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Original Article

Undergraduates' preparedness for practice is associated with professional identity and perception of educational environment: A validation study

Shiuan-Ruey Yu [a,1], Yang-Chun Cheng [b,c,1], Hsu-Min Tseng [a,d], Yu-Che Chang [a,b,e], Shou-De Ma [e], Chien-Da Huang [a,e,f], Ming-Ju Hsieh [a,e,g], Ji-Tseng Fang [e,h], Chung-Hsien Chaou [a,b,e,*]

[a] Chang Gung Medical Education Research Centre, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
[b] Department of Emergency Medicine, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
[c] Camillian Saint Mary's Hospital Luodong, Yilan, Taiwan
[d] Department of Health Care Management, Chang Gung University, Taoyuan, Taiwan
[e] College of Medicine, Chang Gung University, Taoyuan, Taiwan
[f] Department of Thoraic Medicine, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
[g] Department of Thoracic Surgery, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan
[h] Department of Nephrology, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan

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ABSTRACT

Background: Medical schools prepare undergraduates for clinical practice. Clinical competencies build up gradually and continuously. Existing literature suggests that new graduates are often unprepared for independent practice. This study aims to validate a Chinese version of a Preparedness for Hospital Practice Questionnaire (PHPQ) in a Taiwanese undergraduate cohort.

Methods: The original eight-domain English version PHPQ was translated into Chinese and back-translated for expert panel discussion. The eight domains encompass interpersonal skills, confidence, collaboration, management, science, prevention, holistic care, and self-directed learning. Reliability and validity were checked by Cronbach's alpha and by confirmatory factor analysis (CFA), respectively. Participants were divided into higher and lower preparedness groups according to PHPQ results, and compared by age, sex, professional identity, and perception of educational environment.

Results: A total of 129 undergraduate medical students (55% males) participated in the study. The overall Cronbach's alpha was 0.94. Participants were found to be best prepared in the domain of disease prevention (M = 4.37, SD = 0.68) and least prepared in interpersonal skills (M = 2.68, SD = 0.77). A satisfactory goodness of fit data was yield from CFA

* *Corresponding author*. Department of Emergency Medicine, Chang Gung Memorial Hospital, Linkou and Chang Gung University College of Medicine, Taoyuan, Taiwan.
E-mail address: m7088@cgmh.org.tw (C.-H. Chaou).

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[1] Shiuan-Ruey Yu and Yang-Chun Cheng are the first authors. The first 2 authors contributed equally to this article.

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with a CMIN/DF of 2.02. Higher levels of preparedness are associated with stronger professional identity ($p < 0.001$) and better perceived learning environment ($p < 0.001$).
Conclusion: The Chinese version of PHPQ showed good reliability and validity. Preparedness for practice was associated with how learners feel about themselves as doctors and how well they had integrated into medical teamwork.

At a glance commentary

Scientific background on the subject

Medical schools prepare undergraduates for clinical practice, but existing literature suggests that new graduates are often underprepared. Inadequate preparedness causes adverse effects in both personal and system levels. Relevant studies and measurement tools in Asian countries are relatively scarce.

What this study adds to the field

The Chinese version of PHPQ showed good reliability and validity. Taiwanese undergraduates were best prepared in disease prevention and least prepared in interpersonal skills. Preparedness for practice was associated with how learners feel about themselves as doctors and how well they had integrated into medical teamwork.

The goal of medical schools is to prepare medical students for clinical practice after graduation. Unlike attaining board certification, which provides a clear cut-off point between students and doctors, clinical competencies are continuously and gradually being built up. Existing literature shows that many new graduates do not feel ready for independent hospital practice as a junior doctor [1,2]. In a previous UK national survey of 5243 newly qualified doctors, only 36.3% of respondents agreed that their training had prepared them well for their postgraduate clinical jobs [3]. Other studies demonstrate an uneven level of preparedness among different clinical competencies or task domains. Medical students were usually reported as being more prepared in knowledge–based areas or those that can be simulated during a rotation curriculum, such as taking histories and physical examinations [4,5]. On the other hand, Morrow et al. [2] reported that UK medical graduates were less prepared for applying knowledge of alternative and complementary therapies. In other studies, graduates appeared unprepared for non–knowledge–based competencies, such as emergency management, multidisciplinary team–working, clinical prioritization, time management, and understanding ethical issues [6,7].

The effect of inadequate preparedness during transition can be viewed from the personal and from the system level. On the personal level, new doctors during transition were reported to experience higher levels of stress, emotional disturbance, and even evidence of depression [8]. Some of this stress results in physical or psychological symptoms, such as shivering and sweating, coupled with reduced enthusiasm for work, emotional retreat, anger, and loss of concentration [9,10]. On the system level, inadequate preparedness of new graduates poses negative impacts on health care quality or endpoints; it has been referred to as the "July effect." [11,12] In fact, the period during which changeovers occur has been called, even more ominously, the "killing season." [13] Adverse effects reported as being associated with underprepared learners include an increase in medical errors, epilepsy complications, length of hospital stay, and surgical mortality [12,14–16]. Although the actual impact of the July effect remains controversial [17–19], the importance of preparedness for clinical practice among recent graduates cannot be overlooked.

Various methods for assessing preparedness for individual clinical practice have been proposed in the literature. The simplest and perhaps most intuitive method is to ask a single dichotomous question about whether the participant feels well prepared to be a doctor [20]. Another similar study used a five point Likert scale, from strongly agree to strongly disagree, to answer the question of "My experience at medical school prepared me well for the jobs I have undertaken so far." [3,21] More complex measures have also been created for this evaluation. Bleakley and Brennan [22] developed a two-part questionnaire using a 5-point Likert scale to evaluate the extent to which the undergraduate coursework prepared the learners for individual competencies (39 questions) and their ability to carry out clinical tasks (19 questions). The items were developed in accordance with *Tomorrow's Doctors* and the *MMC Foundation Programme* in the UK medical training system [4,22]. Other multi-dimensional questionnaires, with as many as 53 items in 11 domains, are being developed in various curriculums to evaluate the preparedness of learners during this transition [2,23]. A more commonly used version of a questionnaire measuring preparedness for hospital practice was developed by Hill et al. [24] This 41-item, eight-domain questionnaire has been validated by several previous researchers, even in non-English–speaking countries [1,25–27].

The field of educating health-care professionals has been developing rapidly in Asia in the last two decades. In Chinese–speaking countries, despite a total population of more than a billion people, there has not yet appeared an adequate tool to evaluate the preparedness for hospital practice of undergraduate or postgraduate medical learners. The aim of this study is to develop and validate a Chinese version of the Preparedness for Hospital Practice Questionnaire.

Methods

Study setting

This is a questionnaire development study with a cross-sectional on-line questionnaire survey of medical students who are receiving their clinical rotation in the final years of medical curriculum. The study was approved by the local institutional review board (IRB No. 20161758B0, 201701981B0). In Taiwan, medical students enter medical school at the average age of 18 for a six-year curriculum. The first four years are preclinical courses conducted mostly in the university; the last two years are clinical rotatory clerkship in a teaching hospital. Clinical rotations combine lecture-based education, formative assessments, and actual patient care experiences under supervision. After graduation, medical students take national medical board exams and become certified physicians to begin another two years of post-graduate rotation (PGY1-PGY2) before entering a residency program. Although supervision is still provided for PGY and residency periods, the new doctors in these post-graduate periods are often thought of as being capable of providing independent hospital clinical practice and decision–making.

Participants and data collection

The participants were volunteers among the medical students from Chang-Gung University college of medicine from September 2017 to October 2018. These students were admitted during 2012–2014. The timing of participants filling out the questionnaire was within 4 months after they entered the clinical rotation. Participants were invited via the Internet to join a three-year prospective cohort study for evaluation of preparedness for clinical practice from undergraduate to postgraduate periods. A 1-h recruitment orientation was given before written consent was requested. The individual demographic information collected included the participant's age, admission year, and high school geographical location. We also inquired about the participants' previous academic performance in medical school by selecting among top, middle, or bottom third ranking.

Instruments

Preparedness for Hospital Practice Questionnaire (PHPQ)
This 41-item questionnaire was developed by Hill et al. [24] It consists of eight subscales: interpersonal skills (IS, four items), confidence (CF, six items), collaboration (CL, four items), management (MG, five items), science (SC, four items), prevention (PV, six items), holistic care (HC, six items), self-directed learning (SDL, six items). The PHPQ subscales' reliability alpha coefficients ranged from 0.78 to 0.88 as stated in a study by Hill et al. [24].

The original author was contacted for permission to develop a Chinese version PHPQ and permission was granted. Two researchers, one with a clinical education and physician background (CHC), the other with an education and statistics background (HMT), independently translated the original questionnaire into the Chinese version. Both researchers are fluent in Chinese and English. The two translators then discussed about the two versions and formed a preliminary version. A panel composed of a statistician, two experts in questionnaire development, including one native English speaker, and two clinicians was formed to review the difference in the initial versions of the Chinese translation, discrepancies between the original English version and the back-translation, and the suggestions from three sampled students about the preliminary version. The following criteria were considered by the panel: (1) semantic representation: does the translation present the whole meaning of the original item, and are there are any alternative sentences that could be considered; (2) clarity: was the wording clear and easy to understand; (3) contextual difference: in item 11, the examples are not applicable under local educational context, and therefore "Carry out basic ward procedures (e.g., drips, catheters)" was changed to "Carry out basic ward procedures (e.g., blood drawing, nasogastric tube placement, and urinary catheter insertion)". The above change is made because most catheters and drips are handled by nurses in Taiwan. The preliminary Chinese version of PHPQ was back-translated by a professional medical translator who was not associated with this study. The reverse translation was compared to the original English version by the expert committee. Before implementation, three randomly sampled last-year medical students, who were not participants, were invited to give opinions on the preliminary version of the Chinese PHPQ regarding comprehensibility and wording of the questions.

Professional identity scale (PIS)
This scale is also called the MacLeod Clark Professional Identity Scale (MCPIS). It was developed by Macleod Clark et al. using a Likert response scale to measure professional identity in health care students [28]. This scale, incorporating the concept of social identity theory, was derived following psychometric testing and validation norms. Psychometric properties were tested later with a good reliability ($\alpha = 0.83$) item–total correlation being reported [29]. A Chinese version of PIS, including team and cognitive flexibility subscales, was also developed during this study, following the process described above.

Scan of post-graduate educational environment domains (SPEED)
SPEED is a 15-item questionnaire developed in the UK by Schonrock-Adema et al. [30] to evaluate various aspects of the clinical learning environment for junior doctors. SPEED contains three domains of the clinical learning environment: (1) learning content, (2) learning atmosphere, and (3) learning organization. The tool has been translated to Chinese and used in Taiwanese medical education study previously [31].

Statistical analysis

Psychometric analyses of the PHPQ included item and scale-level descriptive statistics, reliability, and a confirmatory factor analysis (CFA) to test the theoretical structure of the PHPQ. Statistical software SAS (version 9.4, SAS Institute Inc., Cary, NC) [32] and R (version 3.4.4, R Core Team, 2018) [33] were

employed. Means and standard deviation (SD) are used to describe the central tendency and spread of continuous variables, and the count and percentage for categorical variables. The sum of Likert scales was regarded as a continuous variable in accordance with Norman et al. [34]. Independent T testing was used to compare continuous results between groups. The internal consistency reliability for PHPQ and subscales was measured by Cronbach's alpha, together with inter-scale correlations.

Construct validity was tested by CFA to determine if the eight-domain solution derived from the original PHPQ had been retained in the translated version used on Taiwanese medical students. Following the standard procedures in CFA using lavaan version 0.5–23 (Rosseel, 2012) [35], no cross loadings were permitted and non null correlations between factors were allowed. Goodness of fit indices were reported, including overall model fit indices such as Satorra–Bentler scaled chi-square (S-Bx 2)/degrees of freedom ratio (CMIN/DF) and root mean square error of approximation (RMSEA), as well as the comparative fit index (CFI). In terms of criterion-based validity, a known-group comparison approach was taken. Participating students were divided into two groups according to their levels of preparedness. We anticipated participating students with higher PHPQ scores would score significantly higher on the professional identity (PIS) and learning environment satisfaction (SPEED) score than would their counterparts. A p value of <0.05 was considered statistically significant.

Results

A total of 129 participants completed this study. There were 44 (34.1%) from the 2012 cohort, 41 (31.8%) from the 2013 cohort, and 44 (34.1%) from the 2014 cohort. The average age was 23.4 (SD = 1.39), with 71 (55.0%) males and 58 (45.0%) females. The detailed demographic characteristics are presented in Table 1. About half of the participants (48.1%) believed that they were in the middle third of their class in terms of previous academic performance. The overall Cronbach's alpha for Chinese version of PHPQ and PIS are 0.94 and 0.74, respectively, indicating a good internal consistency. The highest item mean, that is, the ones for which the students were best prepared, were preparedness for taking drug and alcohol history during an initial consultation (M = 4.88, SD = 0.96) and taking responsibility for one's own learning (M = 4.75, SD = 0.98); the lowest item results were their scores for dealing with dying (M = 2.15, SD = 1.03) or difficult (M = 2.43, SD = 1.09) patients.

Table 1 Demographics of the participants.

	Mean/N	(SD/%)
Age	23.4	1.39
Gender		
Male	71	55.0
Female	58	45.0
Geographic area		
North	68	52.7
Central	27	20.9
South	23	17.8
East	2	1.55
Offshore islands	2	1.55
Overseas	7	5.43
Academic performance ranking		
Top	39	30.2
Middle	62	48.1
Bottom	28	21.7

The item descriptive statistics and Pearson item–scale correlations are presented in Table 2. The correlations between items and their hypothesized subscales ranged from 0.50 (CL28) to 0.84 (SDL38 and HC15) but fell generally between 0.6 and 0.7. All items reflected higher correlations with their hypothesized subscales than with other subscales, except CL28 ($\rho = 0.5$ with CL, $\rho = 0.55$ with SDL, and $\rho = 0.61$ with PV) and SC19 ($\rho = 0.57$ with SC, and $\rho = 0.58$ with SDL). The descriptive statistics and the inter-correlation for subscales and PHPQ are presented in Table 3. The eight domains are moderately correlated with each other. The alpha statistics for sub-scales are presented on the diagonal brackets of Table 3. As seen, the internal consistency of most subscales were greater than 0.7 except for collaboration ($\alpha = 0.66$) and science ($\alpha = 0.61$). The internal consistency of collaboration after excluding CL28 increased to $\alpha = 0.7$, and that of science after excluding SC19 is still low at $\alpha = 0.59$. The item–total correlations were all greater than 0.6, with the highest being confidence and self-directed learning (both $\rho = 0.82$) and the lowest being science ($\rho = 0.64$).

The domain reported as being the one in which they felt most prepared was prevention (M = 4.37, SD = 0.68), followed by self-directed learning (M = 4.22, SD = 0.74); the domain in which they reported feeling least prepared was interpersonal skills (M = 2.68, SD = 0.77), followed by patient management (M = 3.22, SD = 0.71). A confirmative factor analysis was done to examine the validity of the Chinese version PHPQ on the study population using the original eight-domain structure. Fig. 1 shows the eight-factor structure of the Chinese version of the PHPQ with standardized parameter estimates and standardized error variances. All parameters estimated were statistically significant. A satisfactory goodness of fit data was yield with a CMIN/DF of 2.02. The fit indices were RMSEA (0.089) and CFI (0.708). Further refinement of the measurement model could be done under different clinical contexts.

For criterion-based validity, the participants were divided into higher and lower preparedness groups according to their sum PHPQ scores. The two groups of participants present with similar ages (23.5 ± 1.43 vs 23.2 ± 1.33, $p = 0.149$), but the better prepared group of participants comprised of higher proportion of males (63.7% vs 45%, $p = 0.033$) (Table 4). Because there is no established similar tool being used for Taiwanese medical students, the two groups of students were compared using their PIS (professional identity) and SPEED (perception of learning environment) scores. The results revealed that the students in the higher preparedness group possessed significantly better professional identity (35.6 ± 3.99 vs 32.6 ± 4.01, $p < 0.001$) and a better perception of their learning environment (44.1 ± 4.88 vs 40.7 ± 5.91, $p < 0.001$) than the lower preparedness group students.

Table 2 Item descriptive statistics and Pearson item–scale correlations corrected for overlap.

Scale (Choice Range)	Item	Mean	SD	IS	CF	CL	MG	SC	PV	HC	SDL
Interpersonal skills	IS20	2.43	1.09	**0.71**	0.32	0.35	0.62	0.44	0.21	0.30	0.29
	IS22	3.00	1.08	**0.76**	0.44	0.40	0.36	0.26	0.40	0.49	0.36
	IS30	3.16	0.99	**0.75**	0.45	0.55	0.48	0.38	0.42	0.50	0.38
	IS36	2.15	1.03	**0.72**	0.22	0.32	0.37	0.26	0.16	0.27	0.18
Confidence	CF2	3.46	1.08	0.29	**0.71**	0.35	0.40	0.28	0.36	0.39	0.52
	CF3	4.16	1.07	0.24	**0.61**	0.19	0.37	0.34	0.45	0.32	0.46
	CF6	3.77	1.18	0.37	**0.71**	0.36	0.34	0.23	0.47	0.43	0.39
	CF17	3.66	1.19	0.18	**0.67**	0.33	0.25	0.17	0.26	0.35	0.53
	CF26	3.56	1.04	0.50	**0.68**	0.45	0.46	0.36	0.43	0.46	0.45
	CF37	3.99	1.08	0.37	**0.61**	0.39	0.38	0.36	0.44	0.31	0.58
Collaboration	CL28	4.57	1.04	0.21	0.45	0.50	0.28	0.32	**0.61**	0.47	0.55
	CL33	3.56	1.18	0.53	0.52	**0.81**	0.48	0.34	0.41	0.53	0.44
	CL40	3.02	1.13	0.48	0.29	**0.80**	0.44	0.37	0.30	0.41	0.32
	CL41	3.19	1.10	0.38	0.26	**0.82**	0.36	0.25	0.30	0.42	0.28
Management	MG4	2.74	1.06	0.50	0.36	0.48	**0.66**	0.42	0.35	0.39	0.31
	MG7	2.37	1.00	0.57	0.38	0.44	**0.74**	0.41	0.26	0.27	0.29
	MG11	3.05	1.28	0.37	0.34	0.29	**0.76**	0.25	0.32	0.18	0.35
	MG25	3.84	0.95	0.34	0.42	0.29	**0.68**	0.32	0.44	0.23	0.41
	MG31	4.08	0.87	0.37	0.40	0.36	**0.59**	0.34	0.47	0.32	0.43
Science	SC8	3.98	1.00	0.19	0.24	0.17	0.16	**0.67**	0.32	0.16	0.28
	SC12	3.33	1.02	0.33	0.24	0.31	0.37	**0.76**	0.29	0.17	0.30
	SC19	4.08	0.80	0.17	0.49	0.21	0.35	0.57	0.51	0.28	**0.58**
	SC29	2.89	1.10	0.50	0.25	0.46	0.47	**0.71**	0.25	0.30	0.26
Prevention	PV5	4.01	0.96	0.37	0.53	0.40	0.46	0.51	**0.77**	0.47	0.50
	PV9	4.10	0.95	0.32	0.46	0.40	0.42	0.40	**0.80**	0.50	0.49
	PV13	4.88	0.96	0.01	0.30	0.28	0.27	0.21	**0.64**	0.23	0.35
	PV18	4.52	0.95	0.28	0.46	0.43	0.31	0.37	**0.76**	0.47	0.47
	PV32	4.54	0.81	0.35	0.52	0.46	0.43	0.29	**0.79**	0.54	0.62
	PV34	4.19	0.81	0.50	0.41	0.46	0.47	0.35	**0.71**	0.57	0.50
Holistic care	HC1	3.96	0.96	0.24	0.44	0.35	0.37	0.20	0.50	**0.66**	0.40
	HC15	4.20	1.00	0.38	0.40	0.50	0.29	0.24	0.57	**0.84**	0.42
	HC16	4.21	1.13	0.45	0.46	0.53	0.24	0.35	0.42	**0.83**	0.43
	HC21	3.92	1.23	0.38	0.47	0.44	0.25	0.24	0.44	**0.81**	0.39
	HC24	4.02	1.13	0.33	0.34	0.37	0.17	0.17	0.34	**0.70**	0.29
	HC35	3.70	1.08	0.60	0.42	0.60	0.49	0.31	0.54	**0.66**	0.45
Self-directed learning	SDL10	4.75	0.98	0.11	0.56	0.39	0.35	0.36	0.57	0.30	**0.75**
	SDL14	4.46	0.88	0.28	0.56	0.33	0.38	0.33	0.52	0.40	**0.78**
	SDL23	4.40	0.93	0.34	0.57	0.38	0.35	0.41	0.55	0.44	**0.83**
	SDL27	3.66	1.07	0.34	0.58	0.40	0.43	0.39	0.38	0.42	**0.71**
	SDL38	4.18	0.99	0.31	0.61	0.40	0.44	0.35	0.49	0.34	**0.84**
	SDL39	3.88	0.96	0.51	0.47	0.55	0.37	0.43	0.46	0.49	**0.66**

Table 3 Reliability, means, and inter-correlation of subscales.

MG	Items	Mean	(SD)	IS	M	CL	SC	CF	HC	SDL	PV
IS	4	2.68	0.77	(0.72)	0.62	0.55	0.46	0.48	0.53	0.41	0.4
MG	5	3.22	0.71		(0.72)	0.53	0.5	0.55	0.39	0.51	0.53
CL	4	3.58	0.82			(0.66)	0.43	0.52	0.62	0.54	0.54
SC	4	3.58	0.67				(0.61)	0.43	0.34	0.5	0.48
CF	6	3.77	0.74					(0.75)	0.56	0.73	0.6
HC	6	4	0.82						(0.85)	0.53	0.62
SDL	6	4.22	0.74							(0.85)	0.65
PV	6	4.37	0.68								(0.84)
Total	41	3.75	0.57	0.71	0.74	0.77	0.64	0.82	0.78	0.82	0.8

Abbreviations: IS: Interpersonal skills; CF: Confidence; CL: Collaboration; MG: Management; SC: Science; PV: Prevention; HC: Holistic care; SDL: Self-directed learning. For diagonal items: (alpha).

Discussion

In the current research, the authors developed and validated a Chinese version of PHPQ for assessing medical students' preparedness during transition periods from school curriculum to clinical learning. This measure appears to be reliable and the model fits well under the original eight-domain structure. The eight domains all showed moderate to high

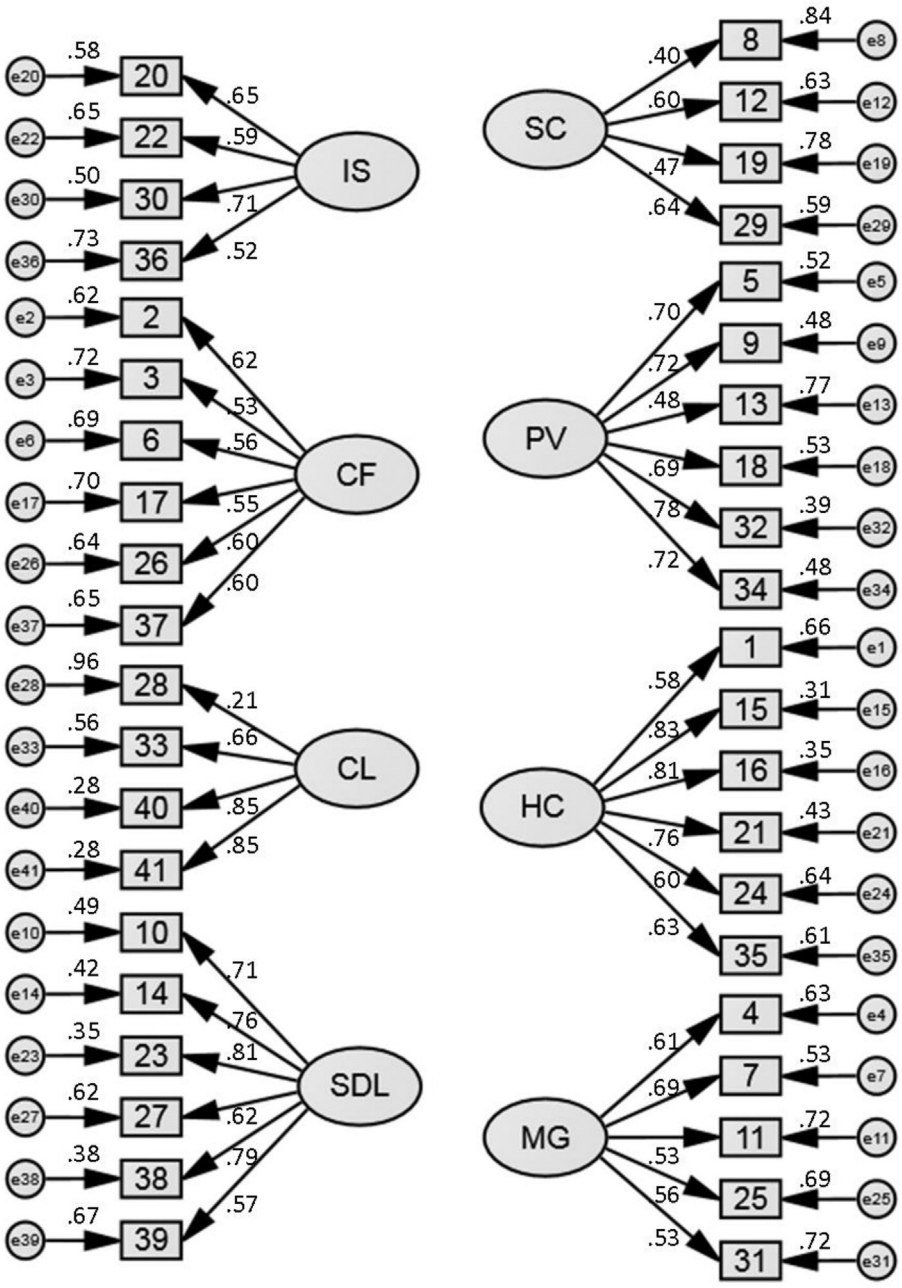

Fig. 1 Eight-factor structure of the Chinese version of PHPQ (n = 129) with standardized factor loadings and standardized error variances. Abbreviations used: IS: interpersonal skills; CF: confidence; CL: collaboration; MG: management; SC: science; PV: prevention; HC: holistic care; SDL: self-directed learning.

correlations with the final PHPQ scores. In addition, the preparedness for practice scores were shown to be closely associated with the professional identity scores (how much do the learners regard themselves as doctors), and perception of learning environment (how well were they integrated into medical team working). Since the transition from undergraduate to postgraduate is also a transition from school learning to workplace learning, measuring attitude is equally as important as measuring knowledge and skills. Most of the final summative assessments during this transition measured "know how" and "show how" and are sometimes questioned for their utility [36,37]. The results of this and previous research suggest that preparedness for hospital clinical practice should be integrated into one of the final overall endpoints in the era of competency-based medical education [38].

Comparing overall preparedness with previous studies, this study's population seemed to present with lower preparedness levels in several domains (Fig. 2). A possible explanation is that the current validation study included undergraduates who were just entering their two-year clinical rotation, while most other studies enlisted recent

Table 4 Comparison of higher vs. lower preparedness subgroups on professional identity scale and learning environment ratings.

	Higher preparedness		Lower preparedness		*p*-value
	Mean	SD	Mean	SD	
Male gender[a]	44	(63.7)	27	(45.0)	0.033
Age	23.5	(1.43)	23.2	(1.33)	0.149
Professional identity	35.6	(3.99)	32.6	(4.01)	<0.001
Learning environment perception	44.1	(4.88)	40.7	(5.91)	0.001

[a] Presented as count (percentage).

postgraduates [24,25,27]. In this study cohort, participants reported being more prepared in the domains of prevention, self-directed learning, and holistic care, and less prepared in the domains related to interpersonal skills, management, and collaboration. That is, more prepared in the cognition-related domains and a lack of preparation for patient care and working with colleagues in a real-life workplace learning environment. During their discipline– or content–based medical school curriculum, undergraduates learned to master contents that were more "self–controllable," such as what to ask when presented with a symptom, the sequence of certain clinical procedures, or the relationship between disease and risk factors.

In the domains for which they were less prepared, similar findings were also reported in previous studies [1,24]. Beginners generally felt less-prepared for the competencies that involve other stakeholders, such as doctor-patient communication skills and inter-professional team collaboration abilities. The two items with the lowest scores in this study were related to management of "difficult" or "dying" patients within the interpersonal skills domain. Previous study also addressed the need for coping strategies when confronting these unusual circumstances [39]. In the area of team collaboration, novel learning models, such as team–based or problem–based methods, have been shown to be effective in preparing trainees for their inter-personal working ability [40]. Nevertheless, there's still a difference between these team learning activities within a relatively homogeneous group of learners and real-life inter-professional patient management in a hierarchical working environment. The undergraduates needed to be reminded about the importance of competencies such as team resource management skills and being immersed in a supportive environment during the transition period [2,38,41].

Two items were found to possess cross-loadings, which were CL28: "Appreciate the importance of group dynamics when working within a team environment" and SC19: "Apply an understanding of basic sciences to clinical conditions". For CL28, group dynamics was rarely taught in Taiwanese medical education system before entering clinical learning environment. In the beginning of clinical rotation, the participants were experiencing a transition

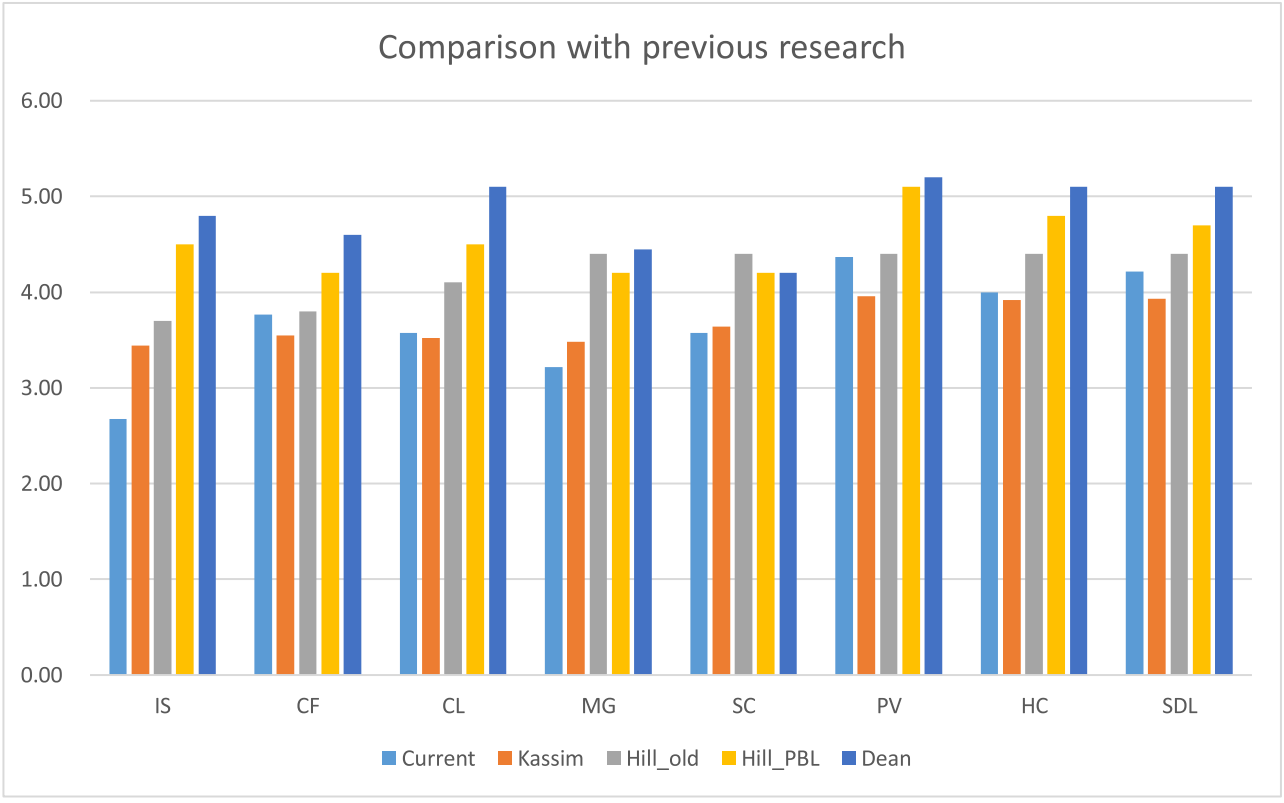

Fig. 2 Comparison of the results of eight PHPQ domains.

from medical students to doctors, from single-professional learning to multi-professional practice. The cross loading may be due to the similarity of experience in learning disease prevention, which also involves other stakeholders other than doctors. On the other hand, SC19 is about applying basic science to clinical conditions. This knowledge application usually involves understanding the concepts previously learned, analyzing the clinical situation which was encountered, and using reasoning skills to come up with an evaluation or decision. Among Taiwanese medical students, this experience may be similar to that of self-directed learning. Further large scale studies may be needed to confirm this phenomenon.

Influential factors on preparedness for practice may be the next step for research. Previously identified factors include academic performance, age, gender, being international graduates, and the cultural climate of the working environment [27,42–44]. In the current study, age was not shown to have an influence on preparedness. This could also be due to the homogeneity of the sample population which can be demonstrated on the relatively small standard deviation of age in Table 1. Male gender, on the other hand, was associated with higher preparedness for practice, but the data available are not sufficient for explaining the etiology of this discrepancy; further qualitative research is needed on how gender affects undergraduates' preparedness.

Limitations

This study has certain limitations. First, this is a single center study. Contextual differences must be taken into account before attempting to generalize across settings. Second, this study involved medical students who volunteered for a questionnaire survey. A selection bias may be present because students who volunteer may be different from the whole population in their knowledge, attitude, or preparedness for practice. Third, the statistical power of the current study may be limited due to its sample size, further large scale validations of this questionnaire may be needed in the future.

Conclusion

The Chinese version of PHPQ is both valid and reliable. Undergraduates in the study cohort were more prepared for self-directed learning, but less prepared for interpersonal and patient management skills. Preparedness for practice is closely associated with how medical undergraduates regard themselves as medical professionals, and how they perceive the educational environment they experienced.

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Conflicts of interest

The authors declare no conflicts of interest.

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