response rate.

Third, we sampled PCPs from the public primary care setting and did not include those from private clinics. Thus, our sample was not representative of all PCPs in Singapore, and caution is required in the generalizability of our results.

Conclusion

With increasing prevalence of metabolic diseases, of which poor diet is a major contributing risk factor, it is imperative that PCPs are competent to provide good nutrition care. Our study highlighted that PCPs had lowest self-perceived confidence in nutrition knowledge and nutrition skills, and formal nutrition education and more work experience were associated with better self-perceived nutrition competence. To improve self-perceived nutrition competence, more can be done to incorporate nutrition care into our formal medical education. Future research will be needed to first establish the required benchmark of nutrition competency for effective nutrition care provision by PCPs and second to study how nutrition competencies can be better integrated into the curriculum of formal education programmes.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/S1463423624000689>

Data availability statement. The data underlying this article will be shared on reasonable request to the corresponding author.

Acknowledgements. The author would like to thank Associate Professor Lauren Ball for her kind permission to use the NUTCOMP questionnaire, as well as the Dietetic Service, Clinical Services of NHGP, for their kind permission to use the NHGP fat and fibre questionnaire.

Declarations. The study was approved by the institution review board.

The study was approved by the National Healthcare Group, Domain Specific Review Board, Singapore (DSRB Ref: 2021/00560).

The authors received no financial support for the research, authorship, and/or publication of this article.

All authors have no conflict of interest.

References

- Adams KM, Lindell KC, Kohlmeier M and Zeisel SH (2006) Status of nutrition education in medical schools. *The American Journal of Clinical Nutrition* 83(4), 941S–944S. doi: [10.1093/ajcn/83.4.941S](https://doi.org/10.1093/ajcn/83.4.941S).
- Al-gassimi O, Shah HBU, Sendi R, Ezmeirly HA, Ball L and Bakarman MA (2020) Nutrition competence of primary care physicians in Saudi Arabia: a cross-sectional study. *BMJ Open* 10(1), e033443. doi: [10.1136/bmjopen-2019-033443](https://doi.org/10.1136/bmjopen-2019-033443).
- Ball L, Desbrow B and Leveritt M (2014) An exploration of individuals' preferences for nutrition care from Australian primary care health professionals. *Australian Journal of Primary Health* 20(1), 113–120. doi: [10.1071/PY12127](https://doi.org/10.1071/PY12127).
- Ball L, Leveritt M, Cass S and Chaboyer W (2015) Effect of nutrition care provided by primary health professionals on adults' dietary behaviours: a systematic review. *Family practice* 32(6), 605–617. doi: [10.1093/fampra/cmz067](https://doi.org/10.1093/fampra/cmz067).
- Ball LE and Leveritt MD (2015) Development of a validated questionnaire to measure the self-perceived competence of primary health professionals in providing nutrition care to patients with chronic disease. *Family practice* 32(6), 706–710. doi: [10.1093/fampra/cmz073](https://doi.org/10.1093/fampra/cmz073).
- Barnes K, Desbrow B and Ball L (2016) Personal trainers are confident in their ability to provide nutrition care: a cross-sectional investigation. *Public Health* 140, 39–44. doi: [10.1016/j.puhe.2016.08.020](https://doi.org/10.1016/j.puhe.2016.08.020).
- Benziger CP, Roth GA and Moran AE (2016) The global burden of disease study and the preventable burden of NCD. *Global heart* 11(4), 393–397. doi: [10.1016/j.ghert.2016.10.024](https://doi.org/10.1016/j.ghert.2016.10.024).
- Bleich SN, Bennett WL, Gudzone KA and Cooper LA (2012a) Impact of physician BMI on obesity care and beliefs. *Obesity* 20(5), 999–1005. doi: [10.1038/oby.2011.402](https://doi.org/10.1038/oby.2011.402).
- Bleich SN, Bennett WL, Gudzone KA and Cooper LA (2012b) National survey of US primary care physicians' perspectives about causes of obesity and solutions to improve care. *BMJ Open* 2(6), e001871. doi: [10.1136/bmjopen-2012-001871](https://doi.org/10.1136/bmjopen-2012-001871).
- Chung M, van Buul VJ, Wilms E, Nellessen N and Brouns FJPH (2014) Nutrition education in European medical schools: results of an international survey. *European Journal of Clinical Nutrition* 68(7), 844–846. doi: [10.1038/ejcn.2014.75](https://doi.org/10.1038/ejcn.2014.75).
- College of Family Physicians Singapore. [no date]. *Professional Development of the Family Physician*. Available at: <https://www.cfps.org.sg/programmes/professional-development-of-the-family-physician/> [Accessed: 18 May 2022].
- Crowley J, Ball L, Han DY, McGill A-T, Arroll B, Leveritt M and Wall C (2015) Doctors' attitudes and confidence towards providing nutrition care in practice: comparison of New Zealand medical students, general practice registrars and general practitioners. *Journal of Primary Health Care* 7(3), 244–250.
- Crowley J, Ball L and Hiddink GJ (2019) Nutrition in medical education: a systematic review. *The Lancet. Planetary health* 3(9), e379–e389. doi: [10.1016/S2542-5196\(19\)30171-8](https://doi.org/10.1016/S2542-5196(19)30171-8).
- Crowley J, Ball L and Hiddink GJ (2020a) Nutrition care by primary-care physicians: advancing our understanding using the COM-B framework. *Public Health Nutrition* 23(1), 41–52. doi: [10.1017/S1368980019003148](https://doi.org/10.1017/S1368980019003148).
- Crowley J, Ball L, McGill, A-T, Buetow S, Arroll B, Leveritt M and Wall C (2016a) General practitioners' views on providing nutrition care to patients with chronic disease: a focus group study. *Journal of Primary Health Care* 8(4), 357. doi: [10.1071/HC15048](https://doi.org/10.1071/HC15048).
- Crowley J, Ball L and Wall C (2016b) Nutrition advice provided by general practice registrars: an investigation using patient scenarios. *Public Health* 140, 17–22. doi: [10.1016/j.puhe.2016.09.022](https://doi.org/10.1016/j.puhe.2016.09.022).
- Crowley J, Ball L and Wall C (2020b) How does self-perceived nutrition competence change over time during medical training? A prospective longitudinal observational study of New Zealand medical students. *BMJ Nutrition, Prevention & Health* 3(2), 270–276. doi: [10.1136/bmjnph-2020-000080](https://doi.org/10.1136/bmjnph-2020-000080).

- Danek RL, Berlin KL, Waite GN and Geib RW** (2017) Perceptions of nutrition education in the current medical school curriculum. *Family Medicine* **49**(10), 803–806.
- Davis DA** (1995) Changing physician performance: a systematic review of the effect of continuing medical education strategies. *JAMA* **274**(9), 700. doi: [10.1001/jama.1995.03530090032018](https://doi.org/10.1001/jama.1995.03530090032018).
- Davis DA, Mazmanian PE, Fordis M, Van Harrison R, Thorpe KE and Perrier L** (2006) Accuracy of physician self-assessment compared with observed measures of competence: a systematic review. *JAMA* **296**(9), 1094–1102. doi: [10.1001/jama.296.9.1094](https://doi.org/10.1001/jama.296.9.1094).
- Devries S, Willett W and Bonow RO** (2019) Nutrition education in medical school, residency training, and practice. *JAMA* **321**(14), 1351. doi: [10.1001/jama.2019.1581](https://doi.org/10.1001/jama.2019.1581).
- van Dillen SM, Hiddink GJ and van Woerkum CM** (2013) Determinants of dutch general practitioners' nutrition and physical activity guidance practices. *Public Health Nutrition* **16**(7), 1321–1331. doi: [10.1017/S1368980012003564](https://doi.org/10.1017/S1368980012003564).
- Dumic A, Miskulin M, Pavlovic N, Orkic Z, Bilic-Kirin V and Miskulin I** (2018) The nutrition knowledge of croatian general practitioners. *Journal of Clinical Medicine* **7**(7), 178. doi: [10.3390/jcm7070178](https://doi.org/10.3390/jcm7070178).
- England CY, Andrews RC, Jago R and Thompson JL** (2015) A systematic review of brief dietary questionnaires suitable for clinical use in the prevention and management of obesity, cardiovascular disease and type 2 diabetes. *European Journal of Clinical Nutrition* **69**(9), 977–1003. doi: [10.1038/ejcn.2015.6](https://doi.org/10.1038/ejcn.2015.6).
- Epidemiology & Disease Control Division, Ministry of Health Singapore and Institute for Health Metrics and Evaluation.** (2019) The Burden of Disease in Singapore, 1990–2017: An overview of the Global Burden of Disease Study 2017 results. *Seattle, WA: IHME*.
- GBD 2017 Diet Collaborators.** (2019) Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet (London, England)* **393**(10184), 1958–1972. doi: [10.1016/S0140-6736\(19\)30041-8](https://doi.org/10.1016/S0140-6736(19)30041-8).
- Health Promotion Board.** (2021) *My Healthy Plate*. Available at: https://www.healthhub.sg/sites/assets/Assets/Programs/my-healthy-plate/pdfs/My_Healthy_Plate_Fact_Sheet_-_Updated_4May_2021.pdf [Accessed: 18 May 2022].
- Hung OY, Keenan NL and Fang J** (2013) Physicians' health habits are associated with lifestyle counseling for hypertensive patients. *American Journal of Hypertension* **26**(2), 201–208. doi: [10.1093/ajh/hps022](https://doi.org/10.1093/ajh/hps022).
- Keaver L, O'Meara C, Mukhtar M and McHugh C** (2018) Providing nutrition care to patients with chronic disease: an irish teaching hospital healthcare professional study. *Journal of Biomedical Education* **2018**, 1–7. doi: [10.1155/2018/1657624](https://doi.org/10.1155/2018/1657624).
- Kolasa KM and Rickett K** (2010) Barriers to providing nutrition counseling cited by physicians: a survey of primary care practitioners. *Nutrition in Clinical Practice: Official Publication of the American Society for Parenteral and Enteral Nutrition* **25**(5), 502–509. doi: [10.1177/0884533610380057](https://doi.org/10.1177/0884533610380057).
- Kris-Etherton PM, et al.** (2015) Nutrition competencies in health professionals' education and training: a new paradigm. *Advances in Nutrition* **6**(1), 83–87. doi: [10.3945/an.114.006734](https://doi.org/10.3945/an.114.006734).
- Marinopoulos SS, et al.** (2007) Effectiveness of continuing medical education. *Evidence Report/Technology Assessment* **149**, 1–69.
- Mogre V, Stevens FCJ, Aryee PA, Amalba A and Scherpbier AJJA** (2018) Why nutrition education is inadequate in the medical curriculum: a qualitative study of students' perspectives on barriers and strategies. *BMC Medical Education* **18**(1), 26. doi: [10.1186/s12909-018-1130-5](https://doi.org/10.1186/s12909-018-1130-5).
- Moore H and Adamson AJ** (2002) Nutrition interventions by primary care staff: a survey of involvement, knowledge and attitude. *Public Health Nutrition* **5**(4), 531–536. doi: [10.1079/PHN2001326](https://doi.org/10.1079/PHN2001326).
- National Health and Medical Research Council.** (2013) Australian Dietary Guidelines. Canberra: National Health and Medical Research Council.
- Reeves MM, Winkler EAH and Eakin EG** (2015) Fat and fibre behaviour questionnaire: reliability, relative validity and responsiveness to change in Australian adults with type 2 diabetes and/or hypertension. *Nutrition and Dietetics* **72**(4), 368–376. doi: [10.1111/1747-0080.12160](https://doi.org/10.1111/1747-0080.12160).
- Smith S, Seeholzer EL, Gullett H, Jackson B, Antognoli E, Krejci SA and Flocke SA** (2015) Primary care residents' knowledge, attitudes, self-efficacy, and perceived professional norms regarding obesity, nutrition, and physical activity counseling. *Journal of Graduate Medical Education* **7**(3), 388–394. doi: [10.4300/JGME-D-14-00710.1](https://doi.org/10.4300/JGME-D-14-00710.1).
- Verma S, Paterson M and Medves J** (2006) Core competencies for health care professionals: what medicine, nursing, occupational therapy, and physiotherapy share. *Journal of Allied Health* **35**(2), 109–115.
- Wharton, S., et al.** (2020) Obesity in adults: a clinical practice guideline. *CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne* **192**(31), E875–E891. doi: [10.1503/cmaj.191707](https://doi.org/10.1503/cmaj.191707).
- Zhu DQ, Norman IJ and While AE** (2011) The relationship between doctors' and nurses' own weight status and their weight management practices: a systematic review. *Obesity Reviews* **12**(6), 459–469. doi: [10.1111/j.1467-789X.2010.00821.x](https://doi.org/10.1111/j.1467-789X.2010.00821.x).