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Psychometric properties of the social determinants of health questionnaire (SDH-Q): development and validation

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Abstract

Background The influence of social determinants of health (SDH) on sustainable development goals (SDG) has gained attention in recent years. However, there is a scarcity in the availability of valid and reliable instruments to assess the multiple aspects of SDH. Hence, this study was conducted to develop a brief self-reported measure for assessing SDH.

Method A cross-sectional survey was conducted among university undergraduate students in Nigeria. The study consisted of 300 participants in the EFA (males 55.7%, females 44.3%) and 430 participants in the CFA (males 54.0%, females 46.0%). Participants were selected using a convenience sampling approach to assess their perceptions regarding SDH. Content Validity Index (CVI), Face Validity Index (FVI), Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), Composite Reliability (CR), Average Variance Extracted (AVE), Cronbach's alpha, and Intraclass Correlation Coefficient (ICC) were computed to determine the psychometric properties of the newly developed SDH scale.

Results In the EFA, two factors were extracted (structural determinants of SDH and intermediary determinants of SDH), with all 20 items retained. The total variance explained by the EFA model was 61.8%, and the factor correlation was 0.178. The Cronbach's alpha values of the two factors were 0.917 and 0.939. In the CFA, the initial model did not fit the data well based on fit indices. After several re-specification of the model, the final re-specified measurement model demonstrated adequate fit factor structure of the SDH scale with two factors and 20 items (CFI = 0.943, TLI = 0.930, SRMR = 0.056, RMSEA = 0.053, RMSEA p-value = 0.220). The CR was 0.797 for structural determinants of SDH and 0.794 for intermediary determinants of SDH. The ICC was 0.938 for structural determinants of SDH and 0.941 for intermediary determinants of SDH.

Conclusion The findings indicate that the SDH scale has adequate psychometric properties and can be used to assess the perceived level of SDH. We recommended that this tool be tested in other populations with diverse age groups and other demographic characteristics.

Keywords Social determinants of health, Questionnaire, Validity, Reliability, Construct

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Background

Health inequities caused by the influence of social determinants of health (SDH) have become critical issues globally that necessitate immediate action to improve the quality of life and well-being for all [1]. SDH was recognized as an essential component for the Sustainable Development Goals (SDG), which are a set of 17 global goals established by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development [2]. SDH has generated a great deal of interest in the field of public health in recent decades [3]. The term "social determinants of health" generates a lot of research studies and documents, most of which have just recently been published [4]. The necessity for a multifaceted approach to the SDH, the rapid introduction of theoretical frameworks and models, and the rise in the volume of research in a very short period of time have led to significant ambiguity surrounding this concept [5].

The term "social determinants of health" has taken on a dual meaning, referring to both the social factors that affect an individual's or population's health as well as the social processes that result in an unequal distribution of these factors among groups with unequal status in society [5–7]. As a result, SDH refers to both the factors that influence health and the factors that influence health inequities [6]. Essentially, this idea involves improving social factors that affect health and distributing them fairly. Therefore, researchers suggested changing the phrase to "social determinants of health and related inequalities" to encompass both the factors influencing health and those influencing health inequalities [4, 8, 9].

The wide and expanding number of societal factors that affect SDH serves as another source of complexity. Initially, researchers frequently reported a small number of factors—such as diet, education, employment, and living conditions—but in peer-reviewed literature and academic textbooks, the list has significantly expanded recently [1, 10, 11]. In fact, the list has become so lengthy that if someone wishes for a comprehensive list of SDH, their enthusiasm may immediately decrease upon learning how extensive it is [4]. Some of the most prominent SDH factors that were common in the previous research include education [12], housing and/or living conditions [13], wealth and its distribution [14], stress, young life, social isolation, career, unemployment, social protection, addiction, food, and transportation [15]. Moreover, recent studies have identified the healthcare system, sexual identity, and gender preference as components of SDH [14, 16, 17].

The World Health Organization Commission on Social Determinants of Health (CSDH) work has played a crucial role in consolidating the SDH framework into two essential components: (1) structural determinants of SDH and (2) intermediary determinants of SDH [18–20]. According to the CSDH [18], the most critical indicators of structural determinants include income, education, occupation, social class, gender, and race or ethnicity. These factors, in conjunction with surrounding circumstances, help establish and reinforce class divisions, determining a person's socioeconomic position within hierarchies of authority, status, and access to resources. Similarly, the key components of intermediary determinants include material conditions, psychological factors, behavioral and/or biological factors, and the health system, all of which influence differences in exposure to and susceptibility to poor health outcomes [18, 20].

The need for available questionnaires to assess and address SDH at the outpatient, inpatient, and community-based levels is becoming increasingly apparent to health care providers in various settings [1, 21]. Most of the available screening tools only look at one aspect of SDH, such as food insecurity and shelter [22], health literacy [23, 24], social support [25], sexual abuse [26], and social support for exercise [27]. Additionally, a recent systematic review by O'Brien [1] reported that four screening tools look at multiple aspects of SDH, including the Income, Housing, Education, Legal Status, Literacy, and Personal Safety (IHELLP) Questionnaire; the Questionnaire Literacy Screen; Well, Child Care, Evaluation, Community Resources, Advocacy, Referral, and Education (We Care); and the Child Poverty Tool and Resource Guide. However, none of these scales account for factors like social support, childhood, access to healthcare, and other resources and take time to complete, which may limit their applicability during many healthcare screenings where a brief summary is usually required [28–30].

A brief self-report measure of SDH called the social determinants of health, the Steps to Better Health Questionnaire (STBH-Q), was recently developed and validated among the Australian adult population [28]. The STBH-Q, which consists of 16 items and five underlying constructs, was created to assess multiple factors that influence SDH at the individual level. These factors include: access (six items); employment, finances, and education (three items); safety at home and in the community (two items); physical and mental health (three items); and family and childhood (two items) [28]. However, the main limitation of their study is the many cross-loadings of the items in the EFA, and some factors had only two items. Therefore, in this study, we aim to develop a new and brief SDH questionnaire (SDH-Q) based on the CSDH framework [18] with two factors: (1) structural determinants of SDH (10 items) and (2) intermediary determinants of SDH (10 items) that can overcome the previous limitations.

Materials and methods

Study design

The current study was a cross-sectional survey, and a total of 730 undergraduate students from the College of Medicine and Allied Medical Sciences at Federal University Dutse, Nigeria (FUD), were recruited using a convenience sampling approach between 3rd April 2023 and 30th June 2023. We started by distributing the Online Google Survey Form link to the students through emails, WhatsApp groups, and Telegrams. The link included a brief introduction to the study and outlined the inclusion criteria. We asked those who agreed to participate and met the inclusion criteria to click on the link and submit their responses. In exploratory or preliminary studies aimed at generating hypotheses or insights, convenience sampling may be considered appropriate, although random sampling is widely recognized as a more rigorous method for participant selection [31, 32]. This method enables researchers to efficiently collect data and lay the groundwork for future investigations [31]. We opted for a convenience sampling approach in participant selection for this study because of its accessibility, simplicity, and potential to establish a solid foundation for generalizability, ensuring that the sample data accurately represent the population from which the sample was drawn [33].

Data collection

The data collection process involved sharing the Online Google Survey Form link with students who met the study's inclusion criteria. Online Google Survey Form are widely preferred for research and survey purposes because of their practical, adaptable, and cost-effective features, effectively reducing response bias [34]. The inclusion criteria for the study included being enrolled in the College of Medicine and Allied Medical Sciences at FUD, undergraduate students ranging from first to final year, being registered students during the data collection period, and expressing consent to participate. Additionally, we specifically targeted participants from the college of medicine and allied medical sciences due to their presumed familiarity and understanding of the concepts and constructs being assessed. Participants possessing a certain level of understanding of a specific scale contribute to the enhancement of the scale's construct validity, ensuring that it accurately measures the intended concepts [35].

Ethical approval

The Human Research Ethics Committee, Ministry of Health, Jigawa State, Nigeria [JGHREC/2023/151], and Universiti Sains Malaysia's Human Research Ethics Committee [USM/JEPeM/22110695], granted ethical approval for the study. The participants were informed about the research aim and methods before signing the informed consent form. The investigation conforms to the principles outlined in the Declaration of Helsinki.

Generation of items

The items were generated based on the conceptual framework of the World Health Organization Commission on Social Determinants of Health (CSDH) principles [18, 20], which we structured into two (2) factors: structural and intermediary determinants of SDH. We solicited input and recommendations from experts in public health, psychometrics, health psychology, and questionnaire validation regarding the generated items. Additionally, an in-depth literature search and interviews were conducted with 12 undergraduate students to gather further information. Initially, the SDH-Q consisted of 20 items, with 10 items assigned to each construct. For the structural determinants of the SDH factor, the responses were evaluated using a five-point Likert scale from 1 (totally unsatisfied) to 5 (totally satisfied), whereas the responses of the intermediary determinants of the SDH factor were evaluated using a five-point Likert scale from 1 (very poor) to 5 (very good).

Content validity, face validity, and pre-testing of the SDH-Q

Following the item generation, we conducted content validity by inviting six experts using the non-face-to-face approach from health psychology, psychometrics, public health, and questionnaire development to rate each item's relevance to its respective factor. The item content validity index (I-CVI) and scale content validity index (S-CVI) were computed to determine the scale content validity based on the recommended guidelines [36–38]. These guidelines recommend having at least six experts for an acceptable CVI of 0.83. The rating of relevance was transformed into either 1 (the item is quite relevant or the item is highly relevant) or 0 (the item is not relevant or the item is somewhat relevant) for each item. The I-CVI was determined by computing the proportion of content experts who rated the items as 1 for relevance. Subsequently, the S-CVI was computed by averaging the I-CVIs for each construct on the SDH-Q. The I-CVI of the SDH scale ranged from 0.83 to 1, and the S-CVIs for the two SDH-Q factors were 0.93 and 0.95. These CVI values therefore satisfied the required cutoff of 0.83 (for six experts) [37].

Furthermore, the clarity and comprehension of the items were assessed using the face validity index (FVI). Ten undergraduate students from the targeted population evaluated each item for clarity and comprehension. The item face validity index (I-FVI) and scale face validity index (S-FVI) were computed to determine the scale face validity based on the recommended guidelines [39, 40]. These guidelines recommend having at least 10 raters for an acceptable FVI of 0.83. All the responses were

received using a Google Form. The rating of relevance was transformed into either 1 (the item is clear and understandable, or the item is very clear and understandable) or 0 (the item is not clear and understandable, or the item is somewhat clear and understandable) for each item. The I-FVI was determined by computing the proportion of participants who assigned a relevance rating of 1 to the items. The S-FVIs were computed by averaging the I-FVIs for each construct on the SDH-Q. The I-FVI of the SDH scale ranged from 0.90 to 1, and the S-FVIs for the two SDH scale factors were 0.98 and 1. These FVI values therefore satisfied the required cutoff of 0.83 (for 10 raters) [40].

Sample size

In exploratory factor analysis (EFA), the recommended minimum sample size ranges from 100 to 250 [41]. Initially, for our study, we set the EFA minimum sample size at 200, and after factoring in a 30% adjustment for missing values, the adjusted sample size became 286. Consequently, we rounded up the sample size to 300 for the EFA, consistent with the recommendation by Tabachnick et al. [42], who advocate for an acceptable sample size of 300 for the EFA. For confirmatory factor analysis (CFA), the recommended minimum sample size for studies with seven or fewer constructs is 300 [43]. In our study, we adhered to this guideline and set the CFA sample size at 300. After incorporating a 30% adjustment for missing values (i.e., 300/(1-0.3)), the final adjusted sample size for CFA was 430. Therefore, the total sample size consisted of 730 undergraduate students, with 300 for the EFA and 430 for the CFA.

Data analysis

The data were pre-screened to check for wrong data entry and missing values, and only the items with complete responses were included in the analysis. The EFA was performed using the Statistical Package for Social Sciences (SPSS) version 27 (IBM, Armonk, NY, USA). The CFA was conducted using Mplus 8 to test the initial hypothesized model. In this study, the Maximum Likelihood Ratio (MLR) Estimator was used during the CFA because of its robustness to non-normal data distributions [44].

The EFA study had a total of 300 participants. The 20 completed items on the SDH scale were tested using principal axis factoring with Promax rotation to extract the main contributing factors. In EFA, researchers applied Promax rotation when they desired a more practical and comprehensible factor structure or expected and had a theoretical rationale for correlated factors [42]. Moreover, Promax rotation facilitates better alignment of the hypothesized model with established theories or expectations [42]. The factors with an eigenvalue greater than one were examined, and those with a factor loading greater than 0.40 were regarded as significantly relevant and were retained for subsequent analysis [43]. If there is a deletion of an item, the EFA model will be re-specified, and the factor loadings will be inspected following each re-specification. A Cronbach's alpha value of 0.60 or higher was regarded as acceptable for each construct's internal consistency [43].

The EFA model was further tested using the CFA with a total of 430 participants. The standardized factor loading of equal to or greater than 0.40 was recommended as a cut-off for acceptable factor loading, and as such, for the current study, it was applied as a criterion to retain or delete an item [44, 45]. According to Hair et al. [46], the acceptable fit indices for a sample size greater than 250 with 12 items and higher were: root mean square error of approximation (RMSEA) less than 0.07; standardized root mean square residual (SRMR) less than 0.08; and comparative fit index (CFI) or Tucker and Lewis index (TLI) greater than 0.92. Model re-specification was performed by referring to the CFA modification index to improve the model fit indices. The models were respecified after considering sufficient theoretical guidance.

To further investigate the convergent validity of the SDH scale, average variance extracted (AVE) and composite reliability (CR) were computed. The acceptable cut-off values were equal to or greater than 0.70 and 0.50 for CR and AVE, respectively [38, 45, 47]. However, convergent validity is still regarded as adequate if the AVE values are less than 0.50 but the CR values are greater than 0.60 [47]. The discriminant validity, or the degree to which a factor differs from another factor, was investigated by examining the correlation between the factors [45]. A correlation coefficient between two factors of 0.85 or less was deemed to have adequate discriminant validity [45]. Also, Fornell and Larcker [48] pointed out that the AVE of the constructs must be greater than the shared variance (i.e., the square of the correlation coefficient) between the factors in order for discriminant validity to be established. Furthermore, a sub-sample of 70 respondents completes the SDH questionnaire twice over the course of a 7-day period to determine test-retest reliability. There was sufficient reliability when the intraclass correlation coefficient (ICC) values were above 0.70 [49].

Results

Table 1 presents the general characteristics of study participants for both the EFA and CFA samples. A total of 730 students completed the study survey (100 response rate) over a period of 3 months. The researchers used the first 300 responses for the EFA and the remaining 430 responses for the CFA. Among the 300 samples used for EFA, 55.7% were males and 44.3% were females, with a

Table 1 General characteristics of the participants in EFA and CFA ($n=730$)

	EFA (300)		CFA (430)	
Variables	Mean (SD)	n (%)	Mean (SD)	n (%)
Age	21.1 (3.00)		22.4 (2.43)	
Frequency of exercise/ week	4.1 (2.25)		3.4 (2.12)	
Duration of exercise (min)	46.2 (37.42)		46.2 (52.01)	
Gender				
Male		167 (55.7)		232 (54.0)
Female		133 (44.3)		198 (46.0)
Ethnicity				
Hausa		212 (70.7)		305 (70.9)
Yoruba		31 (10.3)		45 (10.5)
Igbo		11 (3.7)		6 (1.4)
Others		46 (15.3)		74 (17.2)
Field of study				
Medicine		131 (43.7)		229 (53.4)
Human anatomy		109 (36.3)		118 (27.5)
Human physiology		60 (20.0)		82 (19.1)
Study year				
Year 1		131 (43.7)		16 (3.7)
Year 2		51 (17.0)		14 (3.3)
Year 3		5 (1.7)		301 (70.0)
Year 4		113 (37.7)		99 (23.0)

Note: EFA=exploratory factor analysis; CFA=confirmatory factor analysis; SD=standard deviation; n=number; min=minutes

mean age of 21.1 years (SD=3.00). The mean frequency and duration of exercise per week were 4.1 (SD=2.25) and 46.2 (SD=37.42), respectively. The majority of the students were Hausa (70.7%) and studying Medicine (43.7%). Furthermore, most of the students were in Year 1 (43.7%). Whereas, Among the 430 samples used for CFA, 54.0% were males and 46.0% were females, with a mean age of 22.4 years (SD=2.43). The mean frequency and duration of exercise per week were 3.4 (SD=2.12) and 46.2 (SD=52.01), respectively. The majority of the students were Hausa (70.9%) and studying Medicine (53.4%). Furthermore, most of the students were in Year 3 (70.0%).

EFA results of the SDH-Q

The initial EFA model of the SDH with 20 items yielded good sampling adequacy with an estimated Kaiser-Meyer-Olkin (KMO) value of 0.899, and the Bartlett's test of sphericity was significant ($p<0.001$). Thus, the model is considered to have adequate validity. Three factors in the initial EFA model had eigenvalues greater than 1, but only two of the factors loaded well with all the items (Fig. 1). Hence, the number of factors was set at two in the subsequent stage, which conforms with the SDH-Q proposed structure. Using principal axis factoring with Promax rotation, two factors were extracted. The findings indicate that the two factors had factor loadings greater than 0.40 with no cross-loadings, a factor correlation of 0.178, and a cumulative percentage of 61.8%. As such,

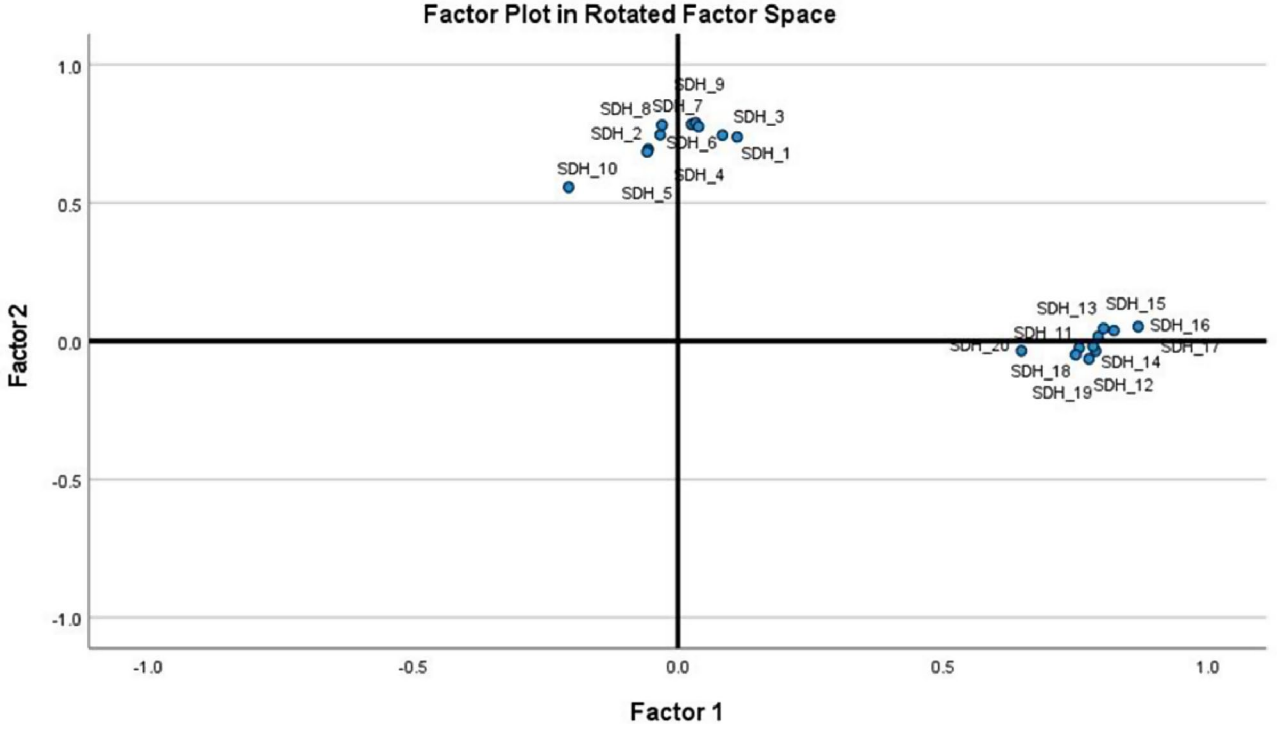

Fig. 1 Factor loading plot of exploratory factor analysis (EFA)

Table 2 Items descriptive statistics, exploratory factor analysis, and reliability analysis ($n=300$)

Item content	Mean	SD	Factor loading	
			1	2
How satisfied are you with your gender?	4.29	1.12	0.738	
In terms of all the opportunities in your community, how would you evaluate gender equality?	3.48	1.16	0.694	
How satisfied are you with your ethnic background?	4.20	1.14	0.745	
In terms of all the opportunities in your community, how would you evaluate ethnic equality?	3.50	1.18	0.746	
How satisfied are you with your present financial income?	3.24	1.29	0.684	
How do you rate your financial opportunities in the future?	3.87	1.10	0.784	
How satisfied are you with your present education?	3.74	1.09	0.789	
How do you rate your employment opportunity in the future?	3.61	1.13	0.781	
How satisfied are you with your present standard of living?	3.64	1.14	0.776	
How do you rate the government's effort towards improving your standard of living?	2.60	1.23	0.557	
How do you rate the state of your current housing or accommodations?	3.41	1.23		0.757
How do you rate the availability of healthy food or safe water in your neighbourhood?	3.29	1.18		0.789
How do you rate the support you received from your family members?	4.00	1.27		0.793
How do you rate the support you received from your friends?	3.56	1.20		0.784
How do you rate the state of your mental health?	3.92	1.24		0.803
How do you rate the state of your physical health?	3.89	1.22		0.869
How would you rate your good lifestyle habits, such as healthy eating?	3.63	1.19		0.823
How do you rate the quality of the health system services in your community?	3.13	1.08		0.751
How do you rate your access to health services when needed?	3.19	1.10		0.776
How do you rate the affordability of health services in your community?	3.03	1.11		0.757
Eigenvalue			7.20	5.16
Variance explained (%)			36.00	25.80
Cumulative variance (%)			36.00	61.80
Cronbach's alpha			0.917	0.939

SD = standard deviation; Factor correlation = 0.178, item-total correlation = 0.511–0.756 (structural SDH) and 0.627–0.837 (intermediary SDH)

Table 3 Summary for SDH model fit indices ($n=430$)

Path model	RMSEA (90% CI)	CFI	TLI	SRMR	RMSEA *p*-value
Model-1	0.114 (0.108, 0.121)	0.715	0.680	0.083	< 0.001
Model-2	0.053 (0.046, 0.061)	0.943	0.930	0.056	0.220

Notes: RMSEA = Root Mean Square Error of Approximation, CI = Confidence Interval, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, SRMR = Standardised Root Mean square Residual, Model-2 with 15 correlated items residual: SDH16 with SDH15; SDH20 with SDH19; SDH3 with SDH1; SDH14 with SDH13; SDH8 with SDH6; SDH4 with SDH2; SDH19 with SDH18; SDH20 with SDH18; SDH8 with SDH7; SDH17 with SDH15; SDH17 with SDH16; SDH10 with SDH5; SDH6 with SDH1; SDH10 with SDH3; SDH9 with SDH5

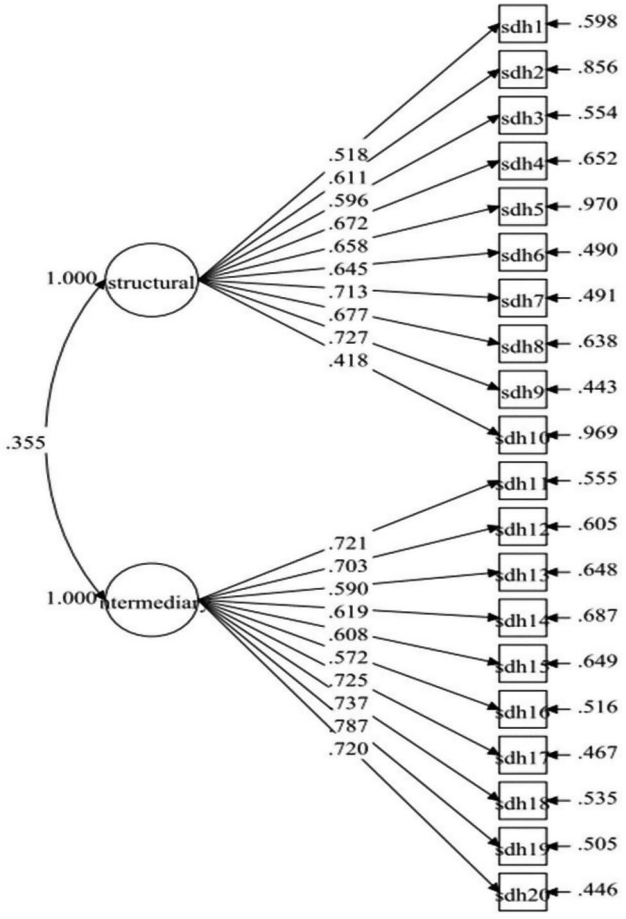

Fig. 2 SDH measurement (Model-1)

none of the items were deleted from the EFA (Table 2). The factor loading plot is shown in Fig. 1.

CFA results of the SDH-Q

We further tested the EFA measurement model using CFA with an independent sample of 430 students, comprising 20 items and two factors: structural determinants of SDH (10 items) and intermediary determinants of SDH (10 items). The results of the initial specified measurement model (Model-1) show poor fit indices (Table 3). However, all the items had a standardized factor loading greater than 0.40 (Fig. 2). The model fit indices were

improved after adding 15 pairs of error covariances between items within the same factor (Fig. 3). The fit indices of the respecified model (Model-2) were acceptable (Table 3), with all the items retained. The result of the final model (Model-2) showed standardized factor loading ranging from 0.435 to 0.780, which was considered moderate to very good (Fig. 3).

Composite reliability (CR), average variance extracted (AVE), and discriminant validity

The CR was 0.797 for structural determinants of SDH and 0.794 for intermediary determinants of SDH. The AVE was 0.356 and 0.404 for structural determinants of SDH and intermediary determinants of SDH, respectively. Even though the AVE values were below the recommended cut-off of 0.50, all the CR values were above 0.60, so it was concluded that the SDH scale had sufficient convergent validity [47]. The correlation coefficient between the two factors is 0.149. Furthermore, the squared of the correlation coefficient between the two factors (0.022) is lower than all the AVE values. This indicates sufficient discriminant validity [48]. The final SDH model's CR and AVE values, correlation coefficients, and square of the correlation coefficient are shown in Table 4.

Test-retest reliability

A total of 70 participants completed the SDH scale twice within the interval of 7 days. For the structural determinants of SDH, the mean score decreased from 38.8 (SD=4.77) at day 1 to 37.4 (SD=5.53) at day 7, with an ICC value of 0.938 (95% CI: 0.901, 0.961, p-value<0.001). For the intermediary determinants of SDH, the mean score decreased from 37.5 (SD=5.37) at day 1 to 37.2 (SD=4.37) at day 7, with an ICC value of 0.941 (95% CI: 0.907, 0.963, p-value<0.001).

The SDH questionnaire development process is presented in Fig. 4.

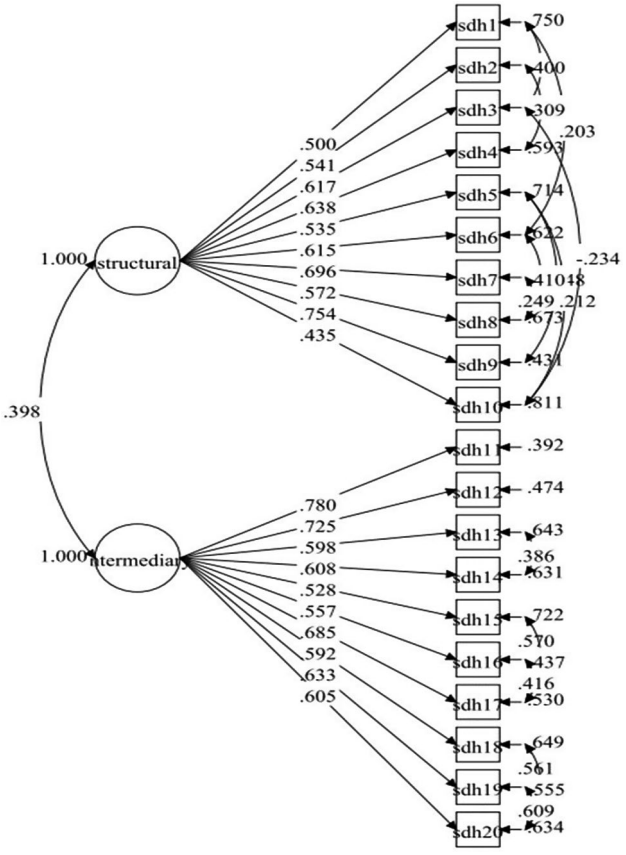

Fig. 3 SDH measurement (Model-2)

Table 4 Composite reliability (CR), average variance extraction (AVE), factor correlation and squared correlation for SDH final model

Construct	CR (95% CI)	AVE	1	2	r^2
Structural	0.797 (0.754, 0.840)	0.356	1	0.149	0.022
Intermediary	0.794 (0.750, 0.839)	0.404		1	

Discussion

According to the WHO Commission on Social Determinants of Health (CSDH), we developed a brief measure to evaluate the perceived level of SDH among university undergraduate students. SDH are referred to as social factors that affect an individual's or population's health as well as the social processes that lead to an unequal distribution of these factors among groups with unequal status in society [5, 6, 10]. These factors include income, education, occupation, social class, gender, race, or ethnicity, material circumstances, psychological circumstances, behavioral, and/or biological factors, both of which were categorized as structural determinants of health and intermediary determinants of health [21]. Therefore, the items were developed to evaluate the individual's perceived satisfaction with these factors and the equal opportunities they provide.

The SDH-Q contained 20 items measuring two underlying constructs, namely, the structural determinants of the SDH (10 items) and the intermediary determinants of the SDH (10 items). The items under SDH structural determinants assess a range of factors that create or reinforce social stratification in society and define individuals' socioeconomic position using a Likert option ranging from 1 (totally unsatisfied) to 5 (totally satisfied). These factors are typically determined by government policies or inheritance [22]. The intermediary determinants of SDH evaluate various factors associated with psychosocial conditions, the individual's environment, and the health care system, employing a Likert scale from 1 (extremely poor) to 5 (excellent). These intermediary determinants of SDH are also referred to as

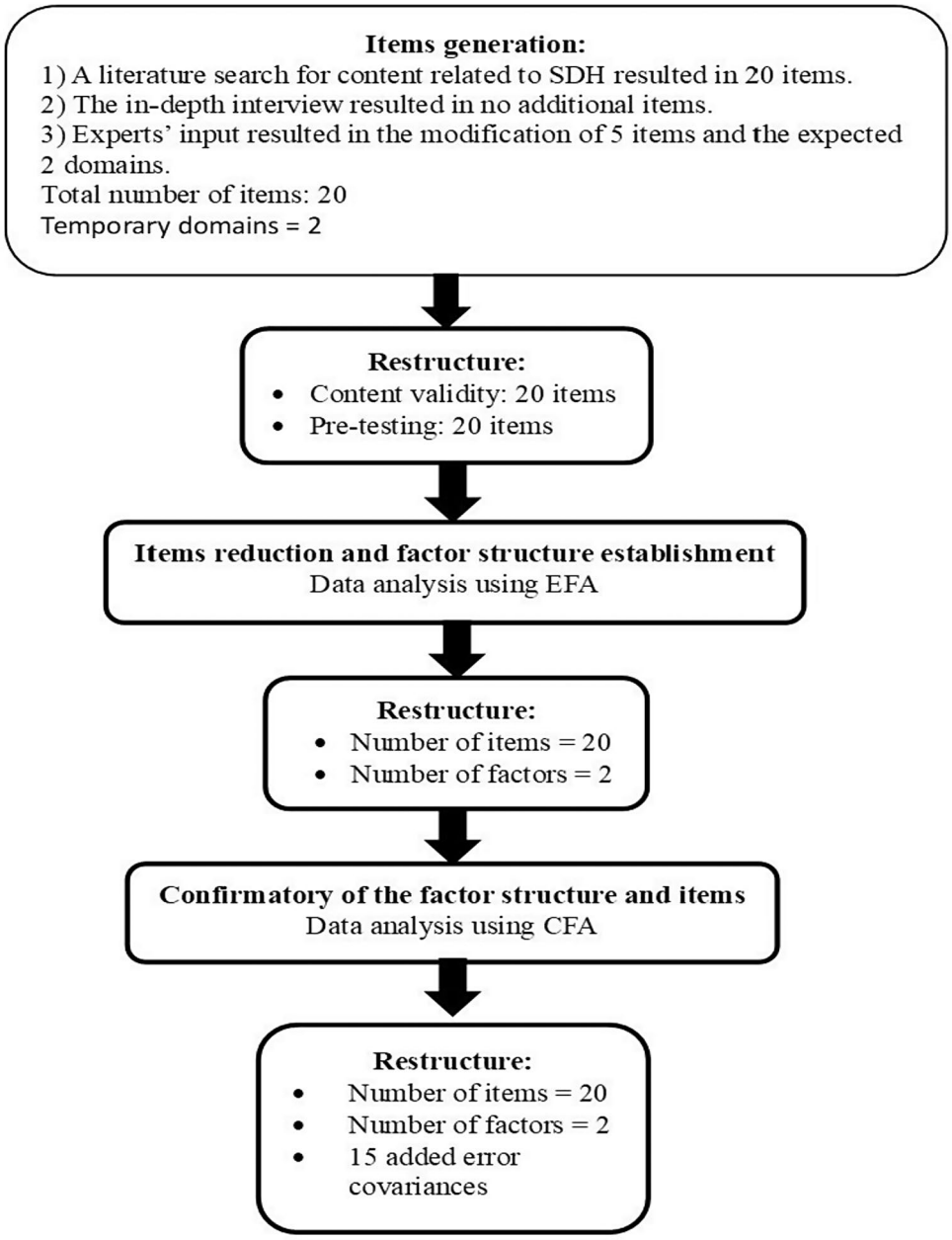

Fig. 4 Summary of questionnaire development process

individual-level mediators of health inequities that shape health outcomes [22].

The content validity results show that the I-CVI of all 20 items ranged from 0.83 to 1, and the S-CVIs were 0.93 and 0.95. For face validity, the results reveal that the I-FVI values ranged from 0.90 to 1, and the S-FVIs were 0.90 and 1. These results indicate acceptable content validity and face validity [36–38]. Subsequently, the SDH scale was tested for EFA and CFA among two independent samples of undergraduate students, who were mostly adolescents. The relationship between health and health behaviors from adolescence to adulthood is significant; therefore, how these social determinants impact adolescent health is critical for both the general population's health and the growth of nations' economies [50]. Additionally, the transition from adolescence to adulthood affects how people develop in terms of their health and quality of life. Both social and economic factors within nations influence these changes, leading to inequalities [50].

A total of 730 students participated in the study, divided into two independent samples, with 300 used for EFA and 430 for CFA. The EFA sample includes a higher proportion of first-year students (43.7%), while the CFA

sample has a higher proportion of third-year students. However, since the distribution of other characteristics (e.g., mean age, gender, ethnicity, and field of study) is relatively consistent between the two samples, they are considered homogenous. In addition, using undergraduate students as a sample has limitations, such as potential biases and limited generalizability, but their convenience, availability, homogeneity, and familiarity with academic settings and research procedures make them more likely to adhere to study protocols [51, 52]. Consequently, undergraduate students remain a valuable sample for exploring research questions or testing hypotheses [52].

In the EFA, two factors were extracted, comprising 20 items. All the items loaded satisfactorily on their respective constructs, with factor loading above 0.40 and no cross-loading. In a previous study [28], the EFA extracted the SDH with five underlying constructs comprising 16 items. The constructs were: Access; Employment, Finances and Education; Family and Childhood; Physical and Mental Health; and Safety at home and in the community. However, there was cross-loading of items throughout their EFA process [28]. We believe that this might happen because of the similarities between the constructs. Therefore, the current study resolves these issues by creating a similar scale with two constructs, namely, structural determinants of health and intermediary determinants of health, which is in line with the WHO's CSDH work [18]. Furthermore, Patton et al. [50] emphasized that, while safe and supportive relationships with families, schools, and peers are critical to assisting young people in developing to their full potential, structural factors such as national wealth, financial inequality, and access to education are the strongest determinants of health worldwide.

The CFA results confirmed the final 20-item, 2-factor model of the new SDH scale, with all the items retained. The final model showed adequate fit indices, and all the items had acceptable factor loading on their respective constructs. Also, the two constructs had acceptable internal consistency, composite reliability, and discriminant validity. These demonstrate that the SDH scale has adequate psychometric properties and can be applied to assess individuals perceived social determinants of health [45, 47, 48, 53]. In addition, 15 pairs of error covariances were added between items within the same construct (8 for structural determinants of health and 7 for intermediary determinants of health). These residual covariances were added based on the MI values reported in Mplus output after taking into account sufficient theoretical backing. When residual covariances have important meaning in social psychological studies, they can be included in the model [54].

There are some limitations related to this study. Firstly, since the survey was conducted solely at one university, inferences regarding the study findings should be made with caution. However, the large sample size may give the study's conclusions and results greater weight. Second, using a self-reported survey may lead to response bias and lower the accuracy of the information obtained. We assured all participants that their information would remain private, urged them to answer all questions accurately based on their real perceptions, and advised them not to discuss the results with their friends. We also used a convenience sample approach to recruit study participants, potentially explaining the differences in sociodemographic variables between the EFA and CFA samples.

Conclusions

The objective of this study was to create a novel self-report tool for evaluating perceived social determinants of health (SDH-Q). This was achieved through a thorough examination of existing literature, along with assessments of content validity and face validity. Subsequently, the measure's construct validity and stability were evaluated among a sample of undergraduate students in Nigeria. The final results provide psychometric evidence of the underlying structure, consisting of structural determinants of SDH and intermediary determinants of SDH. We recommend that future research replicate this study and assess the psychometric properties of the SDH-Q in diverse populations with varying sociodemographic characteristics. This would enable researchers and healthcare professionals to assess individuals' SDH, facilitate the provision of accessible social support services, and inform service development efforts.

Abbreviations

FUD	Federal University Dutse
SDH	Social determinants of health
CSDH	Commission on social determinants of health, EFA: Exploratory factor analysis
CFA	Confirmatory factor analysis
CVI	Content validity index
FVI	Face validity index
KMO	Kaiser-Meyer-Olkin
CR	Composite reliability
AVE	Average variance extracted
ICC	Intraclass correlation coefficient

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-024-19990-w.

Supplementary Material 1

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Author contributions

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San Kuay, and Yee Cheng Kueh.Visualization: Abdulwali Sabo, Garry Kuan, Sarimah Abdullah, Hue San Kuay, Mohammed Dauda Goni, and Yee Cheng KuehWriting: original draft: Abdulwali Sabo.Writing, review, and editing: Abdulwali Sabo, Garry Kuan, Sarimah Abdullah, Hue San Kuay, Mohammed Dauda Goni, and Yee Cheng Kueh.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The Human Research Ethics Committee, Ministry of Health, Jigawa State, Nigeria [JGHREC/2023/151], and Universiti Sains Malaysia's Human Research Ethics Committee [USM/JEPeM/22110695], granted ethical approval for the study. The participants were informed about the research aim and methods before signing the informed consent form. The investigation conforms to the principles outlined in the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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