COVID-19 pandemic: adaptation and psychometric assessment of the Face Mask Use Scale

Pandemia da COVID-19: adaptação e avaliação psicométrica da "*Face Mask Use Scale*"

Pandemia de COVID-19: adaptación y evaluación psicométrica de la *Face Mask* Use Scale

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Abstract

Objective: To culturally adapt the Face Mask Use Scale to Brazilian Portuguese and assess its psychometric properties.

Methods: This is a methodological, cross-sectional, quantitative study, which comprised the following steps: translation; Portuguese version consensus; assessment by an expert committee; back-translation and comparison with the original version; pilot test; and psychometric assessment of the Face Mask Use Scale (FMUS).

Results: The original version of FMUS was translated into Brazilian Portuguese. Content validity was performed by a panel of five experts. The Content Validity Index for the scale (CVI-S/Ave) was 0.87 and for the items (CVI-I) it ranged from 0.6 to 1.0. The FMUS – Brazilian Portuguese version (FMUS-BP) was applied to 4822 adults with a mean age of 30 years (SD = 11.7). For internal consistency, Cronbach's alpha was 0.86. The original two-factor model of the FMUS was not suitable for the Brazilian population due to the use of Exploratory Factor Analysis and Confirmatory Factor Analysis. Thus, an Exploratory Factor Analysis was carried out to investigate the factor structure of the FMUS-BP again and a new potential model of the FMUS-BP for better explanation. The FMUS-BP presented a factor structure different from the original model. Items were aligned on a single factor, creating a one-dimensional instrument that explained 59.7% of the total variance. Construct validity by known-groups was satisfactory (p <0.001).

Conclusion: The FMUS-BP is reliable and valid to measure the practice of using masks among the Brazilian population, especially in the COVID-19 pandemic.

Resumo

Objetivo: Adaptar culturalmente para o português do Brasil a *Face Mask Use Scale* e avaliar suas propriedades psicométricas.

Métodos: Estudo metodológico, transversal, com abordagem quantitativa, que compreendeu as etapas de: tradução; consenso da versão em português; avaliação por comitê de especialistas; retrotradução e comparação com a versão original; teste piloto e avaliação psicométrica da *Face Mask Use Scale* (FMUS).

Resultados: A versão original da FMUS foi traduzida para o português do Brasil. A validade de conteúdo foi realizada por um painel de cinco especialistas. O índice de validade de conteúdo para a escala (IVC–S/Ave) foi 0,87 e para os itens (IVC-I) variou de 0,6 a 1,0. A versão para o português do Brasil da FMUS (FMUS-PB) foi aplicada em 4822 adultos com idade média de 30 anos (DP = 11,7). Na consistência interna, o Alfa de Cronbach foi de 0,86. O modelo original de dois fatores da FMUS não se mostrou adequado para a população

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brasileira pelo uso da análise fatorial confirmatória e exploratória. Assim, realizou-se uma análise fatorial exploratória para investigar a estrutura fatorial da FMUS-PB novamente e um novo modelo potencial da FMUS-PB para melhor explicação. A FMUS-PB apresentou estrutura fatorial diferente do modelo original. Os itens foram alinhados em um único fator, criando um instrumento unidimensional que explicou 59,7% da variância total. A validade de construto por grupos conhecidos foi satisfatória (p <0,001).

Conclusão: A FMUS-PB é confiável e válida para medir a prática do uso de máscaras entre a população brasileira, sobretudo na pandemia da COVID-19.

Resumen

Objetivo: Adaptar culturalmente la *Face Mask Use Scale* al portugués de Brasil y evaluar sus propiedades psicométricas.

Métodos: Estudio metodológico, transversal, con enfoque cualitativo, que comprendió las siguientes etapas: traducción, consenso de la versión en portugués, evaluación de comité de especialistas, retrotraducción y comparación con la versión original, prueba piloto y evaluación psicométrica de la *Face Mask Use Scale* (FMUS).

Resultados: La versión original de la FMUS fue traducida al portugués de Brasil. La validez de contenido fue realizada por un panel de cinco especialistas. El índice de validez de contenido de la escala (IVC-S/Ave) fue 0,87 y el de los ítems (IVC-I) varió de 0,6 a 1,0. La versión en portugués de Brasil de la FMUS (FMUS-PB) fue aplicada a 4.822 adultos de edad promedio de 30 años (DP = 11,7). En la consistencia interna, el Alfa de Cronbach fue de 0,86. El modelo original de dos factores de la FMUS demostró no ser adecuado para la población brasileña mediante el uso del análisis factorial confirmatorio y exploratorio. De esta forma, se realizó un análisis factorial exploratorio para investigar la estructura factorial de la FMUS-PB nuevamente y un nuevo modelo posible de la FMUS-PB para una mejor explicación. La FMUS-PB presentó una estructura factorial diferente al modelo original. Los ítems fueron alineados en un único factor y se creó un instrumento unidimensional que explicó el 59,7 % de la varianza total. La validez del constructo por grupos conocidos fue satisfactoria (p < 0,001).

Conclusión: La FMUS-PB es confiable y válida para medir la práctica del uso de mascarillas en la población brasileña, sobre todo durante la pandemia de COVID-19.

Introduction

Between the end of 2019 and beginning of 2020. the world faced an alert from the World Health Organization (WHO) about a respiratory disease initially reported in China. The clinical condition was named Coronavirus Disease 2019 (COVID-19), which has the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus as causative agent.[1] With the report of the first cases, the WHO monitored the epidemiological situation and later characterized it as a health situation of international importance, providing information on the number of reported cases and guidance on best practices for preventing and controlling infection transmission.[2]

SARS-CoV-2 transmission can occur through respiratory droplets from infected people, in addition to contaminated objects or surfaces.[3] The most common clinical manifestations are fever, tiredness and dry cough; in addition, other symptoms may be present, such as pain, diarrhea, loss of smell and taste, and rashes.[4] Despite the growing number of deaths, most of those infected do not develop the severe stage of the disease.[5,6]

Considering the pandemic, international and national bodies such as the World Health Organization, the Pan American Health Organization, the Centers for Disease Control and Prevention (CDC) in the United States and the Ministry of Health in Brazil committed to publishing regulations with in order to reduce the chances of transmission, such as the use of masks. This guidance is recommended for both healthcare professionals and the general population. The use of this personal protective equipment (PPE) is relevant, as many infected people do not show the characteristic symptoms.[4,7,8] This practice provides additional protection against respiratory diseases, evidence supported by a systematic review of the use of masks to control the pandemic.[9]

A study developed using mathematical models and scientific evidence assessed the potential impact that the use of masks in public places represents in fighting the pandemic and found that the use of this PPE is an effective non-pharmaceutical intervention in the fight against COVID-19.[10]

However, use by the general population was more frequent in Asian countries due to other outbreaks of respiratory diseases that occurred in previous historical moments.[11,12] With the advance of the pandemic in different regions worldwide, the use of masks started to be encouraged, especially in public environments with a greater flow of people movement.[13]

The Ministry of Health of Brazil reinforced this recommendation and added the use of homemade

masks, those produced in homes with easily accessible materials such as tissues, to expand access to protection and direct the use of surgical masks for health professionals during direct patientcare.[8] However, as the pandemic has progressed around the world, more evidence about the effectiveness of masks has been added to scientific knowledge. A systematic review indicated that the use of tissue masks adds some barrier to droplets, when compared to no use of this PPE.[14]

Therefore, there is a need to assess the practice of using a mask in terms of frequency and places where it has been used, considering different environments, such as public environments, healthcare services and/or home.However, in Brazil, no valid instruments were identified for this type of assessment, in order to support educational strategies in health with the population on this theme.

However, a scale developed in China assesses the frequency of mask use, allowing this practice to be analyzed in different environments and situations, namelyin public places, health environments and at home, seeking to identify both self-protection and the protection of the other.[15] The psychometric properties of the English and Chinese versions of this instrument, called Face Mask Use Scale (FMUS), consisting of six items, were assessed in a study carried out in Hong Kong and proved to be satisfactory for measuring the practice of using a mask.[16]

Given the pandemic scenario, there is a need to assess the use of masks by the general population in Brazil.However, considering that there are no valid and specific instruments in Brazil for assessing this practice among Brazilians, this study aimed to culturally adapt the Face Mask Use Scale to Brazilian Portuguese and assess its psychometric properties.

Methods

This is a methodological, cross-sectional study with a quantitative approach, carried out via electronic form among the adult population of the five regions of Brazil between April and May 2020.

Cultural adaptation and assessment of psychometric properties

The study was carried out through cultural adaptation and assessment of psychometric properties of the original instrument in English, using the following steps: translation; Portuguese version consensus; assessment by an expert committee; back-translation and comparison with the original version; pilot test; and assessment of psychometric properties.[17] It is noteworthy that back-translation in this study occurred after assessment by a committee of judges, as the recommendation is that this step should follow all processes of idiomatic and semantic adjustments (Figure 1).[18]
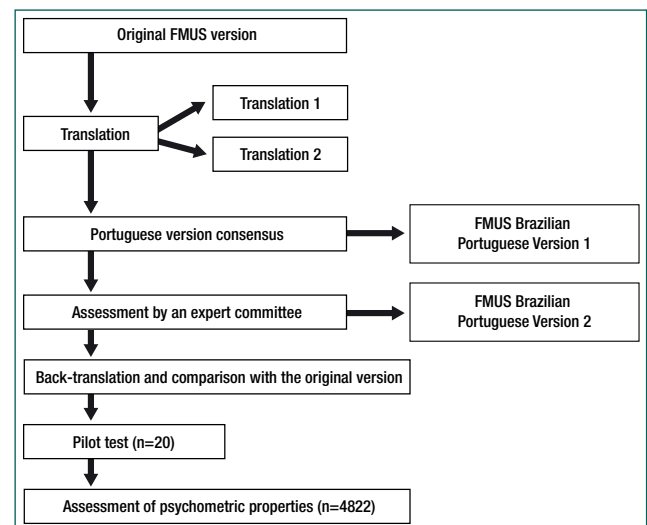
Source: Borsa JC, Damásio BF, Bandeira DR. Adaptação e validação de instrumentospsicológicos entre culturas: algumas considerações. Paidéia (Ribeirão Preto). 2012 [cited 2021 Mar 26], 22(53), 423-32. Available from: https://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-863X2012000300014[18]

Figure 1. Cultural adaptation and validation process of the Face Mask Use

Translation: The scale was translated from English to Brazilian Portuguese by two independent translators from the health field, generating two versions of the instrument.

Portuguese version consensus: Versions were compared and resulted in FMUS Brazilian Portuguese Version 1(v.1-FMUS-BP).

Assessment by an expert committee: FMUS-BP version 1 was made available to a committee of five experts, selected for convenience. The aforementioned committee was composed of professionals

with an approach to the subject and expertise in instrument validation methods. Thus, the committee was composed of three specialists in infectious diseases and validation studies and two specialists in the development of research on the use of PPE. The judges assessed the instrument for content validity. It is noteworthy that the number of judges is in accordance with what is indicated in the literature, which suggests a minimum of five and a maximum of ten of these experts.[19] A Likert-type scale with scores ranging from one to four was used in order to assess the clarity of the instrument items, as follows: 1 - unclear, 2 - unclear; 3 - clear; 4 -very clear. Still, the instrument had fields for suggestions in the item description, considering their understanding. After this step, a new version called FMUS Brazilian Portuguese Version 2 was generated(FMUS-BP V2).

Back-translation and comparison with the original version: FMUS-BP V2 was back-translated by a bilingual translator, native to the original FMUS language (English), who acted blindly, i.e., without prior knowledge of the original version. This back-translated version was compared with the original, aiming to verify the coherence of meaning of both; then, it was sent to the author of the original instrument for consent, who approved it, without changes.

Pilot test: It was carried out both to explore the understanding of the items and the pattern of responses of the participants, to ensure equivalence of the adapted version when applied.[17] FMUS-BP V2 was applied online to 20 adult individuals selected for convenience, considering being an adult and having access to the internet as an inclusion criterion, thus generating FMUS - Brazilian Portuguese version (FMUS-BP). This step ends the cultural adaptation process, which includes the validation of the content of the items and the scale through assessment of semantic, idiomatic, cultural and conceptual equivalence between the original and the adapted instrument.[17] Changes suggested in a specific field during cultural adaptation were accepted, when more than 80.0% of participants suggested changes.

Assessment of psychometric properties: the study included the participation of people living in the five regions of the country belonging to the general population. Participants had to be over 18 years of age and have access to the internet.Questionnaires were intentionally sent and the sample size for psychometric analyzes was established following the recommendation that for a significant factor loading of 0.30. at least 350 respondents are needed.[20] In this phase, two instruments were applied: 1- Information on the sociodemographic characterization of the general population and FMUS-BP V2.

The data collection strategy for all study stages was online. Forms were sent via messages via WhatsApp, Instagram, Facebook and/or other social media.The instruments were stored on the Google Forms platform. The settings to restrict the receipt of only one answer per participant (device) were activated, thus avoiding repeated answers from the same person. For all phases of the process of cultural adaptation and assessment of psychometric properties, all forms were completed in full, no one being excluded.

The FMUS used consists of six items that address the use of face masks in public places, in healthcare services, in the work environment and at home for self-protection and protection of others against flu-like illnesses.The answer choices are distributed on a Likert-type scale with five answer choices: Never; Rarely; Sometimes; Often; Ever. The scale score ranges from 1 to 4 points, distributed over the five answer options in ascending order, i.e.: the option never corresponds to 1 and always corresponds to 4. The score varies between 6 and 30 points.[15] The factor structure of the original scale is divided into two factors: cautious practices (items 2, 4 and 5) and negligent practices (items 1, 3 and 6). The results of the instrument validation study indicated that the scale is reliable and valid.[16]

For the characterization of participants, descriptive statistics were used. The IBM® SPSS v.20 was adopted for the analyses. In the analysis of agreement among judges, the Content Validity Index for Items (CVI-I) and the Average Content Validity Index for Scales (CVI-S/Ave) were adopted. The calculation of CVI-I was obtained by the number of experts who classified the items with answers of 3 or 4 (clear or very clear), divided by the total number.

For CVI-S/Ave, the average of the results of CVI-Is was calculated in relation to the total number of items in the instrument.[21] The values recommended as satisfactory for CVI-I must be greater than 0.78[19] and for CVI-S/Ave greater than 0.80.[22]

To measure the scale's internal consistency, Cronbach's alpha statistical reliability analysis was used, adopting the reference value >0.7, this value being fixed as the ideal minimum.[20] To verify the factorial structure of the instrument, Confirmatory Factor Analysis (CFA) was used, followed by Exploratory Factor Analysis (EFA). Before starting EFA, Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity (AIC) tests were performed in order to verify if the sample was adequate and susceptible to factorization.[23] KMO values can range from zero to one, and the closer to one the better and the AIC is considered statistically significant ($p<0.05$) when no variable is correlated with the other, thus indicating the existence of sufficient correlations between them.[20,24]

After the KMO and AIC tests confirm that the matrix can be factored, the factors are extracted. The factor extraction method adopted was Main Axis Factoring and, to determine the number of factors to extract, eigenvalues ≥ 1.00 were considered.[23] The CFA used to confirm the factorial structure of the scale was performed according to the Structural Equation Model (SEM).[20]

Satisfactory adjustments were considered for CFA: chi-square/degree of freedom ratio (x2/df) <5.00; Root Mean Square Residual (RMR) <1.00; Comparative Fit Index (CFI) and Goodness of Fit Index (GFI)> 0.90; root mean square error of approximation (RMSEA) <0.08.[25]

The construct validity by known-groups (known-groupsvalidity)[26] was used to verify the instrument sensitivity to measure the differences in the scale scores, (minimum:1 and maximum:30) between variables holding a degree and working in the health field.

The study was approved by the Brazilian National Research Ethics Committee (CONEP - *Comissão Nacional de Ética em Pesquisa*), under Opinion 3.971.512 and CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 30572120.0.0000.0008. Ethical aspects were respected and confidentiality was guaranteed to participants. The Informed Consent Form (ICF) was signed online using the option "agree", after clarification about the research. The second copy of the ICF was guaranteed to participants through the "download" option.

Results

Cultural adaptation

The committee of judges was composed of five (100%) experts, four (80.0%) women and one (20.0%) man, with a mean age of 38 years (SD=3.8) ranging between 29 and 51 years. With regard to academic training, three (60.0%) held a PhD degree, one (20.0%) held a master's degree and one (20%) held a post-doctoral degree. The average time in the profession was 9.8 (SD=2.55), with a minimum of two and a maximum of 17 years. The assessment carried out by experts resulted in suggestions for changes in the wording of some items. These changes are provided in Chart 1.

Chart 1. Modifications suggested by experts to the items of the Face Mask Use Scale – Brazilian Portuguese version

Item	Translated items	Suggestions for modification
1	*Uso máscara facial em locais públicos para me proteger contra doenças semelhantes à gripe*	Change the verb "*uso*" for "*eu uso*".
2	*Eu uso uma máscara facial na clínica do médico para me proteger contra doenças semelhantes à gripe*	Replace "*na clínica do médico*" for "*nos serviços de saúde*".
3	*Uso uma máscara facial em casa quando tenho sintomas de doenças como gripe*	Replace "*uma máscara facial*" for "*Eu uso máscara facial*".
4	*Uso máscara facial em locais públicos quando tenho sintomas doenças como gripe*	Replace "*uma máscara facial*" for "*Eu uso máscara facial*".
5	*Uso máscara facial na clínica do medico quando tenho sintomas de doenças como gripe*	Change the verb "*uso*" for "*eu uso*". Replace "*na clínica do médico*" for "*nos serviços de saúde*".
6	*Uso uma máscara facial em casa quando os membros da família sofrem de doenças semelhantes à gripe*	Replace "*uma máscara facial*" for "*Eu uso máscara facial*".

The CVI-S/Ave obtained was 0.87 and the CVI-I ranged between 0.6 and 1.0. A pilot test was carried out with 20 (100%) individuals, 18 (90.0%) women and 2 (10.0%) men, with a mean age of 37 years (SD=2.18). Regarding education, 2 (10.0%) completed high school, 12 (60.0%) completed higher education and 6 (30.0%) had graduated. In

the form assessment, changes were suggested by all participants, only in the layout of the scale presentation, being accepted.

Assessment of psychometric properties

The study included 4,822 (100%) people with a mean age of 30.0 years (SD=11.7), minimum 18 and maximum 88 years. Regarding gender, females totaled 3,305 (68.5%) and males, 1,517 (31.5%); moreover, 1,414 (29.3%) reported not having a degree and 3,408 (70.7) had one. Of the total number of participants 3,433 (71.2%) did not work in the health field while 1,389 (28.8%) worked.

Reliability

For the reliability of the FMUS-BP, a Cronbach's Alpha of 0.86 was obtained for a total of six items. Also, according to Table 1, Cronbach's Alpha was obtained if an item was excluded, ranging from 0.82 to 0.85.

Table 1. Total correlation of itemsand Cronbach's Alpha of the Face Mask Use Scale – Brazilian Portuguese version (n=4822)

Items	Mean if an item is excluded	Total correlation of items	Cronbach's Alphaif an item is excluded
1	16.11	0.59	0.85
2	16.38	0.65	0.84
3	18.09	0.59	0.85
4	16.79	0.76	0.82
5	16.78	0.76	0.82
6	18.06	0.60	0.85

Item allocation and factor structure

To confirm the factor structure of the FMUS-BP, a CFA was carried out, considering the same structure as the original version. The adjustments obtained for RMR=0.292, RMSEA=0.253, GFI=0.877, CFI=0.844 were not satisfactory, i.e., the FMUS-BP does not have the same factorial structure as the original version. Thus, EFAwas performed and KMO 0.758 and Bartlett's sphericity test values were obtained(p=0.000). These results indicated a satisfactory correlation for the analysis. All items had satisfactory factor loadings (greater than 0.3), so there was no need for any exclusion. However, it is noteworthy that the items did not follow the same allocation in the factors of the original version, which was previously confirmed in the previous analysis. Thus, considering factor loadings and theoretical affinity, the items formed a set of a factor, making the FMUS-BP a one-dimensional instrument with explained variance of 59.7% (Table 2).

Table 2. Rotated matrix of factors in the Face Mask Use Scale – Brazilian Portuguese version

Items	Factor loadings
01	0.690
02	0.811
03	0.487
04	0.810
05	0.853
06	0.494

Extraction method: Factor analysis of the main axes; Rotation method: Promax with Kaiser Normalization

Construct validity

Construct validity was performed using the known-groups method. The overall mean score of the scale was 20.4 (SD=7.6) ranging between 6.0 and 30.0.When comparing the score between groups, having a degree and being or not a health professional, there was a statistically significant difference, i.e., individuals holding a degree had higher scores when compared to those who reported not having a degree. Regarding working in the health field, the score was higher for participants who reported working in this field (Table 3).

Table 3. Comparison of mean scores for the practice of using a mask between individual variables(n=4822)

Variables	n	Score	SD*	Test value	p-value
Hold a degree					
No	1,414	19.6	7.9	t=-4.76	0.000
Yes	3,408	20.7	7.4		
Work in the health field					
No	3,433	19.8	7.8	t=-9.68	0.000
Yes	1,389	22.0	6.7		

*Standard deviation. t=Student's t value.

Discussion

This study carried out the adaptation and validation of the FMUS, demonstrating satisfactory results from a sample of the general population in the COVID-19 pandemic context.

The use of masks was oriented towards the general population right at the beginning of the pandemic, as it increases the protection against droplets dispersed in ambient air. A study that compared the incidence

of COVID-19 from the use of masks between Hong Kong and some European countries early in the pandemic found that incidence in Hong Kong was lower than in compared countries.[27] Another investigation suggested that the adoption of masks by the general population had the potential to contribute to a 17% to 45% reduction in deaths in New York. However, the authors stressed that this practice must be added to other prevention strategies in order to increase protection against viral infection.[28]

In the content assessment, experts suggested some changes in the wording of some items. The importance of the effectiveness of this step is highlighted, since the realization of semantic, cultural, idiomatic and conceptual equivalence of the scale is essential to achieve satisfactory psychometric properties.[17] The CVI obtained was satisfactory. The importance of this phase is highlighted and the need to carry it out, to ensure a broad process of adaptation and validation, aiming to generate reliable and adequate results for the population of interest.[29]

After this step, a pilot test was carried out in accordance with what is established in the literature, which points out the need for the instrument to be tested before being approved for general use, in order to identify and solve potential situations such as complex or ambiguous sentences.[26]

With regard to validation, it was observed that reliability, verified through the internal consistency of the scale, was satisfactory, since Cronbach's alpha value was greater than 0.7. Values greater than 0.7 and close to 1 are considered satisfactory and the closer they are to 1, the more reliability increases.[20] In fact, the reliability of measurement instruments is a psychometric indicator. Cronbach's alpha has been one of the most used by researchers in recent decades.[30]

UsingCFA, it was found that the factor structure of the FMUS-BP is different from the original version. This fact may be related to cultural issues regarding the use of masks among the Brazilian population, as this measure in Brazil has been adopted only during the COVID-19 pandemic, based on the Ministry of Healthrecommendations,[8] different from happens in Asian countries.[31]

For EFA, it was possible to verify, through the factor loadings and theoretical affinity, that the items formed a set of a factor, making the FMUS-BP a one-dimensional instrument, as the items measure the same construct.[32] The original version of the FMUS consists of two domains each consisting of three items.[16] Furthermore, in the Brazilian version of the scale, for most items, the factor loadings were greater than 0.5, which indicates a practical significance.[20]

The last step included the verification of the construct validity by known-groups and made it possible to verify that the FMUS-BP showed sensitivity to measure differences between groups. A measurement instrument must be sensitive in distinguishing between groups,[26] which is an essential assessment for measurement scales.

In addition to this, it is highlighted that the practice of wearing masks among the general population of Brazil is a complex issue and that it depends on different factors for it to be effectively present in the entire population. Although there is an individual interest in using a mask to protect against the coronavirus, this practice may be limited in the face of collective conflicts such as resistance and refusal to mandatory use.[33]

It should be noted that the use of the FMUS-BP will support healthcare professionals in establishing and directing educational strategies by favoring the identification of weaknesses in the practice of using masks by Brazilians. Educational health promotion actions are essential, since by taking possession of knowledge, the population is able to improve their quality of life and health.[34]

The non-inclusion of people without access to digital tools stands out as a limitation of this study. However, this investigation brings important advances to the science of nursing, as no national study was identified that addressed this issue as a reliable and valid instrument to measure the practice of using masks among the general population during the COVID-19 pandemic.

Conclusion

After completion of the FMUS validation process, semantic, idiomatic, cultural and conceptual equiv-

alence between the adapted version and the original version were obtained;moreover, the psychometric properties indicated that this instrument is valid and reliable to measure the practice of using masks in Brazil among the general population in the context of the COVID-19 pandemic. Although the FMUS-BP has been validated during the ongoing COVID-19 pandemic, its use can be extended to other studies in future periods, especially in the post-pandemic period.

Collaborations

Pereira-Ávila FMV, Lam SC, Ho H, Gir E, Caldeira NMVP, Góes FGB and Sousa LRM contributed to the project design, data analysis and interpretation, article writing, critical review and final approval of the version to be published.

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