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Naveed, Muhammad Asif; Shaukat, Rozeen; and Anwar, Mumtaz Ali, "Development and Validation of a Covid-19 Literacy Scale" (2020). *Library Philosophy and Practice (e-journal)*. 4362.

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Development and Validation of a Covid-19 Literacy Scale

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Abstract

This research intended to develop and validate a Covid-19 Literacy Scale (CLS). This study was conducted in two phases. In the first phase items were generated based on an extensive literature review, public advisory platforms, and public service messages related to Covid-19. After that these statements were submitted to a panel of experts for content and face validity. While in the second phase, a cross-sectional survey was conducted using students of three university from the province of Punjab, Pakistan for construct validity and reliability. An online questionnaire was administered among students with permission from the concerned authorities. A total of 369 responses received which were imported in SPSS for data analysis. The construct validity was assessed through exploratory factor analysis and the reliability of the instrument was determined using Cronbach alpha coefficient. The results indicated a 23-items scale structured into two dimensions, namely, 'infection spread and symptoms' (11 items) and 'infection prevention and treatment' (12 items), Each statement had loading strengths greater than .56 and the model explained 66.6% of the total variance. The values of reliability coefficient for overall scale (CA = .970) as well as for both sub-dimension such as 'infection spread and symptoms' (CA = .957) and 'infection prevention and treatment (CA = .936) were great. The correlation coefficients of test retest ranged from 0.71 to .87 which also appeared at satisfactory level. Thus, the newly developed instrument appeared as a reliable and valid measure for Covid-19 literacy assessment. This research would make a worthwhile contribution to health literacy in general and Covid-19 literacy in particular as no such scale was available in the existing literature.

Keywords: Covid-19 pandemic; Health Literacy; Covid-19 Literacy Scale; Pakistan.

Introduction

The coronavirus disease (Covid-19), caused by SARS-COV-2, was reported for the first time in the city of Wuhan, China (Khan, Kazmi, Bashir, & Siddique, 2020; Li, Lu, & Zhang, 2020; Phan, 2020) which was later on turned into global pandemic as designated by World Health Organization (Cucinotta & Vanelli, 2020; LloydSherlock et al., 2020; Mahase, 2020; Watkins, 2020). Since the emergence of Covid-19, it has infected more than 16.5 million people along with about .67 million deaths worldwide so far (World Health Organization, 2020; Worldometer, 2020). It has wreaked havoc, dismantled almost every activity of the daily life at workplace, academia and in everyday life, caused panic and mental health problems, and put pressor on health care systems of the world

(Bao, Sun, Meng, Shi & Lu, 2020; Xu, Li, Tian, Li & Kong, 2020). It also exposed the ill-preparedness of governments, health care systems, and social safety networks to respond to the emerging and longstanding health related needs of people requiring individual preparedness besides systems preparedness to respond Covid-19 pandemic properly (Duan, Wang & Yang, 2020; Nguyen, et al., 2020a; Nguyen, et al., 2020b; Rosenbaum, 2020).

The rapid and drastic progression of Covid-19 infection called for peoples' ability not only for acquiring and applying credible health information but also adoption of health protective behaviours at a faster pace (Paakkari, & Okan, 2020; Zarocostas, 2020). Knowledge of risk factors of communicable diseases is, and has always been essential not only to control and avoid getting and spreading infection but also to avoid devastating consequences of pandemics (Abel & Mcqueen, 2020; Parikh, et al., 2020). Considering the prevailing pandemic scenario, the health personnel intended to educate people about the Covid-19 and how to avoid getting and spreading the infection. The valuable information providing practical solutions (e.g. washing hands, wearing masks, social distancing, etc.) and where to find credible advice were made widely available through public advisory platforms (Paakkari, & Okan, 2020; Prem, et al., 2020). Besides, the abundance of misinformation and disinformation spreading faster and further like virus through social media platforms and other outlets posed a serious challenge for public health known as Covid-19 infodemic (DeLuca, 2020; Zarocostas, 2020). WHO Director General also said, "We're not just fighting an epidemic; we're fighting an infodemic" while addressing at the Munich Security Conference on 15th of February 2020 (Zarocostas, 2020). The Covid-19 infodemic put public health at sever risk (Naeem, Bhatti & Khan, 2020) and spotlighted the people's poor health literacy underestimated worldwide as a public health problem (Paakkari, & Okan, 2020) posing an unprecedented challenge for health education, communication and healthcare systems (Nguyen, et al., 2020a). The need for development of health literacy has never been more realized than in days of Covid-19 pandemic and infodemic when people faced a health crisis simultaneously worldwide (Abel & Mcqueen, 2020; Paakkari & Okan, 2020).

Health literacy has a considerable potential to cope with pandemic situations (e.g. Covid-19) while enhancing people's knowledge for particular health issue, adapting their existing life styles, reducing carelessness, preventing from over-reactions, and adopting health protective behaviors (Able & McQueen, 2020; Greenhalgh, 2015; Maverick Insider, 2020 Moro, et al., 2010; Nguyen, et al. 2020a; Watson, 2011). People with inadequate health literacy are more at risks of being infected with Covid-19 as the low health literacy predicts health deprivation (Okan et al., 2020; Sørensen, 2020). The people with limited health literacy are less likely to adopt health preventive measures (Nielsen-Bohlman, Panzer & Kindig, 2004), likely to have higher fear and depressions (Nguyen, et al., 2020a; Nguyen, et al., 2020b), more likely to use medical care (Cho, Lee, Arozullah, & Crittenden, 2008), more likely to be hospitalized (Baker, et al., 2002), likely to increase inpatients costs and burden on health care system (Howard, Gazmararian & Parker, 2005), and likely to have high mortality rates (Baker, et al., 2007). An adequate health literacy is essential to cope with the Covid-19 pandemic as it helps people to acquire and use credible health related knowledge and adopt protective behaviours. The general public and the governments usually pay high cost for low health literacy without its realization.

Paakkari and Okan (2020) stated, "health literacy should be seen in relation to social responsibility and solidarity" and is required not only by people in need of health information but also information service providers (p. e250). The social responsibility and solidarity are required

from the entire populations including those individuals involved in the production and sharing of unreliable and false information about SARS-CoV-2. A number of studies attempted to examine health literacy related to COVID-19 among medical and non-medical populations of Asia and North America using an online questionnaire (e.g. Fauzi, Husamah, Miharja, Fatmawati, Permana, & Hudha, 2020; Nguyen, et al., 2020a; Nguyen, et al., 2020b; Parikh, et al., 2020). Such studies measured the aspect of health literacy that were assessed included knowledge, attitudes, and practices. Most of these studies did not perform validation of their health literacy questionnaires comprising of 11 to 20 items. In additions, the results of these studies reported the health literacy related to Covid-19 pandemic of both general and medical populations at sub-optimal level which was quite worrisome.

The study of Seng, Yeam, Huang, Tan, and Low (2020) emphasized that “understanding the levels and determinants of pandemic related health literacy across different populations is essential for healthcare policymakers to formulate optimal strategies for effective communication of critical medical information in the COVID-19 crisis and future pandemics” (p. 5). However, an extensive search for published literature on Covid-19 pandemic and infodemic indicated the non-availability of a standardized instrument assessing health literacy specifically related to Covid-19 despite the importance given to health literacy. A systemic review of pandemic related health literacies such Covid-19, SARS, and MERS by Seng, Yeam, Huang, Tan, and Low (2020) also indicated an urgent need for development and validation of an up-to-date and standardized measure for assessment of health literacy related to Covid-19 pandemic. This research was, therefore, designed to develop and validate a Covid-19 Literacy Scale so that health literacy focusing specifically to Covid-19 pandemic might be assessed among different populations. This study would contribute in the existing literature on health literacy in general and Covid-19 literacy in particular as no such instrument was available so far. It would also help information professionals and librarians associated with health communication and promotion to assess Covid-19 literacy before making decisions about the information services for improvement of health literacy skills of general populations.

Materials and Methods

This study was conducted in two phases. In the first phase, the items having potential to measure Covid-19 literacy was generated based on an extensive literature review, public advisory platforms, and public service messages in the mass-media. Afterword, these items were submitted to a panel of experts for content and face validity. In the second phase, a cross sectional survey using students of three universities in Pakistan was conducted to investigate the psychometric properties such as construct validity and reliability of the finalized items.

Phase 1: Scale Development

Generation of items

This study deployed both approaches, deductive and inductive, for items generations. Deductive scale development requires an extensive review of the related literature along with a clear understanding of the constructs whereas inductive scale development involve generation of items by asking participants for descriptions related to the phenomenon under investigation (Hinkin, 1995). The later was utilized when a little literature could be used for identification of constructs. In this study, the items were generated initially based on literature review and using public advisory

platform developed by World Health Organization (WHO), governments of different countries, hospitals, and public service messages of mass media. Furthermore, the focus group interview was conducted with the seven health professionals, involved in treatment of Covid-19 patients, from different hospitals for reconceptualization and uncovering the constructs not yet identified in the existing literature. The responses of these health professionals were analyzed using thematic analysis. The initial pool of 33 items were generated based on the extensive literature review and the results of focus group interview to capture the domain of Covid-19 Literacy Scale (CLS). The initial pool of 33 items were examined for duplications and merger of some items if possible, which resulted a final list of 27 items to measure self-perceived Covid-19 literacy on a 5-point Likert scale, that is, 1=strongly disagree, 2=disagree, 3=undecided, 4=agree, and 5=strongly agree.

Content and face validity

Once the items generated for CLS, the next step was to examine how well these items tap into its conceptual domain (Podsakoff, 2003). Therefore, the initially generated items evaluated for face validity of the items and content validity of the measure. Five experts (e.g. three doctors, one educationist, and one researcher having extensive research experience in the area of health information seeking and literacy) were invited to review the initial 27 items for both content and face validity. Content validity refers to whether or not the content of the scale is capable of measuring what it is intended to measure, that is, the defined objective (Firouzbakht, *et. al.*, 2018; Hinkin, 1995). This study adopted a matrix method for content validity of Covid-19 literacy scale. A matrix method reports the relationship of items with dimensions of the construct (Podsakoff, 2003). The measure would not be either deficient (too few items) or contaminated (too many items). The experts were asked for classification of randomly ordered items one of several categories (e.g. CLS dimensions plus an 'other' dimensions). The experts panel examined whether each item tap into each category through matrix method. Out of 27 items, 23 items were assigned to proper category with 85% or higher by the experts' panel. The rest of four items were deleted to make sure that the measure was neither deficient nor contaminated resulting a revised CLS comprising of 23 items to measure Covid-19 literacy. Face validity refers to whether or not an item, on its face, appear to measure construct (Podsakoff, 2003). After verification of content validity, face validity was assessed to determine whether the appearance of items was appropriate or not. Overall, the experts panel reported the face validity of the 23 items because these items appeared good, adequate, and clear. In addition, it was pilot tested for face validity with 41 students which was not include in the study sample and slightly revised for few words.

Phase 2: Scale Validation

Construct validity and reliability

The construct validity of the instrument was assessed using exploratory factor analysis. All the 23 items were analyzed using principal component analysis with varimax rotation using SPSS® for Windows® version 21.0. The sampling adequacy was assessed using Kaiser-Meyer-Olkin (KMO) statistics. The presence of correlation between statements was determined with Bartlett's test of sphericity. The reliability of the instrument was assessed by calculating the values of Cronbach alpha coefficient for each item of the instrument, overall scale as well as its sub-dimensions.

Population and data collection

This study purposively selected three universities, two public and one private sector, from the province of Punjab, Pakistan such as University of the Punjab, Lahore (PU), University of Sargodha, Sargodha (SU) and University of Management and Technology, Lahore (UMT). The PU and SU are public sector universities whereas UMT was a private sector university. PU was the oldest and the largest university and SU was an emerging and fast-growing university in Pakistan. Whereas UMT is a W4 category university which belonged to private sector. In this phase, the data needed to be collected from at least 230 respondents as recommended by Munro's (2005) criterion, that is, 10 respondents necessary for each item to study. Therefore, all the students enrolled in social science and business programs at these universities were considered as the population of this study. The survey instrument, containing 23 items of CLS along with certain socio-academic variables, created in Google forms was administered online with the permission of concerned authorities in June-July as it was possible due to online classes being carried out in these universities due Covid-19 Pandemic. The follow up reminders were also sent to increase responses. The students were requested to participate in the survey voluntarily. A total of 369 responses received which was imported in SPSS for data analysis.

Results

Demographic profile

Out of 369 total respondents, 179 (48.9%) students belonged to PU, followed by those students belonged to SU (n=138, 37.5%) and UMT (n=50, 13.5%). There were 147 (39.8%) males and 223 (60.4%) females. A large majority of the survey respondents (n=301, 81.6%) belonged to 16 years of education programs (BS/MA). This was followed by those students (n=55, 14.9%) belonged to 18 years of education programs (MS/MPhil) and doctoral program (n=13, 3.5%). As far as age is concerned, it ranged from 18 to 49 years. A large majority of the survey respondents (n=312, 84.5%) had their age up to 25 years, followed by those having age in range of 26 – 30 years (n=30, 8.2%). There were only 27 (7.3%) respondents who had age greater than 30 years. A large majority (n=349, 94.6%) of these students did not infected with Covid-19. Only 20 (5.4%) students infected with Covid-19. In addition, a large majority of these students (n=333, 90.2%) did not experience Covid-19 symptoms. Only 36 students (9.8%) experienced such symptoms.

Construct validity using exploratory factor analysis

Prior to factor analysis, the sampling adequacy and presence of correlation in statements needed to be examined. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were used to examine the sampling adequacy. The KMO measure yielded a value .967 that was closer to 1.0 which is superb (Kaiser, 1981; Hutcheson & Sofroniou, 1999; Tabachnick & Fidell, 2007; Field, 2009). Moreover, the Bartlett's test of sphericity was performed to determine the correlation between the statements. The value of Bartlett's test of sphericity was statistically significant (chi-square= $\chi^2=7749.706$, df=253, p=.000 < 0.05) indicating that the data were not homogenous and the presence of correlation among statements. These values of Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity confirmed the suitability of this data set for performing factor analysis as these measures met the assumptions of factor analysis, that is, sampling adequacy and homogenous variance.

Principal factor analysis using varimax rotation was used to explore the adequate number of factors and grouping of items in each of these factors as it is most commonly used rotation in exploratory factor analysis which maximizes the variance of factor loading (Tabachnick & Fidell, 2007; Field, 2009). The initial analysis resulted two factor solution with eigenvalues more than one as eigenvalue criterion was common to identify factors to be useful (Leech, Barrett, & Morgan, 2005). These factors explained 66.6% of the total variance observed. The scree plot criterion, retaining all factors within the sharp descent before eigenvalues level-off (Johnson, 1998; Rencher, 1998; Tabachnick & Fidell, 2007; Field, 2009), also corroborated the two-factor solution as indicated in Figure 1.

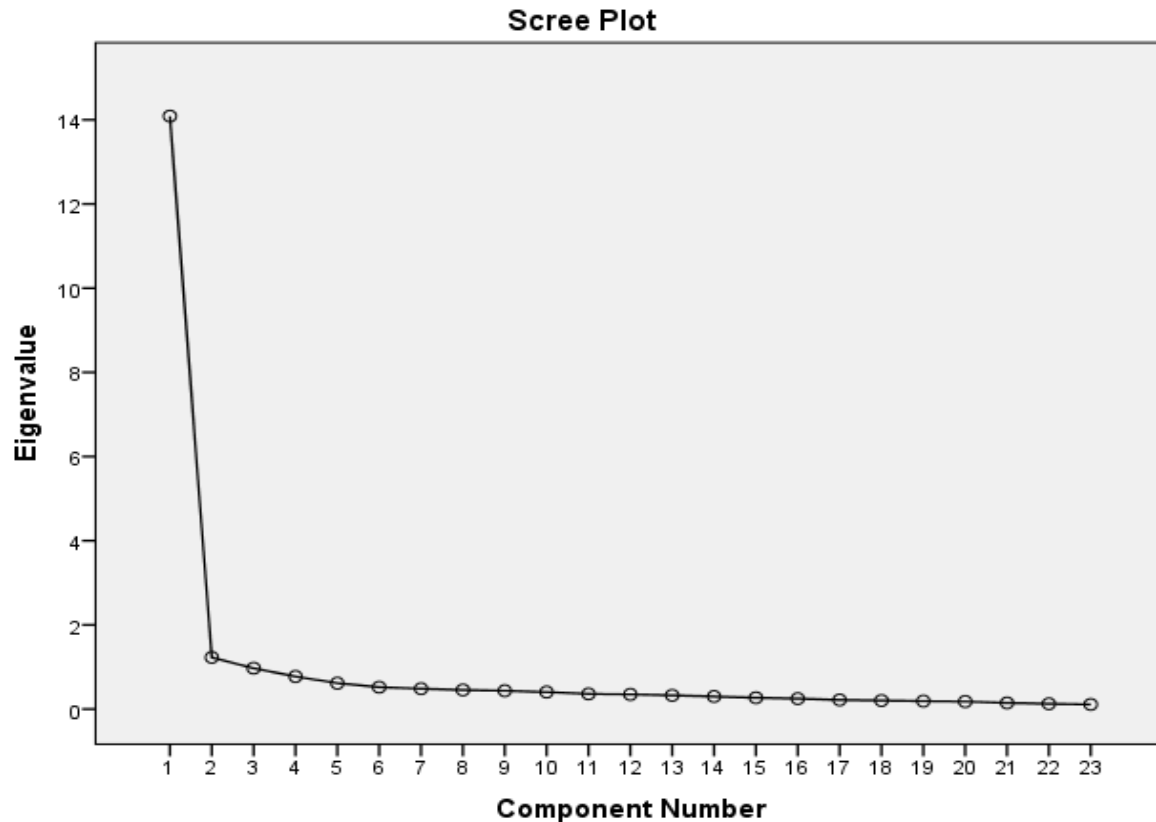


Figure 1: Scree plot for PCA solution with varimax rotation

Table 1 outlined the results of exploratory factor analysis with varimax rotation. The first factor (F1) comprised of 11 statements that explained the 61.250% of the total variance with eigenvalue 14.087. These statements had rotated factor loadings that ranged from .563 to .839. This factor was labeled as “Infection Spread and Symptoms”. While the second factor (F2) consisted of 12 statements, accounted for 5.336% of the total variance with eigenvalue of 1.227, and had rotated factor loadings ranging from .565 to .841. This factor was tagged as “Infection Prevention and Treatment”.

Table 1
Rotated factor loadings for each component of Covid-19 literacy

No.	ID*	Statements	F1	F2
1	S3	I know that the Covid-19 infected person must be isolated for two to three weeks.	.839	
2	S2	I am aware that the person who has contacted with the Covid-19 infected person must be isolated for two to three weeks.	.815	
3	S12	Avoiding physical contact with infected persons is useful for self-protection.	.800	
4	S8	I am aware of Covid-19 symptoms (e.g. coughing, sore throat, fever, shortness of breath, etc.).	.789	
5	S13	Avoiding the body fluids of infected people is helpful for self-protection.	.761	
6	S23	I am aware of that quarantine and isolation are effective measures to reduce the spread of Covid-19 infection.	.759	
7	S10	I understand that the infected people can spread it up to 14 days.	.757	
8	S14	I know that isolation is compulsory for symptomatic people.	.756	
9	S1	I understand that Covid-19 is transmitted form one person to another.	.749	
10	S11	I know that asymptomatic person can spread Covid-19 infection for 15 days when infected with it.	.653	
11	S6	I understand the transmission ways and levels of Covid-19.	.563	
12	S9	I am aware of precautionary measures (e.g. washing hands, using sanitizer, wearing mask, social distancing, avoiding public gatherings and traveling, covering mouth while sneezing, and self-quarantine).		.841
13	S19	I understand the role of alternative medicine healing Covid-19.		.785
14	S7	I am aware of the risks of possible infection from cured patients.		.680
15	S5	I am able to identify the possible infected people and areas around me.		.675
16	S17	I know that when to contact health professionals for treatment.		.654
17	S20	I understand the role of spiritual healers in pandemics.		.654
18	S15	I am aware of when to go for self-quarantine.		.652
19	S22	I know where to find credible information about Covid-19 pandemic.		.642
20	S4	I understand that the Covid-19 infected people can be cured.		.635
21	S18	There is no vaccine for treatment of Covid-19.		.611
22	S16	I understand when to go for Covid-19 test.		.610
23	S21	I am aware of the death rate due to Covid-19 pandemic.		.565

*It denotes the position of statement in the Covid-19 Literacy Scale

Reliability Analysis

The reliability of Covid-19 Literacy Scale was determined using both types, that is, internal reliability and external reliability. Internal reliability refers to the consistency of scores across items within a test whereas external reliability refers to the stability of a test and assesses the extent to which a test varies from one utilization to another (McLeod, 2007).

Internal reliability

The internal consistency of the overall Covid-19 Literacy Scale as well as of each sub-scale was determined by calculating the values of Cronbach alpha (CA), the internal reliability coefficient as it is the most commonly used and accepted measure of internal consistency. The value of CA varies from zero to one. The value closer to one indicates the higher level of reliability whereas the value closer to zero indicates low level of reliability (Field, 2009; Gliner & Morgan, 2000). The proposed value of Cronbach alpha is as .70 to be the minimum acceptable standard for internal consistency (Nunnally, 1978; Nunnally & Bernstein, 1994). Table 2 outlined the details of reliability analysis of the statements loaded this factor one labeled as “Infection Spread and Symptoms”. The range of reliability coefficient varied from .950 to .958 for each statement loaded on this factor. Since the values of Cronbach’s alpha was high and acceptable, it was decided to keep all these statements in this factor. The reliability coefficient for the factor one “Infection Spread and Symptoms” was .957.

Table 2

Internal reliability analysis for the dimension of “Infection Spread and Symptoms”

S. No.	Statements	Cronbach's Alpha if Item Deleted
1	I understand the transmission ways and levels of Covid-19.	.958
2	I know that asymptomatic person can spread Covid-19 infection for 15 days when infected with it.	.955
3	I understand that Covid-19 is transmitted form one person to another.	.953
4	Avoiding the body fluids of infected people is helpful for self-protection.	.952
5	I understand that the infected people can spread it up to 14 days.	.952
6	I am aware of that quarantine and isolation are effective measures to reduce the spread of Covid-19 infection.	.952
7	I know that isolation is compulsory for symptomatic people.	.951
8	I am aware of Covid-19 symptoms (e.g. coughing, sore throat, fever, shortness of breath, etc.).	.951
9	I am aware of that the person who has contacted with the Covid-19 infected person must be isolated for two to three weeks.	.951
10	Avoiding physical contact with infected persons is useful for self-protection.	.951
11	I know that the Covid-19 infected person must be isolated for two to three weeks.	.950
Infection Spread and Symptoms		.957

Table 3 presented the reliability analysis for the factor two having label as “Infection Prevention and Treatment”. The range of reliability coefficient varied from .927 to .940 for each statement loaded on this dimension. Since these values were also high and acceptable, none of these items were deleted. The value of the reliability coefficient for the factor two “Infection Prevention and Treatment” was .936. In addition, the reliability coefficient for overall Covid-19 literacy scale was also calculated. The results indicated very high value of the reliability

coefficients for overall Covid-19 Literacy Scale, that was, .970. Thus, it can be concluded that the newly developed scale had sufficient internal reliability.

Table 3

Internal reliability analysis for the dimension of “Infection Prevention and Treatment”

S. No.	Statements	Cronbach's Alpha if Item Deleted
1	I am able to identify the possible infected people and areas around me.	.940
2	I am aware of the risks of possible infection from cured patients.	.933
3	There is no vaccine treatment for Covid-19.	.932
4	I understand that the Covid-19 infected people can be cured.	.931
5	I understand the role of spiritual healers in pandemics.	.931
6	I am aware of precautionary measures (e.g. washing hands, using sanitizer, wearing mask, social distancing, avoiding public gatherings and traveling, covering mouth while sneezing, and self-quarantine).	.930
7	I am aware of the death rate due to Covid-19 pandemic.	.930
8	I know where to find credible information about of Covid-19 pandemic.	.930
9	I understand when to go for Covid-19 test.	.929
10	I understand the role of alternative medicine healing Covid-19.	.929
11	I know when to go for self-quarantine.	.928
12	I know that when to contact health professionals for treatment.	.927
Infection Prevention and Treatment		.936

External reliability

The external reliability of the Covid-19 Literacy Scale was assessed through test retest. In this strategy, the reliability is estimated through calculations of the correlation between two sets of scores obtained by administering the measure on two occasions (Anwar, Al-Qallaf, Al-Kandari, & Al-Ansari, 2012). Thus, the instrument was administered twice in the same group students with a gap of two weeks. The completed questionnaires in two sessions was compared through their ID numbers, resulted in 30 matching cases. The Covid-19 literacy scores for the two sets of 30 students were calculated. The results indicated the correlation between the test and re-test Covid-19 literacy scores as it ranged from 0.71 to 0.87 which was acceptable and found to be satisfactory (Ghanbari, Ramezankhani, Montazeri & Mehrabi, 2016)

Conclusions

This research developed and validated a scale with desirable psychometric properties having potential to measure Covid-19 related health literacy. The development and validation of this scale was completed in two phases. In the first phase, items related Covid-19 health literacy were generated based on an extensive and careful review of the related literature and public service messages in different advisory platforms resulting 27 potential items. Afterwards, these statements were submitted to a panel of experts for content and face validity. Based on the advice received

from expert panel, 23 items were finalized and pilot tested with 41 students. While in the second phase, a cross-sectional survey was conducted using students of three universities using online questionnaire for construct validity and reliability. A total of 369 received questionnaires were imported in SPSS for exploratory factor analysis. Prior to exploratory factor analysis, the sampling adequacy was assessed using Kaiser-Meyer-Olkin (KMO) statistics whereas the presence of correlation among items was determined with Bartlett's test of sphericity that confirmed the suitability of this data set for performing factor analysis. The results of principal component analysis using varimax rotation yielded two dimensions, namely, 'infection spread and symptoms' (11 items, CA= .957) and 'infection prevention and treatment' (12 items, CA=.936). Each statement had loading strengths greater than .56 and the model explained 66.6% of the total variance. The values of internal consistency coefficients for overall scale (CA = .970) as well as for both sub-dimensions and the correlation coefficients for external consistency (test retest) ranged from 0.71 to .87 were satisfactory. The newly developed Covid-19 Literacy Scale (CLS) had satisfactory content, face, and construct validity along with high internal and external consistency. Hence, it can be concluded that CLS is a valid and reliable measure for Covid-19 literacy assessment.

The utilization of a suitable instrument for assessing the Covid-19 literacy in different social groups from varied geographical locales may help health policy makers and health care providers for health education, communication and promotion in society. The CLS has a potential to be a useful tool to assess Covid-19 literacy that could be utilized in future investigations to determine Covid-19 literacy in students of other universities at different countries. This research initiated the first step for measurement of Covid-19 literacy. The CLS needed to be evaluated for its psychometric properties such as validity and reliability in other socio-cultural, educational, geographical settings to decide whether or not it is a valid and reliable measure on time and space scale. In addition, future inquiries should examine the nature of the relationship with different personal, socio-academic, and psychological variables. This research would make a worthwhile contribution to health literacy in general and Covid-19 literacy in particular as no such scale was available in the existing literature. In limitations, the CLS can be used only be used for self-perceived assessment rather than actual assessment of Covid-19 literacy. The findings and implications drawn in this research should not be readily generalized to other groups of population as this study collected data in one go from students of social science and business science from only three universities in the province of Punjab, Pakistan. Furthermore, there may be sampling bias as the sample was not randomly drawn and students filled this questionnaire in online environment. More in-depth investigations needed to conducted for evaluation of clinical outcomes associated with Covid-19 literacy.

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