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Methodological Study on the Evaluation of Face Mask Use Scale among Public Adult: Cross-Language and Psychometric Testing

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Purpose: This study aimed to establish the translation adequacy and examine the psychometric properties of Face Mask Use Scale (FMUS). **Methods:** This methodological study employed a cross-sectional design with repeated measures. Phase 1 examined the equivalence and relevance of English and Chinese versions of FMUS. Phase 2 examined the internal consistency, stability and construct validity. Different sample batches (213 university students and 971 general public) were used appropriately for psychometric testing. The 2-phase data were collected between January and April 2017. **Results:** In Phase 1, the semantic equivalence and relevance (item- and scale-level content-validity-index=100%) was satisfactory. Furthermore, from 133 paired test-retest responses, the quadratic weighted kappa (.53~.73, p<.001) and Intraclass Correlation Coefficient (ICC=.81) between the English and Chinese version of FMUS were satisfactory. In Phase 2, FMUS demonstrated satisfactory internal consistency (Cronbach's α=.80~.81; corrected item-total correlation coefficients=.46~.67) and two-week test-retest stability (ICC=.84). The known-groups method (t=3.08, p<.001), exploratory (71.10% of total variance in two-factor model) and confirmatory factor analysis (x^2/df=4.02, Root Mean Square Residual=.03, Root Mean Square Error of Approximation=.06, Goodness of Fit Index=.99, Comparative Fit Index=.99) were all satisfactory for establishing the construct validity. **Conclusion:** The FMUS has an equivalence Chinese and English versions, satisfactory reliability and validity for measuring the practice of face mask use. This poses clinical and research implications for those community health nurses who works on respiratory protection. Further research should be conducted on the 'negligent practice' of FMU.

Key Words: Masks; Psychometrics; Validation study; Factor analysis

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INTRODUCTION

Influenza is an acute viral infection, seriously invading the health of the population worldwide [1,2]. The primary transmission of viruses is person-to-person contact through respiratory droplets when coughing, sneezing, talking or even breathing [1-3].

Influenza viruses circulate worldwide and attack 5~10% of adults and 20~30% of children globally annually. Such attack is one of the serious public health problems causing severe morbidity and mortality each year, especially among high-risk populations [1]. The respiratory system of people with severe influenza may be adversely affected [2]. They may also develop fatal complications such as viral or bacterial pneumonia which requires hospitalisation or causes death [4]. WHO [2] claimed that approximately five million cases of severe diseases and approximately 500,000 deaths associated with influenza occur every year worldwide. As a seasonal epidemic, influenza is prevalent in winter (from January to March) and summer (from July to August) in Hong Kong [4]. It caused 9,647 hospitalisations and 93 deaths from April 2009 to July 2010 [5]. In 2017, the reported infection rate of influenza remains high at approximately 28.1 to 76.4 (mean of 48.2) Influenza-Like-Illness (ILI) cases per 1,000 consultations [5,6]. Therefore, the prevention of influenza is important.

Previous primary studies [7-10] and recent systematic review [11] indicated that Face Mask Use (FMU) is one of the most effective non-pharmaceutical methods to prevent the transmission of influenza, which mainly spreads through contact, droplet and aerosol transmission. For contact transmission, influenza virus can be transmitted by direct or indirect contact, as it attaches to skin surface and survives on nonporous surfaces for 8 to 48 hours. Face mask could protect wearers from touching their noses or mouths by contaminated hands [7]. For droplet transmission, virus is mainly transmitted by particles that are generated during talking, sneezing and coughing by host. WHO indicated that face masks are used to protect caregivers and healthcare providers against droplet-transmitted pathogens [2] no matter people wear the face mask properly or not. As a physical barrier, face mask can block the particles expelled effectively [10]. For aerosol transmission, a study reported that face mask can reduce an average of 6-fold exposure to aerosolized infectious virus [9]. The above literature clearly indicated the importance and effectiveness of FMU in control of respiratory virus transmission in different settings globally.

For measurement, seven studies have adopted different self-developed instruments to measure FMU practice [3, 12-14]. Most of them have depicted the dimensions of their instruments used on certain categories or areas as only one. However, Ho [3] stated that the practice of FMU can be divided into two categories and three circumstances. The two categories represent the purposes of FMU, namely, protecting oneself and others. The three major circumstances wherein people use face masks are public, home and clinics. The concept of FMU practice provided a comprehensive coverage that integrated different notions from the literature. With such understanding, nurse would effectively deliver the accurate health promotion message in primary care setting.

"Just as language molds the way we think, our health measurements influence and are also influenced by the way we define and think about health"(p. 11) [15]. Accurate measurement of FMU practice among general adult is essential to inform the health promotion strategy as well as prevention measures [3,12-14]. Face Mask Use Scale (FMUS) based on such concept was developed in 2012 to measure how frequent people wear face masks in a given circumstance. FMUS is brief and relevant with satisfactory adequacy. Although Chinese and English versions of FMUS were developed [3], the translation adequacy between them remained uncertain. This uncertainty influences its cross-language adaptation [16], rendering that cross-cultural comparisons are still unavailable. Furthermore, the psychometric properties of FMUS have not yet been examined. Therefore, the study performed cross-language testing between Chinese and English versions. A comprehensive psychometric testing was conducted to provide solid evidence on the reliability and validity of FMUS for facilitating future cross-cultural population-based investigation on the practice of FMU.

METHODS

1. Overall Study Design

This study employed two phases: I. examination of equivalence and relevance of English and Chinese versions of FMUS and II. examination of psychometric properties. The mentioned phases adopted classical and latest instrument adaptation and validation procedures [16-19], which ensure the appropriateness of the content before performing psychometric testing [17,19].

2. Phase 1: Examination of Equivalence and Relevance of English and Chinese versions

This phase aimed to establish the translation equivalence and relevance of the English and Chinese versions through three steps: semantic equivalence, content validation, and cross-language testing.

1) Semantic equivalence

The English and Chinese versions of FMUS were reviewed by a panel of six bilingual experts (i.e., academic experts in infection control, physicians, and nurses) for semantic equivalence [17]. This review was the first step to check the appropriateness of translation. The semantic equivalence score was calculated from a rating on a four points options (1=not appropriate to 4=most appropriate). Experts were invited to examine the linguistic and cultural equivalence of the translation. Any item rated as 'not appropriate' by more than 20% of respondents was suggested to be revised [17].

2) Content validation

The relevance of FMUS items was reviewed by another six experts (i.e., academic experts in infection control, physicians, nurses, allied health care professionals) on a four points options (i.e. 1=not relevant, 2=somewhat relevant, 3=quite relevant, 4=highly relevant) in Step 2 [18,20]. Written comments were sought from responses with a rating less than or equal to 2. Content Validity Index (CVI) was then computed by the proportion of responses in agreement with relevance. The formula can be found elsewhere [20]. Item-level CVI (I-CVI) and Scale-level CVI (S-CVI) were regarded as satisfactory with CVI greater than .80 [19,20]

3) Cross-language testing

Step 3 aimed to provide empirical evidence for the equivalence of the English and Chinese versions of FMUS using cross-language testing, which is the most stringent method for that.

Setting and sample: A convenience sample of 350 university students in Hong Kong was invited to participate in this step of Phase 1. University students were appropriate participants because their education level was able to comprehend and interpret both English and Chinese items of FMUS [18]. The exclusion criteria were no influenza-like illnesses in the past two years and living alone (i.e. not cohabiting with any family member). FMUS measures the actual FMU practice of individuals when they have influenza-like illnesses to reflect the concept of 'protect others.' The first exclusion criterion was used to exclude a participant without a recent FMU experience of 'protect others', which enhances the credibility of the result. The second criterion excluded a participant without other family member cohabiting because the FMUS required a participant to recall the practice of FMU towards other people at home.

Data collection procedure: Participants responded to the Chinese FMUS first and were invited to respond to the English FMUS two weeks later. Each participant was recorded with a 6-number code (created by them based on individual mobile phone and student identity number for pairing purpose and maintaining their anonymity.

Data analysis: The quadratic weighted kappa statistics (k) for item-to-item agreement and Intraclass Correlation Coefficient (ICC) for overall equivalence were all employed to indicate the equivalence of Chinese and English version. The value of $k > .40$ and ICC $> .75$ indicate a satisfactory equivalence [19].

3. Phase 2: Psychometric Testing of FMUS

A cross-sectional and correlation design with repeated measures was employed in Phase 2. Apart from the content validation in Phase 1, the psychometric testing was further conducted to investigate the internal consistency, stability, and construct validity of FMUS.

Setting and sample: Two convenience sample batches were used appropriately to perform the psychometric testing of FMUS. Batch 1 sample was a total of 213 students from a university in Hong Kong, whereas batch 2 recruited 971 adults from three railway stations in Hong Kong. Participants of both batches applied the same exclusion criteria: no influenza-like illnesses in the past two years and living alone (i.e. not cohabiting with any family member). FMUS measures the actual FMU practice of individuals when they have influenza-like illnesses to reflect the concept of 'protect others.' The first exclusion criterion was used to exclude a participant without a recent FMU experience of 'protect others', which enhances the credibility of the result. The second criterion excluded a participant without other family member cohabiting because the FMUS required a participant to recall the practice of FMU towards other people at home. Paper-and-pencil data collection was utilised. Batches 1 and 2 participants were invited to reply to a structured questionnaire including demographics and the FMUS. The participants completed the questionnaire within two minutes. The sample size was about 1,000, which was regarded as 'excellent' for Confirmatory Factor Analysis (CFA) [17,21] and appropriate for the psychometric testing in Phase 2.

1) Reliability

Internal consistency was examined by the Cronbach's method (Cronbach's α statistics, α) and corrected item-total correlation (person moment-product correlation coefficient, r). The former reflected the homogeneity of an entire scale and the value greater than .70 has been suggested as satisfactory [17,19]. The latter was used to test the individual coefficients of each item by computing the correlation of each individual item with the total score, excluding the evaluated item itself. This method can identify heterogeneous ($r<.30$) and over-redundant items ($r>.70$). The recommended value of r should fall between .30 and .70 [17]. Data from Batches 1 and 2 samples were used to compute the internal consistency.

Stability was examined using the two-week test-retest reliability. ICC was employed to compute the agreement between the initial score of FMUS and the score obtained from the same participants two weeks later. A sample size of more than 83 valid-paired data is suggested by a conventional formula (expected ICC=.80, 95% Confidence Interval [CI] for ICC=.20 and 40% attrition rate) [22]. An ICC of greater than .75 indicates satisfactory stability. Batch 1 participants were selected to check stability because delivery of questionnaire to a group of the same university students was feasible due to the known class schedule. Moreover, the research team could monitor extraneous factors (e.g. outbreak of influence pandemic in the community, promotion of face mask use advertisements in mass media) during the two-week period to acknowledge interference.

2) Validity

Construct validation was examined through three methods: known-group method, Exploratory Factor Analysis (EFA) and CFA.

Known-groups method was commonly used to establish the construct validity of a scale. The literature has indicated that different FMU practices were consistently observed between healthcare professionals and laypersons [23,24] with more frequent FMU practice among healthcare professionals. Therefore, an independent t-test was conducted on independent variables to compare the FMUS scores of above two groups. If significant results in the known difference were obtained in the Batch 2 sample (i.e. mean score of FMUS of healthcare professionals greater than that of laypersons), then the construct validity of FMUS would be established [17,19].

Factor structure was examined using factor analysis which 'disentangles complex interrelationships among items and identifies items that go together as unified concepts' [22]. The preconceptions about categories (e.g. 'protect others' and 'protect self') might not always be valid when tested against actual responses from the study's respondents. Factor analysis offers an objective method to visualise the underlying dimensions based on empirical data [22].

The EFA method was used to identify the internal structure of FMUS by combining all related items to form a factor-model of the measured construct [16,25,26]. A scree plot was yielded by applying maximum likelihood analysis (for normally-distributed data) to determine the factor number to be extracted [26]. The Varimax rotation method (for orthogonal rotation) with Kaiser normalisation was used to generate the factor solution. Data factorability was checked by the Kaiser-Myer-Olkin (KMO) index (>.60) and Bartlett's test of sphericity ($p<.001$) [21]. The factor loadings of the items to the respective latent factor should be greater than .40 [25]. Batch 1 sample was utilised to explore the internal structure of FMUS.

The CFA method was then used to verify whether a pre-specified factor model (i.e. obtained from the above EFA) provided a good fit to the data (Batch 2 sample) [25]. The following goodness-of-fit criteria were computed to determine the overall fit of data in model: chi-square/degree of freedom ratio (x^2/df) <5.00, Root Mean Square Residual (RMR) <1.00, Comparative Fit Index (CFI) and Goodness-of-fit Index (GFI) >.90, root mean square error of approximation (RMSEA) <.08 [27].

4. Instrument

FMUS conceptualises the practice of FMU into two categories, namely, 'protect self' and 'protect others', under three common circumstances which are public area, clinics and home [3]. This six-item instrument measures how frequent individuals wear face mask with a given circumstance. The response option was a five-point scale (i.e. 'never', 'rarely', 'sometimes', 'frequently' and 'always') to represent the frequency of FMU practice. A score of 0 to 4 was assigned for options in ascending order. The summation of each item score ranged from 0 to 24 to represent the overall practice of FMU. A high score represents a high frequency of FMU. The comprehensibility has been evaluated by 76 respondents in a clinic with satisfactory results [3]. Approval for the use of the FMUS is obtained from the developer [3].

5. Ethical Consideration

Ethical approval was obtained from the School of Science and Technology (Ref: ST-16/17-4) and Division Ethical Committee of Division of Nursing and Health Studies, The Open University of Hong Kong. The research team reproduced the FMUS with permission from the developer [3]. Informed and/or implied consent was obtained from the participants through appropriate methods. All participants' personal information (except their self-generated codes) were not collected.

6. Data Analysis

Statistical Product and Service Solutions version 25.0 for Windows (IBM SPSS Inc.) was used. Descriptive statistics (mean, standard deviations and percentage) were utilised to describe the samples and to compute the score of semantic equivalence and content validity. Inferential statistics (e.g. Cronbach's α, ICC, *k*, independent t-test, statistics used in EFA) were employed as the abovementioned. AMOS version 7.0 (IBM SPSS Inc.) was adopted for CFA. A significant value of p was set at <.050.

RESULTS

1. Phase 1 Result

A panel of six bilingual experts commented that the translation was appropriate. The English and Chinese versions of FMUS indicated satisfactorily linguistic and cultural equivalence. The semantic equivalence of FMUS between English and Chinese versions was established. For content validity of FMUS, I-CVI and S-CVI were both 100%, indicating a satisfactory relevance of items and scale.

A total of 350 university students were available in two university courses to perform cross-language testing. This phase study was participated by 160 students, and a total of 133 (attrition rate=16.9%, mean age=18.42±0.90) responded to the Chinese and English versions of FMUS during a two-week interval. The quadratic weighted *k* of items ranged from .53 to .73 (p<.001) (Table 1) which supported the moderate to good item-to-item agreement. The ICC was .81 (95% CI=.74~.86, p<.001), which provided a satisfactory evidence of overall equivalence of English and Chinese versions of FMUS. Certain preliminary data were presented in an international conference on infection control [28,29].

2. Phase 2 Result

Table 2 presents demographic characteristics of Batches 1 and 2 participants. For Batch 1, among the 567 first-year university students invited, 419 completed the questionnaires. By excluding the participants without influenza-like illnesses and family members' cohabitation, 213 data were available for analysis. For Batch 2, the research assistants invited the pedestrians (n=1,755) to respond to the survey in three railway stations and counted the number of refused cases (n=739). The response rate was 58.4%. After removing those based on the exclusion criteria, a total of 971 data were available for analysis.

Table 3 summarises the results of the psychometric properties of FMUS. According to the results on the two batches, Cronbach's α was .80 (batch 1 sample) and .83 (batch 2 sample). The corrected item-total correlation coefficients of items ranged from .46 to .61 (Batch 1 sample) and .55 to .67 (Batch 2 sample). Both tests indicated the optimal internal consistency of FMUS. Based on the result of the Batch 1 sample, 213 data were available for pairing the initial and post two-week scores of FMUS. However, only 133 data (attrition rate=37.6%) could be paired for the stability analysis because of the unpaired data (n=59), incomplete data (n=13) and significant change on the number of influenza-like-illness (n=8). A two-week test re-test reliability was utilised to examine the stability of FMUS. The ICC was .84 (95% CI=.78~.89, p<.001), indicating satisfactory stability.

Table 1. Agreement of English and Chinese items of Face Mask Use Scale (*N*=133)

Items	Weighted Kappa measure of agreement k value (p)
Item 1. I wear a face mask in public venues to protect myself against influenza-like-illness.	.53 (<.001)
Item 2. I wear a face mask in a doctor's clinic to protect myself against influenza-like-illness.	.60 (<.001)
Item 3. I wear a face mask at home when I have symptoms of influenza-like-illness.	.65 (<.001)
Item 4. I wear a face mask in public venues when I have symptoms of influenza-like-illness.	.63 (<.001)
Item 5. I wear a face mask in a doctor's clinic when I have symptoms of influenza-like-illness.	.73 (<.001)
Item 6. I wear a face mask at home when family members have influenza-like-illness.	.59 (<.001)

Three methods were employed to establish the construct validity of FMUS. Firstly, known-groups method was used to check whether the study scale could differentiate the practice of FMU between healthcare professionals and laypersons based on the batch 2 sample. Independence t-test indicated a significant difference on overall FMU practice between healthcare professionals (mean score=11.30±4.74) and laypersons (mean score=10.04±5.18) (t=3.08, p=.002). Moreover, significant difference of FMU practice was found between two groups (healthcare professionals versus laypersons) regarding the circumstance in clinic (mean score of item 2=2.54 versus 2.12, t=-4.20, p<.001; mean score of item 5=2.97 versus 2.62, t=-3.79, p<.001).

Secondly, EFA was used to explore the internal structure of FMUS. The satisfactory KMO index (.74) and Bartlett's test of sphericity (p<.001) indicated the factorability of the Batch 1 data. Following the maximum likelihood analysis, a two-factor solution was indicated by the scree plot, where explained 71.91% of the total variance. The rotated solution yielded two factors with three items in each sub-construct. All items were loaded to its respective factor with a loading greater than .40. After rotation, the total variance explained was 60.69% for rotation sums of squared loadings. Factor 1 was named as 'cautious practice'(item 2, 4 and 5, 32.63% of variance), whereas factor 2 was named as 'negligent practice'(item 1, 3 and 6, 28.06% of variance). Table 4 presents the EFA results in detail.

Lastly, CFA was employed to verify this two-factor structure of FMUS based on the Batch 2 data. CFA indicated that all paths were significantly loaded to the hypothesised first-order two sub-constructs (range of loadings=.57~.94). However, the goodness-of-fit indices demonstrated a poor model fit (x^2/df=38.00, RMR=.12, RMSEA=.20, GFI=.92, CFI=.88). According to the modification indices of the covariances, two pairs of error terms with the largest modifications indices (i.e. items 3 and 6 as first pairs, items 2 and 4 as second pairs) co-varied [16,30]. The corrected model demonstrated good and satisfactory goodness-of-fit indices (x^2/df=4.02, RMR=.03, RMSEA=.06, GFI=.99, CFI=.99) in the first-order two sub-constructs model. Figure 1 illustrates the factor loadings and parameter estimation of each item to the hypothesised sub-constructs of FMUS. Supplementary information 1 attached English and Chinese FMUS.

DISCUSSION

This is the first methodological study examining the psychometric properties of FMUS. Results showed that FMUS has satisfactory reliability with the evidence of optimal values of Cronbach's α s and corrected-item-total correlation coefficients (data obtained from undergraduate students and general public), as well as satisfactory ICC value from the two-week test-retest reliability [17,19]. These findings indicated that FMUS has high internal consistency and stability in this study.

The EFA of the FMUS identified a two-factor structure that comprises two ambivalent practices on FMU. 'Cautious practice'(Item 2, 4 and 5) reflected the cautious FMU practice in perceived high-risk environment which was susceptible to infection. The concept revealed that people perceived doctors' clinic and public areas as high-risk environment for being infected or infecting others. A local study also showed that people wore face mask frequently in clinics or hospitals for protecting oneself and others in

Table 2. Characteristics of University Students and General Public (*N*=1184)

Variables	Categories	Batch 1 (n=213)	Batch 2 (n=971)
		n (%) or Mean±SD	n (%) or Mean±SD
Age (year)		20.14±3.14	36.94±14.78
Gender	Men	154 (72.3)	389 (40.1)
	Women	59 (27.7)	582 (59.9)
Living with family members		3.50±1.21	3.13±1.23
Marital status	Single/divorced/separated/widowed	208 (97.7)	343 (35.3)
	Married/co-habited	3 (1.4)	628 (64.7)
Education background	Primary school or below	0 (0.0)	54 (5.6)
	Secondary school	20 (9.4)	305 (31.4)
	Tertiary school or above	187 (87.8)	611 (62.9)
Influenza-like illness		2.74±1.83	4.27±3.35

Batch 1=university students; Batch 2=general public; SD=standard deviation.

Table 3. Reliability and Validity of the Face Mask Use Scale with Comparisons of Previous Study

Items	Methods	Statistic methods/sample	The current study	Ho (2012)†
			Results	Results
Reliability				
1. Internal consistency	Cronbach's method	Cronbach's α statistic Batch 1 Batch 2	 α of scale=.80 α of scale=.83	NA
	Corrected item-total correlation	Person moment-product correlation coefficient/ Batch 1 Batch 2	 Corrected item-total correlation=.46~.61 Corrected item-total correlation=.55~.67	NA
2. Stability	2-week test-retest reliability	Intraclass correlation coefficient/ subset of Batch 1‡	r=.84, $p<.001$, 95% CI=.78~.89	NA
Validity				
1. Face validity	Review by target population	Frequency and percentage	NA	Proper comprehension (76 respondents in the clinic)
2. Content validity	Review by expert panel	CVI	I-CVI=1.00, S-CVI=1.00	NA
3. Construct validity	Known-group method	Independent t-test (Difference of FMU practice between healthcare professionals and laypersons)/ Batch 2	Significant difference was found. Healthcare professionals obtained higher FMUS score than that of laypersons for total score (11.30 vs 10.04; t=3.08, p=.002) and some item scores. (2.54~2.97 vs 2.12~2.62; t=3.79~4.20, $p<.001$)	NA
	Factor analysis	Exploratory factor analysis/ Batch 1	Two-factor structure: KMO=.736; Bartlett's test of Sphericity: x^2=2,436.58, d.f.=15, $p<.001$. Total variance explained=60.69% for rotation sums of squared loadings.	
		Confirmatory factor analysis/ Batch 2	x^2/df=4.02, RMR=.03, RMSEA=.06, GFI=.99, CFI=.99. (First-order CFA model)	

CI=confidence interval; FMU=face mask use; FMUS=face mask use scale; GFI=goodness-of-fit index; I-CVI=item-level content validity index; KMO=Kaiser-Myer-Olkin; NA=not available; RMR=root mean square residual; RMSEA=root mean square error of approximation; S-CVI=scale-level content validity index on average; †Ho HSW. Use of face masks in a primary care outpatient setting in Hong Kong: knowledge, attitudes and practices. Public Health. 2012;126 (12):1001-6; ‡The result was calculated based on 133 university students.

non-pandemic period (81.9~91.8%) [3]. In public areas, people with ILI demonstrated high caution to prevent the spread of influenza. This phenomenon of FMU practice was consistently observed in several local studies (86.5~95.0%) after 2003 (i.e. year with the pandemic of Severe Atypical Respiratory Symptoms, SARS) [3,12,13]. By contrast, 'negligent practice' (item 1, 3 and 6) reflected the negligent practice of FMU in perceived safe environment which was unsusceptible to infection. In home environment, the literature indicated that people with or without ILI would unlikely wear face mask to protect oneself or others [3,31]. Although the practice rate varied from 33.3% to 65.7%, people perceived home as a safer environment compared with the circumstances of clinic. Moreover, cross infection rate was remarkably high in a closed environment like home [32]. In public areas, several studies

Table 4. Results of Exploratory Factor Analysis of Face Mask Use Scale

Items	Factor loadings	
	Cautious practice	Negligent practice
2. I wear a face mask in a doctor's clinic to protect myself against influenza-like-illness.	0.64	-
4. I wear a face mask in public venues when I have symptoms of influenza-like-illness.	0.65	-
5. I wear a face mask in a doctor's clinic when I have symptoms of influenza-like-illness.	0.97	-
1. I wear a face mask in public venues to protect myself against influenza-like-illness	-	0.50
3. I wear a face mask at home when I have symptoms of influenza-like-illness.	-	0.74
6. I wear a face mask at home when family members have influenza-like-illness.	-	0.80
Cronbach's α of subscales	.82	.75

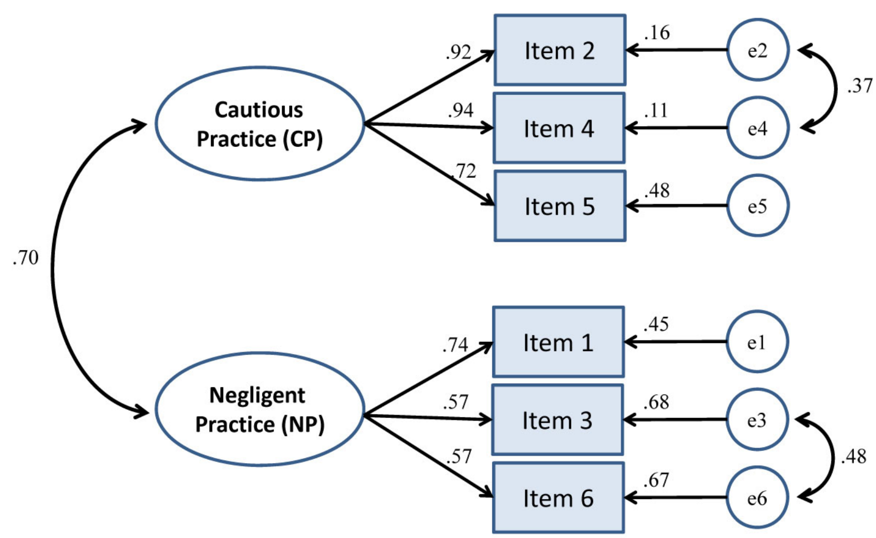

Figure1. Confirmatory factor analysis model of Face Mask Use Scale.

found that only 21.5% to 73.8% people would wear face mask for self-protection [3,13]. The same circumstance was employed, but people practice FMU differently for protecting oneself and others which was consistently demonstrated in previous decade locally. The two-factor structure of FMUS identified in EFA was further confirmed using CFA in a large public sample. The items were loaded to the hypothesised latent factors with satisfactory loadings and in correct pathways. Considering certain modifications of co-variances, the goodness-of-fit indices were all satisfactory. These results confirmed that the internal factor structure of FMUS was good, which establishes construct validity.

FMUS have important clinical and research implications. A six-item FMUS conceptualised the practice of FMU in two categories (protecting oneself and others) and three circumstances (i.e. public, home, and clinics) that comprehensively and swiftly collected all essential data about FMU. The data informed the authority department or government for designing a tailor-made health promotion campaign on FMU, particularly those 'negligent practice' in influenza pandemic. Community health nurse who equips knowledge of primary healthcare and nursing practice in a community setting to provide cost-effective preventive care [33] and health education to communities or populations is one of appropriate professionals to monitor and promote this public health behaviour regarding FMU, particularly the 'negligent practice'. For research application, FMUS was the first Chinese and English questionnaire measuring the practice of face mask use in public. This study employed cross-language testing for establishing the translation equivalence. Results of the quadratic weighted kappa and ICC indicated that Chinese and English versions of FMUS were equivalent in item and scale levels. These findings can facilitate the investigation of the practice of FMU in cross-cultural study [16,18]. Without any previous result for comparison on psychometric property, this study recruited large samples with extensive demographic backgrounds, such as wide range of ages, different educational levels and ILI history which added confidence on the generalisability of the findings.

Certain limitations deserved attention. First, the attrition rate of student sample (37.6%) in conducting a two-week test-retest reliability was high which might be prone to an overestimated value of ICC [34]. Although the scheduled classes of students can facilitate the accurate retest period, the class attendance rate and extraneous factors (e.g. history of ILI in-between retest period) were uncontrollable. Moreover, the research team considered the use of public for conducting the two-week test-retest reliability infeasible. Therefore, future studies should consider selecting a stable group for performing test-retest check. Secondly, criterion-related validation was lacking in this study. No criteria measure of FMU can be recognised as a comparative measure (i.e., gold standard) which provided nothing about the concurrent validity of FMUS. The predictive validity of FMUS was also absent in this study. Further research could explore whether the FMUS predicts the number of influenza infection annually. Lastly, FMUS is a self-reporting instrument subject to response bias. The research team employed two exclusion criteria (i.e. no ILI in the past two years or living alone) unmentioned in previous studies to enhance the credibility of the responses, but the actual practice of FMU of individuals was not cross-checked. Future study could supplement this evidence by using observational research. Besides, the FMUS should not be applicable to those people who are living alone because two items (i.e., item 3 and 6) were irrelevant to them.

CONCLUSION

FMU is one of the most effective non-pharmaceutical methods to prevent the transmission of influenza. The study suggests that FMUS is a reliable and valid instrument to comprehensively measure the practice of FMU. The brevity and self-reporting nature of FMU facilitate its use in population-based study. FMUS can be used to advance the understanding on the practice of FMU among public. The equivalence between Chinese and English FMUS also favours its application over other instruments for cross-cultural comparisons. This poses clinical and research implications for those community health nurse who works on respiratory protection. Further research should be conducted on the 'negligent practice' of FMU.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Conception and design of the study - LSC, CACY, and CJYS; Acquisition of data - CJYS, LMY, CLM, SCY, WEYN, MYM, LaMT, CMM, TKY, COL, SFK, and CJHM; Data analysis - LSC, CACY, CJYS, LMY, CLM, SCY, WEYN, MYM, LaMT, CMM, TKY, COL, and SFK; Interpretation of data - LSC, CACY, LMY, CLM, SCY, WEYN, MYM, LaMT, CMM, TKY, COL, and SFK; Drafting the manuscript - LSC, CACY, CJYS, and CJHM; Critically review - LSC, CACY, and CJYS.

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