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ORIGINAL ARTICLE

PSYCHOMETRIC PROPERTIES AND FACTOR INVARIANCE FOR THE GENERAL HEALTH QUESTIONNAIRE (GHQ-28): STUDY IN PERUVIAN POPULATION EXPOSED TO THE COVID-19 PANDEMIC

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Abstract

Large-scale epidemics are known to significantly disrupt the mental health and perceived well-being of most populations. In spite of the wide range of screening tools, there are not many reliable and widespread tools for the identification of psychological symptoms in non-clinical populations during a health crisis.
Objective: The aim of this study was to conduct a psychometric analysis of the Goldberg's GHQ-28, through a sample of Peruvian adults by using a confirmatory factor analysis.
Materials and Methods: 434 individuals have been examined, studying the goodness and structure of the Goldberg GHQ-28 questionnaire.
Result: We found high reliability indicating optimal values (Cronbach α=0.829), also there are four correlated factors that show strict invariance among the 28 items. Confirmatory factor analysis (CFA) and exploratory factor analysis (EFA) were used to examine the structure of the subscales. There are high levels of anxiety (X=1.01) and social dysfunction (X=1.21) in the assessed sampling. Conclusion: The factorial structure obtained in this study is similar to that originally described by the researchers involved in the original questionnaire. It is concluded that GHQ-28 is suitable to explore prevalence of psychopathologies in sanitary emergency contexts for general non-psychiatric population.

Keywords: Mental Health, Primary Health, Psychological Screening, GHQ-28 Questionnaire.

Introduction

Health, understood as a "feeling of general well-being and not just the absence of disease", according to the perspective of the World Health Organization (WHO), is an essential condition for the continuity and integral development of people [1]. Therefore, assessing functional capacity and general psychological well-being in the context of health epidemics thus becomes a growing challenge for health administrators worldwide. It should be noted that, despite sustained efforts to implement public protection strategies to mitigate infections related to COVID19, reports of the prevalence of diseases associated with emotional instability have increased significantly during the period of the first coronavirus outbreak. [2,3], exposing the development of psychopathologies and states of deterioration of mental health in the population [3-5].

The growing evidence on early identification of psychological symptoms in the non-psychiatric population becomes critical in order to reduce the prevalence of mental disorders. However, despite the extensive list of psychological health screening instruments, there are some problems of diagnostic accuracy [6,7]. For the diagnosis of psychological symptoms it is vital to ensure that the instrument meets the criteria for content adaptation, trust worthiness and validity in the study population [8], in order to

guide treatment programs [9,10]. In particular, psychological tests provide rapid and low-cost diagnostic support [10]. Thus, the General Health Questionnaire (GHQ-28) has been extended as a screening tool for concomitant clinical diagnoses.

This tool was previously used to identify stressful life events in primary care services, such as in the treatment of chronic diseases, being able to differentiate the prevalence of health indicators.

Although there are validations available on the psychometric properties of GHQ-28 with psychiatric patients and/or with physical illness, there is no analysis in normal population in Peruvian territory. In the literature we find studies validation of the GHQ-28 questionnaire in patients with neurological deterioration [7], endocrinological diseases [11], samples from patients with drug addiction [6], dependence on opioids [12], military samples, by, for example, the Arabic version validated on civilians exposed to war [13], as well as predictive validity studies of GHQ-28 in patients with psychotropic use disorders in therapeutic communities [14].

Previous studies have shown the use of confirmatory and exploratory analysis factors to study the psychometric properties of the questionnaire. For example Prady et al., Analyzed multiethnic samples of pregnant women using confirmatory and exploratory analysis for a longitudinal study [15].

Furthermore, the questionnaire has already been used with non-clinical samples from the armed forces in South Africa and population with coronary heart disease in Norway, with configuration, metric and scalar invariants for an experimental study design [16,17].

The clinical evaluation process applied in diverse populations involves challenges related to the translation and adaptation of the instrument. A relevant aspect to consider is the ethnic and semantic differences in the content that can generate "unexpected" responses [15]. In the results of health evaluations, this due to the cultural singularities that serve as mediators in the initiation and manifestation of psychopathologies among population groups [16]. Therefore, given the complexities inherent to cultural and language differences and in particular the need for rapid identification of emotional problems, this study seeks to validate the Goldberg General Health Questionnaire (GHQ-28) in a non-clinical population under global emergency conditions.

Methods

Shows

The data of 434 people who agreed to participate in filling out virtual questionnaires disseminated in groups of social networks with health content at the Peruvian level were used. Only individuals capable of giving their informed consent (≥18 years) and resident in any department of Peru with access to smartphones were admitted to complete anonymous online questionnaires corresponding to an instrumental type study [18]. The estimated size of the sample was calculated using the G-power statistic with a confidence interval of 0.10 and an error range of 15%. We selected a cross-sectional survey design to examine the psychological responses of the population during the COVID-19 pandemic.

The participants received information about the research, purposes and scope, and then gave their informed consent; no monetary compensation was given for completing the questionnaire.

Process

Due to the pandemic, the national government restricted all types of physical interaction, therefore the use of the General Health Questionnaire (GHQ-28) was converted to a virtual format to facilitate filling out and reduce the risk of contagion for researchers. The study protocol was approved by the ethics committee of the Universidad Católica de Santa María (ref. No. 167-2020).

The procedure included advertisements through Peruvian social networks related to health and well-being ("health and well-being Peru", "Ministry of health Peru", "Health community", Peru), also using the snowball sampling strategy that allowed to spread the investigation. Information was provided on the objective and the implicit risks to invite the general population to participate in the research. Participants voluntarily completed the survey, approximately 40 minutes, through their smartphones or desktop computers during the period

of March and April 2020. The instruments were considered valid when fully completed;

Instruments

General Health Questionnaire (GHQ-28)

GHQ-28 is a self-administered general health questionnaire for the detection of mental disorders that contains 28 items. Participants were asked about symptoms and / or discomfort experienced recently (in recent weeks) during the COVID-19 pandemic. Each item is rated on a 4-point scale to identify the severity of symptoms between 0 and 3 ("Not at all", "Not more than usual", "More than usual" and "Much more than usual"). This version contains 4 subscales: somatic symptoms, anxiety, insomnia, social dysfunction and severe depression [19].

The instrument already has validations in Spanish-speaking countries with adaptations for Latin American countries [20], in addition to having been reported in multiple Spanish studies [21,22]. The internal consistency reliability analysis was determined for this study using the McDonald's Omega Coefficient [23] with acceptable values for the depression subscale (ω=0.834; 95% CI=0.818-0.851); anxiety/insomnia subscale (ω=0.908; 95% CI=0.895-0.921); social dysfunction subscale (ω=0.796; 95% CI=0.766-0.825) and the physical symptoms subscale (ω=0.890; 95% CI=0.874-0.906). The detection of psychological problems was identified with a cut-off point 23/24 [24].

Statistical Analysis

To perform the psychometric analysis of the Goldberg questionnaire (GHQ-28), we use JASP software to report descriptive data (mean, standard deviation, skewness, kurtosis and item-test correlation), and with a threshold of ± 2 to identify asymmetric values of normal values [22]. Subsequently, the internal structure of the instrument was evaluated using the Confirmatory Factor Analysis (CFA) corresponding to the theoretical model proposed by the author, which indicated four factors and 28 items. This analysis was performed through RStudio® software using the psych, lavaan and package for analysis of complex surveys of structural equation models [25]. Tools for modeling structural equations [26].

WLSMV estimator (Weighted Least Squares With Adjusted Mean And Variance), this estimator shows robustness in the results in situations of non-normality and categorical nature of the variables. The Comparative Adjustment Index (IAC) was also considered ≥ 0.90 (Curran et al. 1996), and the Tucker-Lewis Index (TLI), the Standardized Root Mean Square Residual (SRMR) and the Mean Square Error of Approximation (RMSEA) with values ≤ 0.80 [27].

We carried out a multigroup CFA, from there four types of invariance were used: configurational, weak, strong and strict (restrictive factor loads, interceptions and error variances), the criteria used were the difference in the Chi square, as well as the index comparative adjustment proposed by Millsap who states that values lower than 0.010 in the CIF and 0.015 in the RMSEA are considered equivalence indicators for the models [28]. Finally, the reliability of internal consistency was evaluated with the Cronbach coefficient and McDonald's Omega Alpha (ω) [29], as well as the average extracted variance (VEP), whose value exceeds 0.5 provides evidence of convergent internal validity [30].

Results

Sample description

Regarding sociodemographic data, lto sample (n=434) was biased in favor of female gender (61.3%), educated (>=85.0%), whose age range ranged between 18 and 68 years with a mean of 33.87 (SD=12.6).It was identified that 40.8% are psychological cases and 59.2% free of psychological disorder. Table 1 shows the characteristics of the study sample.

Table 1. Sampling characteristic

Characteristic		n	%
Gender	Woman	266	61.30%
	Man	168	38.70%
Level of study	High school	64	14.70%
	University students	174	40.10%
	Single	116	26.70%

	Postgraduate	80	18.40%
Diagnosis	Psychologically ill	177	40.80%
	Not psychologically ill	257	59.20%

Analysis of the General Health Questionnaire

The confirmatory factor analysis and exploratory analysis made it possible to evaluate the structure of the subscales (GHQ-28) in a non-psychiatric Peruvian population. Table 2 shows the quantitative analysis, we found that the global averages varied for the subscales of anxiety / insomnia and social dysfunction, whose means are high and are between (M=1.01; SD=0.885) and (M=1.21; SD=0.942) for the elements (1, 5, 8, 9, 10, 11, 15, 16, 17, 18, 20, 21). And the other group, formed by the items (2, 3, 4, 6, 7, 12, 13, 14, 19, 22, 23) of the somatic symptoms and severe depression subscales present low averages (M=0.23; SD=0.608) and (M=0.99; SD=0.963), with asymmetry values less than 2 indicating slight deviations from normality [22]. It is observed that the correlations between the elements are not greater than 0.90 [31].

Table 2. GHQ-28 item analysis

Articles	SUBWAY	Delaware	g1	g2	Cit
Article 1	1.18	0.799	0.451	-0.088	0.486 **
Item_2	0.6	0.866	1,266	0.541	0.537 **
Item_3	0.99	0.963	0.563	-0.766	0.685 **
Item_4	0.94	0.957	0.651	-0.641	0.624 **
Item_5	1.09	0.982	0.489	-0.822	0.574 **
Item_6	0.83	1,029	0.927	-0.449	0.642 **
Item_7	0.78	0.966	0.944	-0.298	0.542 **
Item_8	1.1	1,024	0.544	-0.85	0.666 **
Item_9	1.18	1,090	0.446	-1,111	0.656 **
Item_10	1.18	0.978	0.452	-0.776	0.752 **
Item_11	1.04	0.958	0.551	-0.686	0.759 **
Item_12	0.66	0.924	1,262	0.52	0.733 **
Item_13	0.95	1,022	0.724	-0.685	0.691 **
Item_14	0.81	0.928	0.928	-0.109	0.746 **
Item_15	1.06	0.927	0.474	-0.695	0.515 **
Item_16	1.13	0.964	0.445	-0.777	0.593 **
Item_17	1.07	0.817	0.438	-0.29	0.564 **
Item_18	1.13	0.854	0.372	-0.49	0.557 **
Item_19	0.92	0.855	0.681	-0.164	0.419 **
Item_20	1.01	0.885	0.641	-0.247	0.513 **
Item_21	1.21	0.942	0.371	-0.742	0.524 **
Item_22	0.43	0.813	1,941	2,876	0.558 **
Item_23	0.45	0.765	1,711	2,225	0.612 **
Item_24	0.33	0.723	2,205	4,004	0.576 **
Item_25	0.23	0.608	2,944	8,433	0.513 **
Item_26	0.59	0.842	1,254	0.612	0.696 **

Item_27	0.28	0.662	2,595	6,429	0.560 **
Item_28	0.24	0.619	2,788	7,259	0.506 **

Note: n=434; M=Average; SD=Standard Deviation; g1=Asymmetry; g2=Tannosis; Cit=Proof of Correlation Element

We found an appropriate fit, from the GHQ-28 correlated four-factor model, of 7 items per factor (χ^2=1179.306, gl=344, χ^2/gl=3.42; IFC=0.927; TLI=0.919; RMSEA=0.075 [90% CI: 0.07, 0.08]; SRMR=0.07). Table 3 shows the GHQ-28 goodness-of-fit index.

Table 3. GHQ-28 goodness of fit index

Model	**X2**	**gl**	**CFI**	**TLI**	**SRMR**	**RMSEA [90% CI]**
original model	1,179,306	344	0.927	0.919	0.07	0.075 (0.070, 0.080)

Note: IFC: Comparative Adjustment Index; RMSEA: Mean Square Error Of Approximation; SMRM: Mean Square Standardized Residual Root, p<0.001

Table 4 shows the standardized factor loadings that confirm the four-factor model proposed by the author of the GHQ-28, with adequate values λ>0.581 ($\geq$ 0.5) (except item 19, λ=0.469) [32]. Additionally, we observed that the correlation between the somatic evaluating factor and the symptoms and anxiety/insomnia with high scores (>0.75), likewise the correlations between the variables did not show multicollinearity.

Table 4. Factor loads of the standardized solution AFC for the final model

Number	**Articles**	**F1**	**F2**	**F3**	**F4**
1	Have you been feeling perfectly well and in good health?	0.581			
2	Have you ever had the feeling that you need a restorative toner? (drinks)	0.676			
3	Have you ever felt exhausted and powerless at all?	0.829			
4	Did you feel sick?	0.759			
5	Have you had headaches?	0.778			
6	Have you had a feeling of tightness in your head or that your head is going to explode?	0.872			
7	Have you had a heat wave or chills?	0.646			
8	Have your worries made you lose sleep a lot?		0.852		
9	Have you had trouble sleeping through the night?		0.827		
10	Have you constantly felt overwhelmed or stressed?		0.848		
11	Have you been nervous and in a bad mood?		0.791		
12	Were you scared or panicky for no reason?		0.877		

13	Have you had the feeling that everything is coming to you?		0.816		
14	Have you noticed that you are constantly nervous and "on the verge of exploding"?		0.869		
15	Have you had trouble staying busy and active?			620	
16	Does it take you longer to do the things you usually do?			0.658	
17	Did you get the impression that you are doing things right (generally speaking)?			0.754	
18	Are you satisfied with the way you do things?			0.738	
19	Have you felt that you have a useful role in life?			0.469	
20	Do you feel capable of making decisions?			0.66	
21	Do you enjoy your normal activities every day?			0.647	
22	Do you think you are a useless person?				0.817
23	Do you live life totally without hope? (The last weeks)				0.846
24	Do you feel that life is not worth living?				0.888
25	Have you thought about the possibility of "taking your own life"?				0.894
26	Have you noticed that sometimes you "can't do anything" because your nerves are so upset?				0.884
27	Do you wish you were dead and away from everything?				0.921
28	Have you ever noticed the idea of repeatedly killing yourself come to mind?				0.862
		Correlations			
F1	Somatic symptoms	-			
F2	Anxiety / insomnia	0.75	-		
F3	Social dysfunction	0.62	0.63	-	
F4	Severe depression	0.55	0.63	0.64	-

Table 5 shows the invariance of the four correlated factors of the CFA (Confirmatory Factor Analysis). We found strict invariance, it is highlighted that the factor loadings are similar in the group of participants with a diagnosis of psychological disorder and non-psychological cases, as well as in the group according to level of studies.

However, according to gender (men and women), invariance is evidenced, where the configurational model (baseline) presents adequate fit indices X2 (gl)=595.11 (688), CFI=0.90, RMSEA=0.042, with reference to the model metric (weak invariance), scalar (strong invariance) and strict invariance.

The factor loadings between men and women are equal. There are no statistically significant differences ($p>0.05$) and ($\Delta CFI \leq 0.01$), ($\Delta RMSEA \leq 0.015$) when comparing with the base model (configurational), the values found are below the

cut-off points established with respect to metric invariance.

Finally, the strict invariance is observed (restrictions on factorial loads, intersections and residuals) that indicates variance in the group of men and women, with statistically significant differences ($p<0.05$) and ($\Delta CFI \leq 0.01$), the values found were ($p=0.001$), ($\Delta CFI \leq 0.023$), to verify these differences the Student's t test was used and the effect sizes, using Cohen's re (1992), the referential values are, d=0.20 (small), d=0.50 (medium) and d=0.80 (large), finding statistically significant differences and median ET in two factors, somatic symptoms ($p <0.01$; d=41) and anxiety / insomnia ($p <0.01$; d=35), the other two factors (social dysfunction and severe depression) did not show differences.

Table 5. Measurement invariance for the GHQ-28 four-factor model, according to sex, diagnosis and latest studies performed

	Invariance	X2 (gl)	CFI	RMSEA	Δ x2 (Δ gl)	ΔCFI	ΔRMSEA
Gender	Configural	595.11 (688)	0.901	0.042			
	Weak	717.17 (712)	0.924	0.036	8.22 (24)	0.023	0.006
	Strong	728.72 (736)	0.925	0.035	6.23 (24)	0.001	0.001
	Strict	857.46 (740)	0.902	0.04	13.36 (4) ***	0.023	0.005
Diagnosis	Configural	1118.1 (688)	0.735	0.045			
	Weak	1255.4 (712)	0.71	0.046	28.13 (24)	0.025	0.001
	Strong	1321.9 (736)	0.701	0.046	19.35 (24)	0.009	0
	Strict	4955.3 (740)	0	113		0.701	0.067
Latest studies	Configural	967.79 (1376)	0.896	0.042			
	Weak	1436.91 (1448)	0.914	0.037	21.99 (72)	0.019	0.005
	Strong	1481.78 (1520)	0.913	0.037	18.34 (72)	0.001	0.001
	Strict	1604.95 (1532)	0.905	0.038	8.45 (12)	0.009	2

Note: ** p <0.001; X2: Chi square; gl: Degrees of freedom; ΔX2: Difference between the Chi square values; Δgl: Difference between degrees of freedom; CFI: Comparative Adjustment Index; RMSEA: Root Mean Square Of The Approximation Error; ΔCFI: Difference between the comparative fit indices.

In addition, the mean of the extracted variance (AVE>0.5) was included, which indicates convergent validity, where the factors (somatic symptoms and social dysfunction) do not meet this criterion.

Table 6 Reliability coefficients and descriptive measures of the GHQ-28 four-factor model.

Factors	ω	Alpha	bird	SUBWAY	SINCE	95% CI

scomatic symptoms	0.829	0.825	0.403	0.915	0.917	(0.802,0.852)
Anxiety / insomnia	911	911	0.592	0.988	0.196	(0.895, 0.922)
Social dysfunction	800000	0.798	0.361	1077	0.093	(0.766, 0.824)
Severe depression	900	0.897	0.556	0.364	134	(0.875, 0.906)

Note: ω: McDonald's Omega; AVE: Average Extracted Variance; M: Mean; SD: Standard Deviation

Discussion

In this study, the psychometric properties of the Goldberg general health questionnaire for the non-psychiatric population were determined in the Spanish version for Peruvian adults by confirmatory factor analysis. This analysis indicates that the internal factorial structure of the instrument according to the four-factor model has an adequate fit.

Consistent with our findings, factor analysis from previous studies also they supported the validity of the four-factor construct with samples in different patients. Such as the Malay version in patients with drug addiction, diabetes and normal population [6], the Spanish version in patients with fibromyalgia [33], the Norwegian version in stroke patients, with some differences in factor structure compared to the original version by Goldberg and Hillier [17]. In the Spanish version with patients diagnosed with opioid dependence despite the fact that the 4-factor model is significantly higher than the 3-factor model, proposed by Goldberg and Hillier [13], the proper fit of the original instrument was achieved.
It should be noted that the studies conducted in non-clinical samples of different ethnicities did not obtain a good statistical fit. The three-factor structure was found to fit better than the four-factor scale in a black sample of South African military employees [16], and the five-factor structure best fits a sample of women of various ethnicities and languages in the UK [15]. However, in recent studies with clinical and non-clinical samples, psychological health has been assessed with the four-factor GHQ-28, according to the original version of Goldberg 1972 and Goldberg and Hillier 1979 [34-36].

This is the first study to examine the measurement invariance of the GHQ-28 of four factors in the three groups formed: a) gender, b) psychological diagnosis, and c) educational level. Strict invariance is accepted in the group of participants with a diagnosis of psychological disorder, non-psychological cases, and in the educational level group, that is, it is accepted that the factor loads, factor weights and interceptions are similar in each group. Additionally, strict variance is found according to gender, finding statistically significant differences (median effect size) in two factors, somatic symptoms and anxiety / insomnia; however, the other two factors: social dysfunction and severe depression do not show differences. In the studio of Retolaza y Ballesteros [37], the most stable factors were social dysfunction and depression, which indicates a great invariance regarding their factorial composition in the total sample (58% women) of primary health care patients.

Another important finding is the high internal consistency of the anxiety/insomnia subscale (α=0.911) and the other subscales (ω=0.829, ω=0.900 and α=0.800), consistent with previous studies where all scales are correlated positively and significantly with each other and with the total scale. In the Arabic versión [13], internal consistency was 0.91 and 0.80 in the civilian population living in war zones, in the Malay version [6] from 0.859 to 0.915 analyzed in normal population and with patients. Similarly, acceptable values between 0.70 and 0.83 were reported in a sample of military personnel in

South Africa [16] and values between 0.719 and 0.881 in the Norwegian version with patients who suffered a stroke [18].

In the context of a pandemic, we detect psychological problems in the general population. 40.8% referred psychological problems and obtained higher means in the subscales of anxiety and insomnia and social dysfunction, 61.3% of the total population were women. Being a woman was associated with a higher probability of suffering from anxiety and insomnia and somatic symptoms [2]. These results are similar to those reported by a recent study published in china [35], 42.65% had a high prevalence of psychological problems (GHQ-28 ≥ 5), 48.3% on the subscale of depression, 22.6% in the anxiety subscale and 19.4% in a combination of both, with a higher risk in the group of 18 and 39 years old, students and technical and professional employees, 56.09% were men. In the sample of medical and non-medical professionals, psychological problems were moderate (GHQ-28

total score> 24) in 60.8% of the medical group versus 48% of the non-medical group, in two subscales, somatic symptoms and anxiety and insomnia, with greater risk for women, 74.4% of the non-medical group were women [36]. In another longitudinal study in Poland with an alcohol consuming population, mostly with female participants (78%), compared with a group that did not consume alcohol (27.8%), a higher risk of suffering from depressive symptoms and worse mental health was observed in the participants who consumed more alcohol than before, during the pandemic period, [34].

It should be noted that the gender factor affects the appearance of clinical pictures. In particular, studies with greater participation of women report symptoms of anxiety, insomnia and somatic symptoms associated with isolation [36]. Except in China with a relatively higher percentage of male participants (56.09%), depressive symptoms are not significant. However, under regular contexts, free of health crisis in studies with a higher participation of men (83.6%), the social dysfunction subscale reached the highest average [15]. These studies confirm that gender is an elemental factor associated with anxiety, insomnia and somatic symptoms.

In the review of the literature, we found no evidence of the validation of the GHQ-28 in the Latin American population, so we consider that this study is a contribution to knowledge in the identification of the psychological state of health. The factorial structure of the GHQ-28 confirms the four-factor model, especially suitable for working in the peruvian context with an adult population.

An important strength of the study is that the instrument presents factorial invariance and can be useful for psychological evaluation, in addition it has been shown that it presents adequate reliability for this population. Therefore, the questionnaire is useful for making diagnostic predictions in people seeking help and who may require psychotherapeutic support.

Limitations

We report possible self-selection biases in participants of high socioeconomic status who have access to cell phones with internet available. Internet service users tend to be better educated and have higher income compared to the standard population when using web-based surveys [38]. The validation of the GHQ-28 cannot be generalized to the entire Peruvian population, given the non-probabilistic nature of the sample and the non-inclusion of ethnic groups and different languages. Future studies could focus on a population with low economic resources, with low academic performance and without connection to wireless networks.

Contribution of the authors

RAG generated the proposal,search, analysis of information and designed the study. RAG, JHC, ABP collected the data and contributed to the structuring of the document, JHC analyzed and interpreted the data and ABP contributed to the discussion. All authors participated in the writing and approval of the final version of the article.

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Declaration of conflict of interest

The authors report that the research was conducted in the absence of commercial or financial implications that could be considered a potential conflict of interest.

Ethical approval and consent to participate

The research approval was obtained from the ethics committee of the Catholic University of Santa María (ref. No. 167-2020), the participants gave their consent before being included in the study.

Recognition

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