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Development and validation of the Social Capital Assessment Tool for Maternal health in Low and middle-income countries (LSCAT-MH)

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health in Low and middle-income countries (LSCAT-MH)

Authors

Agampodi T. C., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

Lanka, Saliyapura,Sri Lanka. Email: thilinichanchala@yahoo.com

Agampodi S.B., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

Lanka, Saliyapura, Sri Lanka.Email: sunethagampodi@yahoo.com,

Glozier N., Brain and Mind Research Institute & Discipline of Psychiatry, Sydney

Medical   School, The University of Sydney, Australia.

Email: nick.glozier@sydney.edu.au

Lelwala T. A., Department of Community Medicine, Faculty of Medicine and Allied

Sciences, Rajarata University of Sri Lanka, saliyapura, Sri Lanka.

Email: tishi880@gmail.com

Sirisena K. D. P. S., Department of Community Medicine, Faculty of Medicine and

Allied Sciences, Rajarata University of Sri Lanka, Saliyapura, Sri Lanka.

Email: pushsirisena@gmail.com

Siribaddana S., Department of Medicine, Faculty of Medicine and Allied Sciences,

Rajarata University of Sri Lanka, Email: sisira.siribaddana@gmail.com

Corresponding author:

Agampodi T. C., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

Lanka, Saliyapura,Sri Lanka.

Postal address: Department of Community Medicine, Faculty of Medicine and Allied

Sciences, Saliyapura, Sri Lanka. 50008

Email: thilinichanchala@yahoo.com

Abstract

Objective

Maternal social capital is rarely assessed in relation to health in low and middle-income countries (LIMC). A main reason could be the unavailability of a specific tool. The objective of this study was to develop and validate an instrument to measure social capital among pregnant women.

Setting

The study was conducted in eight different communities resembling urban, rural, resettled, poverty affected, conflict affected, ancestral and Moor ethnic community in the largest district of Sri Lanka.

Participants

Pregnant women (n=41) and key informants (a primary health care worker and a senior community dweller from each community) (n=16), participated in the qualitative component. Construct validity was tested in a sample of 439 pregnant women. Fifty pregnant women participated in test retest reliability check.

Intervention

We developed the tool based on World Bank Social Capital Assessment Tool and its adaptations identified as applicable to LMIC from a previous systematic review and using the findings of an extensive qualitative study. COnsenses-based Standards for the selection of health Measurement INstruments (COSMIN) approach was used. Cognitive validation was performed and construct validity was assessed using the Edinburgh Postpartum Depression Scale (EPDS) for hypothesis testing. Test retest reliability was assessed in a sub sample of 50 pregnant women.

Results

The 24-item Social Capital Assessment Tool for Maternal Health (LSCAT-MH) demonstrated high internal consistency (Cronbach's alpha; 0.94). Factor analytic methods suggested a 4 factor model of (i) neighborhood networks (structural bonding), (ii) domestic and neighborhood cohesion (cognitive bonding), (iii) social contribution and (iv) social participation (structural bridging). Construct validity with antenatal depression and anxiety was confirmed through a negative correlation with the EPDS. Test retest reliability was high with intra class correlation of 0.71 and a Pearson correlation of 0.83.

Conclusion

The LSCAT-MH is a psychometrically valid and reliable tool to measure social capital in pregnancy.

Key words: Social capital, maternal health, pregnancy, measurement, antenatal depression

Strengths and limitations of the study

- The Social Capital Assessment Tool for Maternal Health of Low and middle income countries (LSCAT-MH) is the first tool to assess social capital related to health in pregnancy.

- LSCAT-MH demonstrated high construct validity, internal consistency and reliability.

- The four-factor model in LSCAT-MH represents neighborhood networks (structural bonding), domestic and neighborhood cohesion (cognitive bonding), social contribution and social participation (structural

bridging) as social capital constructs of social capital
in pregnancy.

- Social capital in pregnancy exerted a significant week
  negative correlation to depression and anxiety during
  pregnancy.

- Predictive validity of LSCAT-MH should further be tested using prospective studies.

Summary box

What is already known on this subject?

Social capital is a major social determinant of health studied mostly in high-income

countries. Deficiencies exist in development and validation of social capital tools.

Social capital is yet to be incorporated into the global maternal health agenda and is

timely in relation to recent "obstetric transition".

Although association of social capital is mentioned with self rated health, mental

health and health behaviours in pregnancy, there is no specific instrument developed

to measure maternal social capital in low and middle-income countries.

What does this study add?

The study produce the first systematically developed tool to measure social capital

related to maternal health in low and middle-income countries (the LSCAT-MH).

Validity and reliability of the tool is satisfactory according to relevant standards.

Social capital in pregnancy in Sri Lanka as measured by LSCAT-MH is able to

discriminate between different communities and exert a negative correlation with

antenatal depression and anxiety.

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Introduction

The global maternal health agenda currently focuses on "obstetric transition", where countries gradually shift from, high to low maternal mortality and fertility and from direct causes to indirect causes of maternal deaths.[1] This phenomenon directs international community to view "social development" as an important aspect in elimination of preventable causes of maternal deaths.[2,3] The observation on social development is yet to be incorporated in to the global movement of maternal health.

Social capital, a major social determinant of health is scarcely used in relation to maternal health specially in LMICs.[4] Social capital is defined as "features of social organization, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions".[5] It has two major dimensions. Cognitive social capital refers to norms, beliefs and values that determine mutual benefit.[6] Structural social capital refers to externally observable relationships among people.[7] A more recent approach expresses these same dimensions in three distinct forms; "bonding", "bridging"(horizontal) and "linking"(vertical) social capital.[8] Few available studies on social capital and maternal health show that high social capital during pregnancy is associated with higher levels of self rated health,[9] lower levels of postpartum psychosis,[10] and health related behaviors .[11] However, methods used to assess maternal social capital in these studies ignored the fact that the social capital in pregnancy could be unique.

To overcome this challenge, specific tools are required to assess social capital in pregnancy. Numerous approaches have been used to measure social capital though there is no gold standard measure.[12] Our recent systematic review on methods of measurement of social capital in LMICs indicate that only half of the studies used a

specific tool and very few culturally adapt and validate them.[13] As described by the Commission for Social Determinants of Health (CSDH), "measuring the problem and assessing the impact of action",[14] is integral to incorporate social development as a strategy to reduce maternal mortality.

The present study aims on development and validation of a tool to measure social capital in relation to maternal health. The study was carried out in Sri Lanka, as a model LMIC in which the pioneer maternal health changes are being carried out historically.

Methods

LSCAT-MH was developed in three main phases (Figure 1). The systematic review to identify the best tools available for LMICs,[13] and a qualitative study among pregnant women and key informants to identify the socio-cultural context of social capital,[15,16] are already published[13,15,16] and briefly described below. This paper presents the contextual adaptation and psychometric evaluation.

Prerequisites for tool development

Systematic review

A systematic review conducted on methods of measurement of social capital and health identified the Adapted Social Capital Assessment Tool (A-SCAT) (Harpham et al 2004) ,[12] as one of the most suitable to use in health surveys. *This tool* [17] is adapted from the Social Capital Assessment Tool (SCAT) developed by the World Bank.[18]

Qualitative exploration of social capital in pregnancy

In order to assess the context and composition of social capital in pregnancy, we explored social capital in pregnancy using several qualitative techniques including diaries written by pregnant women (n=41), diary interviews and in-depth interviews with primary health care officers and senior community dwellers (n=16).[15] Ten cognitive and five structural constructs of social capital relevant to pregnancy were identified. Domestic and neighborhood cohesion were strong social constructs during pregnancy. Social contribution was identified as a novel construct. This study revealed that current tools available did not contain the relevant constructs to capture the unique dimensions of social capital in pregnancy and led to this study.

Development of LSCAT-MH

We used the methods proposed by Sumathipala and Murray[19] for translation and cross cultural validation of the English version of A-SCAT to Sinhala language, the vernacular in Sri Lanka. The main social capital constructs and descriptors of pregnant women identified by the qualitative study[16] were used to develop LSCAT-MH. This process included three steps;

1. Making the tool applicable for pregnant women rather than the general public.

2. Adapting it to different social contexts and

3. Changing the item stems to measure individual rather than community social capital.

In this procedure, we developed new items (domestic cohesion; social contribution), omitted few (general collective action; socializing, perceived influence; degree of citizenship) and changed the descriptors and item stems based on the qualitative study.

Validation of LSCAT- MH

We conducted both cognitive and psychometric validation based on standard guidelines for tool development[20] including the COnsenses-based Standards for the selection of health Measurement INstruments (COSMIN) checklist.[21]

Cognitive Validation

The intended referential and connotative meanings of items in the A-SCAT were obtained by personally contacting the developers of original A-SCAT and SASCAT (Trudy Hapham and Mary De Silva). These original meanings were refined using the results of the qualitative study and were re-written with the agreement of the local investigators. A selected list of criteria was used in expanded interviews and expert evaluation to judge the appropriateness of the survey questions.[22]

Expanded interviews with the target group (pregnant women)

We divided the questionnaire into 4-5 items. In the first step the original question was delivered to the participant to get the answer. In the second step, each participant was asked for the perceived meaning of each question. The participants were also asked to explain their thought process as to how they came up with their answer. The perceived ideation was compared with the original intended meanings. Respondent validation was used to confirm whether the respondents perceived the intended meaning or the question depicted a different meaning to them. In the third step the respondents were interviewed on the quality and acceptability of the questionnaire.

Expert evaluation

A panel of experts for reviewed the culturally adapted version of the study tool. The panel included a native language expert, a social scientist, a methodological expert, a

subject expert (community physician) on maternal health, a Public Health Nursing Sister (PHNS) and a Public Health Midwife (PHM). Written comments for each item were collected. The experts were informed of the intended tasks (Table 1).

Table 1: Intended task and experts involved in content analysis

Intended task	Expert/resource person
Assess whether all items refer to relevant aspects of the construct to be measured?	Social scientist, subject expert
Assess whether all items are relevant for the study population?	Social scientist, Public Health Nursing Sister (PHNS), Public health Midwife (PHM)
Assessment of whether all items are relevant for the purpose of the measurement instrument?	Subject expert, Methodological expert
Assess whether all items together comprehensively reflect the construct to be measured?	Subject expert, Methodological expert
Assess the methodology of the study	Methodological expert

Data obtained by cognitive validation procedure were reviewed question-by-question basis and modifications were made.

Assessment of construct validity

Exploratory Factor Analysis (EFA) using maximum likelihood method was conducted to assess the structural validity of the study tool.[5] Association of social capital to mental health of pregnant women was tested as the hypothesis. Item Response Theory (IRT) was not conducted, as the concept did not fulfill the basic assumptions.[20]

Study setting, participants and sample

A descriptive cross sectional study was conducted in Anuradhapura district (the largest district) in Sri Lanka. Total population of Anuradhapura is 886,945. In this district more than 19,000 pregnant mothers are registered annually for antenatal care.[23] Demographic and Health Survey (DHS) data shows that antenatal care coverage through public health system is 100% and 90% of females in the district has at least entered secondary level education.[24] We purposefully selected three Medical Officer of Health (MOH) areas from the whole district representing urban-semi urban (Nuwaragam Palatha East-NPE), rural (Nuwaragam Palatha Central-NPC) and resettled (Rajanganaya) populations based on the observed differences in social capital in the qualitative study. During July to October 2016 maternal clinics were assigned for data collection according to the population proportion. Eligible pregnant women participate in the study.

Sample size for structural validity and hypothesis testing

Sample size depends on the communalities and overdetermination of the factors.[25] The Overdetermination (Variable:factor ratio) was taken as minimum 6:1 (30 variables , 5 factors). We decided on a sample size of 500 (with a subject: variable ratio of 15:1 and a non respondent rate of 10%).[26] The sample size for hypothesis testing was calculated to accommodate 10 predictors with a minimum expected

correlation of 0.1 for each predictor variable, with an effect size of 0.1, an alpha error probability of 0.05, and a power of 0.95. The resultant sample size for hypothesis testing was 254. Adding 10% for non-respondents the total sample size required 267 pregnant women.

Data collection

We used a brief questionnaire on socio-demographic and pregnancy related factors, the LSCAT-MH in Sinhala (*interviewer administered*) and the validated Sinhala version of Edinburgh Postpartum Depression Scale (EPDS) (*self-administered*). Trained pre-intern medical officers performed the interview and data collection.

Testing for reliability

Test-retest reliability was performed in a subsample of 50[20] pregnant women in the second trimester. The gap between two data collection points was two weeks.

Patient and public involvement

Patients were not involved in the study. Participants were mainly pregnant women whose perceptions and feedback were obtained to develop the questionnaire in the cognitive validation process. The results will be disseminated to the public at Antenatal Sessions and to health personnel at Public Health Conferences.

Results

Cognitive validation of questions and responses

Participants identified "community" as the "area surrounding their residence". Almost all the items were interpreted with the same intended meaning and the thought process was rational in terms of that was expected. We tested the two types of response scales [20]; likert ("Fully agree, agree, neutral, disagree, fully disagree") with adjectival ("

always, often, sometimes, rarely and never"). Respondents unanimously agreed that adjectival scale is more applicable and the cognition process is easier.

Domestic cohesion

The thought process was very quick and items were relevant. The women whose domestic cohesion seems to be disrupted took additional time to answer and they visualized the situations where it was disrupted while coming into the answer.

Neighborhood cognitive social capital

These included items on sense of belonging, trust and reciprocity, enjoying being with neighbors, perception of love and care and loneliness. Participants who possessed rich bonding and thick trust readily answered the questions. The participants who selected responses 3-4 took a little more time to think about and answer. When probed they told that "some people we can trust, but not all". Most of these participants had minor incidents that they recall which resemble a break in trust with the neighborhood. We observed that participants who had thin trust,[27] despite reporting high cohesion in other neighborhood cognitive constructs, mentioned that they feel lonely.

Social support

The social support items were very clear to the participants.

Neighborhood structural social capital

Although we asked to mention how often do you engage in different types of social connections there was difficulty in interpretation. Therefore we included a statement under these items asking the interviewer to explain.

Social contribution

Items on social contribution were well understood with an example given. We observed that these items had high discrimination between individuals.

Trust in services

Asking about the trust on services did not credible answers except in public health services and the specialist care. When asked about other services most of the participants (mainly from rural communities) selected the response "greatly trust". There were two aspects where we thought this answer was not credible. Pregnant women tend to concentrate on self and the immediate micro-community and they had less interest in interpreting or thinking about other services. Secondly even they intended to think about the services they did not have exposure to what is available elsewhere in order to genuinely evaluate the services that they receive.

Group membership

Pregnant women had less interest in groups. The most common group was the funeral committee. Women were less active in groups within the pregnancy period. Although the question was clear to mothers it did not seem to be a priority during pregnancy.

Expert evaluation confirmed the relevance and comprehensiveness of the tool.

Endorsement ratio

Although we included 40 variables representing social capital only the 30 items with an endorsement ratio between 0.2 - 0.8 were selected for the psychometric validation.[20]

Results of Psychometric validation

Description of the study sample

Of the 472 pregnant women who participated in the study, 439 provided complete data for present analysis. Table 2 indicates the demographic characteristics of the study sample. The mean social capital score for this sample was 92.4 with a SD=8.83 (Figure2). The percentage of missing values was 6.5% for social capital and 8.2% for EPDS and was managed using appropriate pair-wise and lit-wise deletion.

Table 2: Characteristics of the study sample

Characteristic		Count	%
Age	<20 years	24	5.50%
	20-35 years	373	85.00%
	>35 years	42	9.50%
Parity	1	169	37.10%
	2	175	38.50%
	3 or more	111	24.40%
Gestational age	<14 weeks	103	22.20%
	14-28 weeks	180	38.80%
	>28 weeks	181	39.00%
Highest level of education	Upto grade five or less	6	1.30%

	Upto grade 10	113	24.20%
	Passed O/L	184	39.50%
	Passed A/L	129	27.70%
	University education	34	7.30%
Population type	Urban- semi urban	208	45.10%
	Rural	128	27.80%
	Resettled	89	19.30%
	Other	36	7.80%

Construct validity

Structural validity

In factor analysis with maximum likelihood ratio and Oblimin rotation, the Keiser-Meyer-Olkin value was 0.92. Bartlett's Test of sphericity reached statistical significance supporting the factorability of the correlation matrix. Inspection of the scree plot revealed a clear break after the 4th factor (Figure3). Parallel analysis revealed four factors (Table 2), explaining a cumulative variance of 83.5%. These included informal networks in neighborhoods (structural bonding), domestic and neighborhood cohesion (cognitive bonding), social contribution (bonding and bridging) and Social participation (bridging) (Table3). Group membership and trust on health services were not included in factor analysis as they contained only a single item each.

Concurrent Validity

The hypothesis on social capital and mental health was based on previous literature [28,29],[16]. We found a weak negative but significant (p=0.000) correlation (-.269) between social capital and mental health in pregnancy.

Cross-cultural validity

The mean social capital score was shown to be significantly different between the three different contexts with the lowest social capital was reported in the urban-semi urban population of NPE MOH area (mean 90.3, SD+/-9.2). Highest social capital was reported in NPC which represented the general rural community (mean 95.2, SD +/- 7.8). The resettled population at Rajanganaya had a total score of 92.7 with a SD of +/- 8.5.

Table 3:Social capital dimensions extracted in EFA

	Factor			
	1	**2**	**3**	**4**
"There are times when me and my husband" argue and quarrel		-0.409		
"family memebers argue and quarrel"		-0.59		
"People in this neighborhood treat me as their own"		-0.878		
"I feel loved and cared for by my neighbors"		-0.879		
"I enjoy spending time with my neighbors"		-0.878		
"In this neighborhood, we help each other with our needs"		-0.694		
"In general my neighbors are trustworthy		-0.651		
"There is someone who can help me with my household chores"		-0.797		
"In emergency, there is someone who can help me financially"		-0.691		
"There is someone who I can consult information / knowledge.	0.823			
Meeting with friends or relatives in the neighborhood	0.63			
Connecting with friends neighborhood through telephone	0.793			
Participate in cultural events/festivals/trips.				-0.775
Visit the city or the market				-0.955
"People in this neighborhood face a problem, I would join "				-1.042
Work for yourself or someone else for pay			0.978	
Take responsibilities at home			1.002	
Take responsibilities for social activities in the neighborhood			0.847	
Teach young ones			0.88	
Help a poor family			0.995	

Look after other children		*0.706*
"There is someone who can console me when I'm stressed"	*0.696*	

Extraction Method: Maximum Likelihood.

 Rotation Method: Oblimin with Kaiser Normalization.[a]

a. Rotation converged in 10 iterations.

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Reliability

The total scale demonstrated high internal reliability (Cronbach's alpha; 0.94) with each factor's internal reliability ranging from 0.92 -0.94. In test retest reliability the ICC was 0.71 for the total scale (structural bonding 0.73; structural bridging 0.67; social contribution 0.80 and cognitive bonding 0.67).

Discussion

To our knowledge LSCAT-MH is the only tool available to date, specified to measure social capital of women during pregnancy in LIMC. It will facilitate capturing of social determinants that would address improvement of maternal health.

The strength of LSCAT-MH as a tool of measurement of social capital would be high as we adhered to strict and comprehensive procedures in tool development.[20,21] The scale depicts high content validity, structural validity, construct validity, concurrent validity, internal consistency and reliability while it was observed that not all of these properties are mentioned in most of the tools that measure social capital. Importantly the cultural adaptation and the adaptation of the tool for pregnancy was based on in-depth qualitative observations and interviews which is rarely adhered to in development of tools for social capital in literature. LSCAT-MH does not stand alone as "another new tool" which has been a burden to measurement of social capital. It exerts refinement of already developed tools (SCAT, A-SCAT and SA-SCAT) by experts in the field, which is essential in approaching towards a gold standard measure.[30]

The dimensions extracted (Neighborhood networks, domestic and neighborhood cohesion, social contribution and social participation) collate with the accepted dimensions of social capital (Table 2). In addition to distinguishing structural from cognitive social capital, extraction also distinguishes between bonding and bridging (structural) social capital. We think that the four-factor model extracted in LSCAT-MH validation is more robust to other tools as it exerts above different dimensions. Our recent systematic review indicates that social trust, sense of belonging, social cohesion, social support and group membership as the most associated constructs of social capital to health.[13] During the long procedure of its development LSCAT-MH has been able to retain all above constructs within the tool. We retained group membership as a single item for the integrity of the concept and as it had favorable endorsement value.

Social contribution is a relatively novel construct that we included in the tool, which emerged as a separate factor and distributed adequate internal consistency and reliability with the other constructs. It might show similarity to "perceived social responsibility" assessed in few tools.[27] We argue that it is an important aspect of social capital concept as denoted by "mutual benefit"[5] in development of its notion while most tools tend to measure the one-way process ("what people get"). This will also read "maternal social capital" which is unique from general population but consistent with women in all types of communities in the developing world.

Internal consistency of LSCAT-MH (0.92-0.94) was high compared to other social capital tools (0.5-0.86) [13]. Reliability is not reported in any of the SCAT tools. Test

retest reliability is assessed in very few occasions (0.5)[31] in tool development for social capital.

We expected and observed a negative correlation between social capital and mental health in accordance with current evidence.[29] The direction and magnitude of association suggest credibility of the tool.[21]

Although we adhered to standard procedures in tool development there are several limitations. The tool was culturally adapted for semi-urban-rural community in Sri Lanka. Any tool on social capital will need cultural adaptation to the context and the theme under study when used in a different setting. Group membership, trust in other services and trust in different types of health service provision may play a role in communities with higher disparities in services. Any of these can be incorporated to the tool if necessary. Cross-cultural validation was not performed in different countries though the tool was able to discriminate between three different types of communities. Criterion validity was not assessed, as there is no gold standard tool. Responsiveness[21] could not be assessed as social capital does not seem to change over a reasonable time period during pregnancy and as we did not perform a longitudinal study. Due to the same fact we are unable to talk about the predictive validity although one could argue that in hypothesis testing we assess whether social capital during pregnancy could predict the mental health status at the time of data collection.

Availability of a measurement tool for social capital in pregnant women fulfills the prerequisite to "measure and understand" the relationship of social capital to maternal

health and would help in "assessment of its impact".[32] It would enhance future studies on social determinants governing maternal health in both local and global settings and especially in LMICs where 90% of maternal mortality occurs. Longitudinal studies should be carried out to evaluate how social capital could predict and affect health during pregnancy and its outcome.

Conclusion

LSCAT-MH is a valid reliable tool to measure social capital during pregnancy in semi-urban to rural populations of Sri Lanka as a model LMICs. Cultural adaptations are recommended in using different cultural settings in other LMICs.

List of abbreviations

LMICs	Low and Middle Income Countries
A-SCAT	Adapted Social capital Assessment Tool
COSMIN	COnsenses – based Standards for the selection of health Measurement INstruments
EPDS	Edinburgh Postpartum depression Scale
LSCAT-MH	Low and middle income countries Social Capital Assessment Tool for Maternal Health
CSDH	Commission for Social Determinants of Health
SCAT	Social Capital Assessment Tool
SASCAT	Short version of Adapted Social capital Assessment tool
PHNS	Public Health Nursing Sister
PHM	Public Health Midwife

EFA	Exploratory Factor Analysis
IRT	Item Response Theory
DHS	Demographic and Health Survey
MOH	Medical Officer of Health
NPE	Nuwaragam Palatha East
NPC	Nuwaragam Palatha Central

Declarations

Ethics approval and consent to participate

Informed written consent was obtained by all the participants prior to data collection.

Ethical clearance was obtained by the Ethics Review Committee, Faculty of Medicine

and Allied Sciences, Rajarata University of Sri lanka.

Consent for publication

Consent for publication was obtained by all participants prior to the study.

Availability of data and material

The datasets used and/or analysed during the current study are available from the

corresponding author on reasonable request.

Competing interests

We have no competing interests.

Ethical clearance

Ethical clearance was obtained by the Ethics Review Committee, faculty of Mediicne

and Allied Sciences, Rajarata University of Sri Lanka.

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Contributorship statement

TCA, SBA, NG and SS contributed to the conception and design of the study. TAL

and SPDKS and TCA contributed to acquisition, tool validation and analysis of data.

TCA, SBA, SS and NG contributed in interpretation of data and manuscript

preparation. All authors have read and agreed on the final manuscript. All authors

agreed to be accountable for all aspects of work.

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Figure legends

Figure1: Development flow chart of LSCAT-MH

Figure2: Distribution of social capital scores in the study population.

Figure 3: Scree plot of exploratory factor analysis of social capital in pregnancy.

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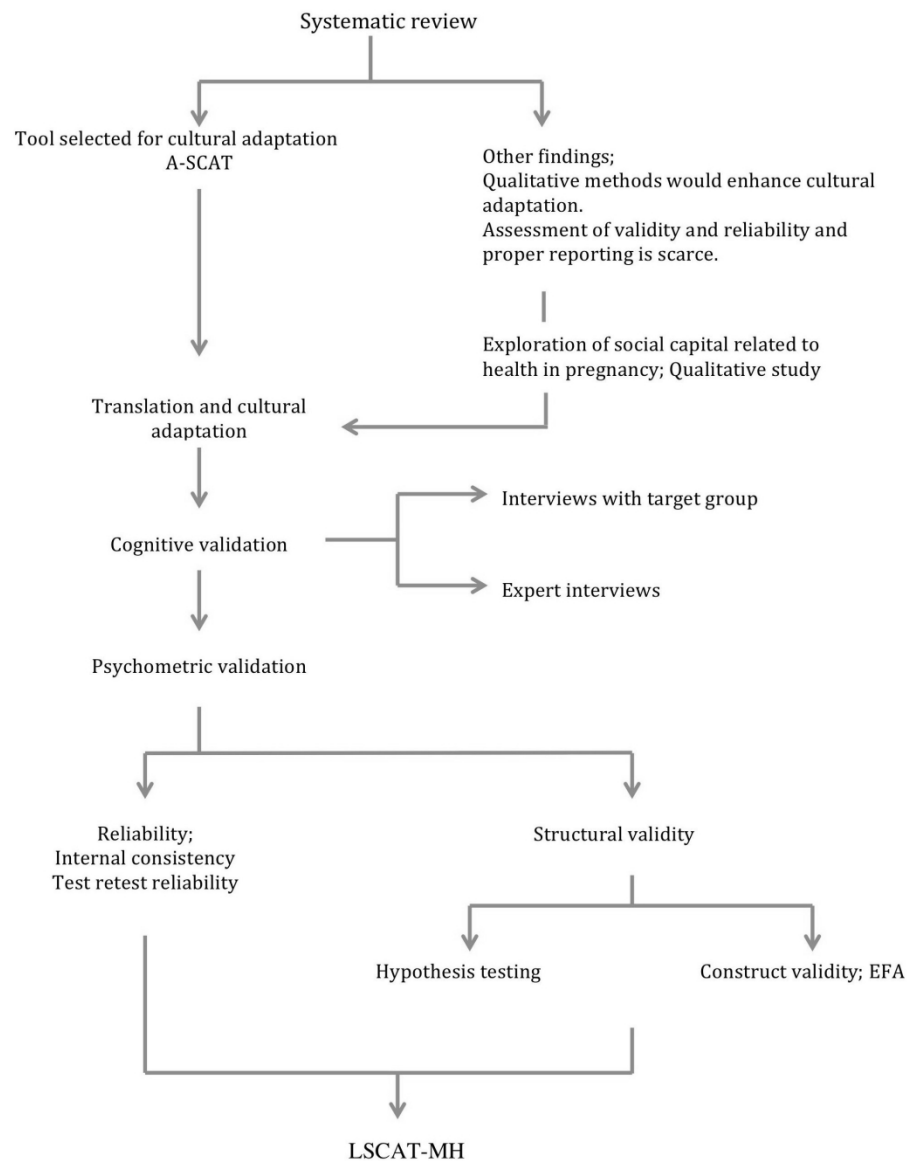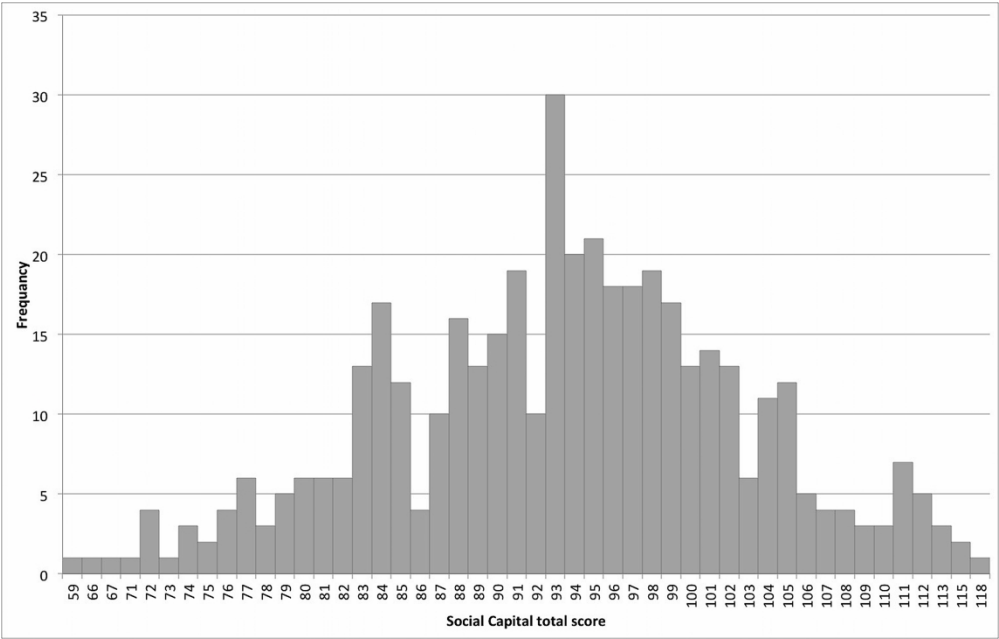41
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Systematic review

Tool selected for cultural adaptation
A-SCAT

Other findings;
Qualitative methods would enhance cultural adaptation.
Assessment of validity and reliability and proper reporting is scarce.

Exploration of social capital related to health in pregnancy; Qualitative study

Translation and cultural adaptation

Cognitive validation

Interviews with target group

Expert interviews

Psychometric validation

Reliability;
Internal consistency
Test retest reliability

Structural validity

Hypothesis testing

Construct validity; EFA

LSCAT-MH

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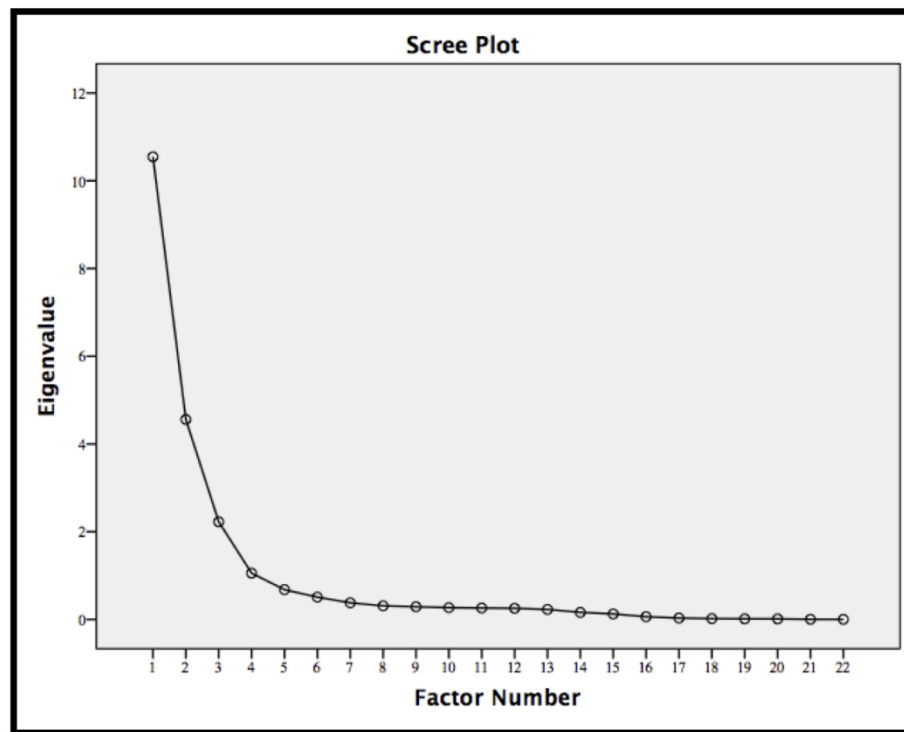

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Figure 3: Scree plot of exploratory factor analysis of social capital in pregnancy.

163x149mm (300 x 300 DPI)

BMJ Open

Development and validation of the Social Capital Assessment Tool in pregnancy for Maternal health in Low and middle-income countries (LSCAT-MH)

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Manuscripts

1 **Development and validation of the Social Capital Assessment Tool in pregnancy**

2 **for Maternal health in Low and middle-income countries (LSCAT-MH)**

3

4 **Authors**

5 Agampodi T. C., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

6 Lanka, Saliyapura,Sri Lanka. Email: thilinichanchala@yahoo.com

7 Agampodi S.B., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

8 Lanka, Saliyapura, Sri Lanka.Email: sunethagampodi@yahoo.com,

9 Glozier N., Brain and Mind Research Institute & Discipline of Psychiatry, Sydney

10 Medical   School, The University of Sydney, Australia.

11 Email: nick.glozier@sydney.edu.au

12 Lelwala T. A., Department of Community Medicine, Faculty of Medicine and Allied

13 Sciences, Rajarata University of Sri Lanka, saliyapura, Sri Lanka.

14 Email: tishi88@gmail.com

15 Sirisena K. D. P. S., Department of Community Medicine, Faculty of Medicine and

16 Allied Sciences, Rajarata University of Sri Lanka, Saliyapura, Sri Lanka.

17 Email: pushsirisena@gmail.com

18 Siribaddana S., Department of Medicine, Faculty of Medicine and Allied Sciences,

19 Rajarata University of Sri Lanka, Email: sisira.siribaddana@gmail.com

20 Corresponding author:

21 Agampodi T. C., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

22 Lanka, Saliyapura,Sri Lanka.

23 Postal address: Department of Community Medicine, Faculty of Medicine and Allied

24 Sciences, Saliyapura, Sri Lanka. 50008

25 Email: thilinichanchala@yahoo.com

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26   **Abstract**

27

28   **Objectives**

29   Social capital which implies "features of social organization, such as trust, norms and

30   networks that can improve the efficiency of society by facilitating coordinated actions"

31   is rarely assessed in relation to maternal health in low and middle-income countries

32   (LIMC). A main reason for this research gap could be the unavailability of a specific

33   tool to measure social capital in pregnancy. The study developed and validated an

34   instrument to measure social capital among pregnant women.

35

36   **Setting**

37   We developed the tool based on World Bank Social Capital Assessment Tool and its

38   adaptations identified as applicable to LIMC from an initial systematic review. The

39   study was conducted in Anuradhapura district in the North central Province of Sri

40   Lanka. Validation process was conducted in urban, rural and resettled communities.

41

42   **Participants**

43   Study participants of the cognitive validation included pregnant women from the three

44   communities, and an expert panel including a social scientist, methodological expert,

45   subject expert, public health officers. The psychometric validation was performed on

46   439 pregnant women permanently residing in the three communities.

47

48   **Results**

49   The 24-item Social Capital Assessment Tool for Maternal Health (LSCAT-MH)

50   demonstrated high internal consistency (Cronbach's alpha; 0.94). Factor analytic

51 methods suggested a 4 factor model of (i) neighborhood networks (structural bonding),

52 (ii) domestic and neighborhood cohesion (cognitive bonding), (iii) social contribution

53 and (iv) social participation (structural bridging). Concurrent validity with antenatal

54 mental ill health was confirmed through a negative correlation with the EPDS. Test

55 retest reliability was high with intra class correlation of 0.71 and a Pearson correlation

56 of 0.83.

57

58 **Conclusion**

59 The LSCAT-MH is a psychometrically valid and reliable tool to measure social capital

60 in pregnancy. Predictive validity was not tested as the study was not a longitudinal

61 follow up.

62

63 **Strengths and limitations of this study**

64 ⇒ **This study describes the development of a tool to measure social capital in**

65   **pregnancy, related to maternal health in LMICs.**

66 ⇒ **The tool development process is comprehensive including a systematic review, an**

67   **in-depth qualitative exploration, cognitive and psychometric validation.**

68 ⇒ **The new tool (LSCAT-MH) possesses adequate reliability, face validity, construct**

69   **validity, concurrent validity and cross cultural validity.**

70 ⇒ **Predictive validity of the tool should be further tested using longitudinal studies.**

71

72 **Key words: Social capital, maternal health, pregnancy, measurement, antenatal**

73 **depression**

74 **Summary box**

75 **What is already known on this subject?**

76 ⇒ Social capital is a major social determinant of health which is defined as "features of

77   social organization, such as trust, norms and networks that can improve the

78   efficiency of society by facilitating coordinated actions".

79 ⇒ It is studied mostly in high-income countries and less commonly in Low and Middle

80   Income Countries (LMICs).

81 ⇒ Deficiencies exist in development and validation of social capital tools.

82 ⇒ It is high time that social capital is incorporated into the global maternal health

83   agenda in relation to "obstetric transition" where social development needs to be

84   addressed in the later stages.

85

86

What does this study add?

88 ⇒ There is no specific instrument developed to measure maternal social capital in low

89   and middle-income countries.

90 ⇒ The study describes the development of the first systematically developed 24 item

91   tool to measure social capital related to maternal health in low and middle-income

92   countries (the LSCAT-MH).

93 ⇒ Cultural adaptation, validity and reliability of the tool is comprehended according to

94   current available standards.

95 ⇒ Social capital in pregnancy in Sri Lanka as measured by LSCAT-MH exert a negative

96   correlation with antenatal depression and anxiety.

How much it will impact on clinical practice in foreseeable future?

98 ⇒ LSCAT- MH can be used to assess social capital related to maternal and women's

99   health in LMICs, as a baseline measure of social determinants and as independent or

100   dependent variable with other health-related issues.

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101   ⇒ Utilization of this tool will act as a corner stone in bridging the gap of social

102   determinants related to maternal health.

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103   **Introduction**

104   The global maternal health agenda currently focuses on "obstetric transition", where

105   countries gradually shift from, high to low maternal mortality and fertility and from

106   direct causes to indirect causes of maternal deaths.[1] This phenomenon directs

107   international community to view "social development" as an important aspect in

108   elimination of preventable causes of maternal deaths.[2,3] The observation on social

109   development is yet to be incorporated in to the global movement of maternal health.

110

111   Social capital is defined as "features of social organization, such as trust, norms and

112   networks that can improve the efficiency of society by facilitating coordinated

113   actions".[4] It has two major dimensions. Cognitive social capital refers to norms,

114   beliefs and values that determine mutual benefit.[5] Structural social capital refers to

115   externally observable relationships among people.[6] A more recent approach

116   expresses these same dimensions in three distinct forms; "bonding",

117   "bridging"(horizontal) and "linking"(vertical) social capital.[7]

118   Social capital, a major social determinant of health is scarcely used in relation to

119   maternal health specially in LMICs.[8] In reducing maternal mortality, the global

120   initiatives were aimed on providing basic and emergency obstetric facilities, improving

121   physical wellbeing of mother and the fetus and risk assessment for medical and

122   obstetric problems. Social aspects to health were rarely addressed as more priority was

123   given to the mentioned fields. Few available studies on social capital and maternal

124   health show that high social capital during pregnancy is associated with higher levels

125   of self-rated health,[9] lower levels of postpartum psychosis,[10] and health related

126   behaviors.[11] The qualitative studies indicate that cognitive social capital tend to

127   reduce daily life stressors, increase psycho-social satisfaction and by provide the

128 perception of care during illness, and structural social capital reduces minor ailments

129 in pregnancy, provide care during medical emergencies and illnesses. Together both

130 these dimensions are found to promote mental and physical wellbeing of a pregnant

131 woman [12]. However, methods used to assess maternal social capital quantitatively s

132 have ignored the fact that the social capital in pregnancy could be unique (with

133 increased bonding in the micro community, restricted bridging and highlighted linking

134 to health services) [13].

135 To overcome this challenge, specific tools are required to assess social capital in

136 pregnancy. Numerous approaches have been used to measure social capital though

137 there is no gold standard measure.[14] Our recent systematic review on methods of

138 measurement of social capital in LMICs indicate that only half of the studies used a

139 specific tool and very few culturally adapt and validate them.[15] To date there is no

140 specific tool available to measure social capital of pregnant women. As described by

141 the Commission for Social Determinants of Health (CSDH), "measuring the problem

142 and assessing the impact of action",[16] is integral to incorporate social development

143 as a strategy to reduce maternal mortality.

144

145 The present study aims on development and validation of a tool to measure social

146 capital in relation to maternal health. The study was carried out in Sri Lanka, as a model

147 LMIC which has been exemplary to the world in maternal and child health care

148 provision.

149 **Methods**

150 LSCAT-MH was developed in three main phases (Figure 1). The systematic review to

151 identify the best tools available for LMICs,[15] and a qualitative study among pregnant

152 women and key informants to identify the socio-cultural context of social

153 capital,[12,17] are already published[12,15,17] and briefly described below. This paper

154 presents the contextual adaptation and psychometric evaluation.

155

156 **Prerequisites for tool development**

157 **Systematic review**

158 A systematic review conducted on methods of measurement of social capital and health

159 identified the Adapted Social Capital Assessment Tool (A-SCAT) (Harpham et al

160 2004) ,[14] as one of the most suitable to use in health surveys. *This tool* [18] is adapted

161 from the Social Capital Assessment Tool (SCAT) developed by the World Bank.[19]

162

163 Qualitative exploration of social capital in pregnancy

164 In order to assess the context and composition of social capital in pregnancy, we

165 explored social capital in pregnancy using several qualitative techniques including

166 diaries written by pregnant women (n=41), diary interviews and in-depth interviews

167 with primary health care officers and senior community dwellers (n=16).[17] Ten

168 cognitive and five structural constructs of social capital relevant to pregnancy were

169 identified. Domestic and neighborhood cohesion were strong social constructs during

170 pregnancy. Social contribution was identified as a novel construct. This study revealed

171 that current tools available did not contain the relevant constructs to capture the unique

172 dimensions of social capital in pregnancy and led to this study.

173

174 **Development of LSCAT-MH**

175 We used the methods proposed by Sumathipala and Murray[20] for translation and

176 cross cultural validation of the English version of A-SCAT to Sinhala language, the

177 vernacular in Sri Lanka. The main social capital constructs and descriptors of pregnant

178   women identified by the qualitative study[12] were used to develop LSCAT-MH. This

179   process included three steps;

1. Making the tool applicable for pregnant women rather than the general public.

2. Adapting it to different social contexts and

3. Changing the item stems to measure individual rather than community social

    capital.

184   In this procedure, we developed new items (domestic cohesion; social contribution),

185   omitted few (general collective action; socializing, perceived influence; degree of

186   citizenship) and changed the descriptors and item stems based on the qualitative study.

187   **Validation of LSCAT- MH**

188   We conducted both cognitive and psychometric validation based on standard guidelines

189   for tool development[21] including the COnsenses-based Standards for the selection of

190   health Measurement INstruments (COSMIN) checklist.[22]

191   **Cognitive Validation**

192   The intended referential and connotative meanings of items in the A-SCAT were

193   obtained by personally contacting the developers of original A-SCAT and SASCAT

194   (Trudy Hapham and Mary De Silva). These original meanings were refined using the

195   results of the qualitative study and were re-written with the agreement of the local

196   investigators. A selected list of criteria was used in expanded interviews and expert

197   evaluation to judge the appropriateness of the survey questions.[23]

198

199   *Expanded interviews with the target group (pregnant women)*

200   We divided the questionnaire into 4-5 items. In the first step the original question was

201   delivered to the participant to elicit the answer. In the second step, each participant was

202   asked for the perceived meaning of each question. The participants were also asked to

203   explain their thought process as to how they came up with their answer. The perceived

204   meaning was compared with the original intended meaning. Respondent validation was

205   used to confirm whether the respondents perceived the intended meaning or if the

206   question meant something different to them. In the third step the respondents were

207   interviewed on the quality and acceptability of the questionnaire.

208   *Expert evaluation*

209   A panel of experts (n=7, three males and four females) reviewed the culturally adapted

210   version of the study tool. The panel included a native language expert, a social scientist,

211   a methodological expert, a subject expert (community physician) on maternal health, a

212   Public Health Nursing Sister (PHNS) and a Public Health Midwife (PHM). Written

213   comments for each item were collected. The experts were informed of the intended

214   tasks (Table 1).

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217 **Table 1: Intended task and experts involved in content analysis**

Intended task	Expert/resource person
Assess whether all items refer to relevant aspects of the construct to be measured?	Social scientist, subject expert
Assess whether all items are relevant for the study population?	Social scientist, Public Health Nursing Sister (PHNS), Public health Midwife (PHM)
Assessment of whether all items are relevant for the purpose of the measurement instrument?	Subject expert, Methodological expert
Assess whether all items together comprehensively reflect the construct to be measured?	Subject expert, Methodological expert
Assess the methodology of the study	Methodological expert

218

219

220 Data obtained by cognitive validation procedure were reviewed question-by-question

221 basis and modifications were made before progression to formal reliability and validity

222 field tests

223 Reliability

224   i)   Internal consistency (the degree to which items in a single dimension co-

225   vary) was measured using Cronbach's alpha (0-1, 1 indicating greatest

226   internal consistency).

227   ii)   Test-retest reliability was performed in a subsample of 50[21] pregnant

228   women in the second trimester. The gap between two data collection points

229   was two weeks. Intra Class Correlation (ICC) was used to assess the

230   reliability (0-1, 1 indicating the greatest reliability).

231   **Validity**

232   **Face validity** was assessed through the cognitive and expert approaches above

233   **Construct validity**

234   Construct validity evaluates the degree to which the items in a measure assess the

235   construct of interest. In addition to the overlap with the cognitve validiity testing above

236   we assessed the structural validity [22] with Exploratory Factor Analysis (EFA) using

237   a maximum likelihood method.[5]

238   Concurrent validity was evaluated by assessing the correlation of scores with a

239   hypothesized similar construct :Mental health in pregnancy (antenatal anxiety and

240   depression) This was measures using , the Edinburgh Postpartum Depression Scale,

241   expecting a negative correlation .

242   Item Response Theory (IRT) tests were not conducted, as the concept did not fulfill the

243   basic assumptions.[21] Item endorsement ratio was used to remove the items that had

244   minimum discrimination ability(Only the items with an endorsement ratio of 0.2- 0.8

245   were included).

246   *Study setting, participants and sample*

247   A cross sectional study was conducted in Anuradhapura district (the largest district) in

248   Sri Lanka. Total population of Anuradhapura is 886,945. In this district more than

249   19,000 pregnant mothers are registered annually for antenatal care.[24] Demographic

250   and Health Survey (DHS) data shows that antenatal care coverage through public health

251   system is 100% and 90% of females in the district have at least entered secondary level

252   education.[25] The maternal mortality ratio of anuradhapura district in 2016 is 38.9 per

253   100000 live births,slightly higher than the national average (33. 8/100000 live births).

254   We purposefully selected three Medical Officer of Health (MOH) areas from the whole

255   district representing urban-semi urban (Nuwaragam Palatha East-NPE), rural

256   (Nuwaragam Palatha Central- NPC) and resettled (Rajanganaya) populations based on

257   the observed differences in social capital in the qualitative study. During July to

258   October 2016 maternal clinics were assigned for data collection according to the

259   population proportion. Eligible pregnant women participate in the study.

260

261   *Sample size for validity testing*

262   Sample size depends on the communalities and overdetermination of the factors.[26]

263   The Overdetermination (Variable:factor ratio) was taken as minimum 6:1 (30 variables

264   , 5 factors). We decided on a sample size of 500 (with a subject: variable ratio of 15:1

265   and a non respondent rate of 10%).[27] The sample size for hypothesis testing of

266   concurrent validity was calculated to accommodate 10 predictors with a minimum

267   expected correlation of 0.1 for each predictor variable, with an effect size of 0.1, an

268   alpha error probability of 0.05, and a power of 0.95. The resultant sample size for

269   hypothesis testing was 254. Adding 10% for non-respondents the total sample size

270   required 267 pregnant women.

271

272 *Data collection*

273 We used a brief questionnaire on socio-demographic and pregnancy related factors,

274 the LSCAT-MH in Sinhala (*interviewer administered*) and the validated Sinhala

275 version of Edinburgh Postpartum Depression Scale (EPDS) (*self-administered*).

276 Trained pre-intern medical officers performed the interview and data collection.

277

278 **Patient and public involvement**

279 This study involved pregnant women, public health officers and senior community

280 dwellers. Their perceptions on social capital in pregnancy was well explored in the

281 qualitative component which was used in the development of culturally adapted items

282 and item response mechanisms for the new tool. The opinion and the experience of

283 Medical Officers of Health were gathered in selecting the communities. Informal

284 discussions as well as in-depth interviews were conducted with public mentioned above

285 to have inputs in designing. Social scientists, subject experts and methodological

286 experts' views were obtained in cognitive validation process. The results of the study

287 will be disseminated at routine public health conferences at divisional, regional and

288 national level.

289

290 **Results**

291 *Cognitive validation of questions and responses*

292 Participants identified "community" as the "area surrounding their residence". Almost

293 all the items were interpreted with the same intended meaning and the thought process

294 was rational in terms of that was expected. We tested the two types of response scales

295 [21]; Likert ("Fully agree, agree, neutral, disagree, fully disagree") with adjectival ("

296 always, often, sometimes, rarely and never"). Respondents unanimously agreed that

297 adjectival scale was more applicable and the cognition process easier.

298

299 *Domestic cohesion*

300 The thought process was very quick and items were deemed relevant for most. The

301 women whose domestic cohesion seemed to be disrupted took additional time to answer

302 often visualizing the situations where it was disrupted while coming to the answer.

303 Some argue whether domestic cohesion should be included in social capital. It is

304 important to mention that the family is the smallest "social structure"[28] of a society.

305 and especially in pregnancy where the "micro community" and bonding social

306 capital"[29] seem to play the major role[12] , the cognitive validation indicated that

307 domestic cohesion should be an integral component of capital that would serve a

308 woman during pregnancy.

309

310 *Neighborhood cognitive social capital*

311 The is included items on sense of belonging, trust and reciprocity, enjoying being with

312 neighbors, perception of love and care and loneliness. Participants who possessed rich

313 bonding and trust readily answered the questions. The participants who selected

314 responses 3-4 took a little more time to answer. When probed they reported that "some

315 people we can trust, but not all". Most of these participants recalled minor incidents

316 which demonstrated a break in trust with the neighborhood. We observed that

317 participants who had less trust, despite reporting high cohesion in other neighborhood

318 cognitive constructs, mentioned that they felt lonely.

319 *Social support*

320 All social support items were very clear to the participants.

321

Neighborhood structural social capital

Although we asked for the frequency of engagement in different types of social connections there was difficulty in interpretation. Therefore we included a statement under these items asking the interviewer to explain.

326

Social contribution

Items on social contribution were well understood with an example given. These items had high inter-individualvariability.

330

Trust in services

Asking about the trust in services did not elicit credible answers except for those assessing public health and specialist car services. When asked about other services participants (especially from rural communities) almost always selected the response "greatly trust". There were two aspects why we thought this answer was not credible. Pregnant women tended to concentrate on self and the immediate micro-community and they had difficulty interpreting or thinking about other services. Secondly they did not have any exposure to services available elsewhere in order to genuinely evaluate the services that they receive.

340

Group membership

Although the question was clear to mothers pregnant women had less interest in social groups. When asked, they reported that although before pregnancy they used to attend but now the husband or another family member would attend, almost as though they were excused from attended. It was observed that during pregnancy these thin ties

346 tended to become weaker as the women limited their interaction to only to the

347 immediate surrounding. However, it was observed that preference to attend committees

348 varied across different communities,he most common being the funeral committee.

349 Expert evaluation confirmed the relevance and comprehensiveness of the tool.

350

351 *Endorsement ratio*

352 Although we included 40 variables representing social capital only the 30 items with

353 an endorsement ratio between 0.2 - 0.8 were selected for the psychometric

354 validation.[21] (Supplementary material)

355

356 *Psychometric Evalaution*

357 *Description of the study sample* Of the 472 pregnant women who participated in the

358 study, 439 provided complete data. (Table 2). The mean social capital score for this

359 sample was 92.4 with a SD=8.83 (Figure2). The percentage of missing values was 6.5%

360 for social capital and 8.2% for EPDS and was managed using pair-wise (in hypothesis

361 testing) and list-wise deletion (in EFA and total scores).

362 **Table 2: Characteristics of the study sample**

Characteristic		Count	%
Age	<20 years	24	5.50
	20-35 years	373	85.00
	>35 years	42	9.50
Family type	Nuclear	237	50.5
	Extended	232	49.5
Family income	< 2$/day	13	2.8
	2-2.99$/day	17	3.6
	3-4.99$/day	55	11.7
	5-9.99$/day	356	75.7
	10$ or more	26	5.5

Parity	1	169	37.10
	2	175	38.50
	3 or more	111	24.40
Gestational age	<14 weeks	103	22.20
	14-28 weeks	180	38.80
	>28 weeks	181	39.00
Highest level of education	Upto grade five or less	6	1.30
	Upto grade 10	113	24.20
	Passed O/L	184	39.50
	Passed A/L	129	27.70
	University education	34	7.30
Population type	Urban- semi urban	208	45.10
	Rural	128	27.80
	Resettled	89	19.30
	Other	36	7.80

363

364

365

Construct validity

In factor analysis with maximum likelihood ratio and Oblimin rotation, the Keiser-Meyer-Olkin value was 0.92. Bartlett's Test of sphericity reached statistical significance supporting the factorability of the correlation matrix. These tests confirm that the data set is suitable for factor analysis to be conducted. Inspection of the scree plot revealed a clear break after the 4th factor (Figure3). Parallel analysis also revealed four factors, explaining a cumulative variance of 83.5%. These were termed informal neighborhood networks (structural bonding), domestic and neighborhood cohesion (cognitive bonding), social contribution (bonding and bridging) and Social participation (bridging) (Table3). Group membership and trust on health services were

376   not included in factor analysis as they contained only a single item each and from the

377   cognitive testing appeared of little relevance to his group.

378

379   *Concurrent Validity*

380   We found a weak negative (-.269) but significant (p=0.000) correlation between social

381   capital and mental health in pregnancy.

382

383   *Cross-cultural validity*

384   The mean social capital score was significantly different (p<0.001) between the three

385   different contexts with the lowest social capital reported in the urban/semi urban

386   population of NPE MOH area (mean 90.3, SD+/-9.2). Highest social capital was

387   reported in NPC, a rural community (mean 95.2, SD +/- 7.8). The resettled population

388   at Rajanganaya had a total score of 92.7 with a SD of +/- 8.5The different findings

389   confirmed the descriptions of social capital elicited in the qualitative studies.

390 **Table 3: Social capital dimensions extracted in EFA**

	Factor			
	1	**2**	**3**	**4**
Domestic and neighborhood cohesion (cognitive bonding)				
"There are times when me and my husband" argue and quarrel		-0.409		
"family members argue and quarrel"		-0.59		
"People in this neighborhood treat me as their own"		-0.878		
"I feel loved and cared for by my neighbors"		-0.879		
"I enjoy spending time with my neighbors"		-0.878		
"In this neighborhood, we help each other with our needs"		-0.694		
"In general my neighbors are trustworthy		-0.651		
"There is someone who can help me with my household chores"		-0.797		
"In emergency, there is someone who can help me financially"		-0.691		
Informal social networks (structural bonding)				
"There is someone who I can consult information / knowledge.	0.823			
Meeting with friends or relatives in the neighborhood	0.63			
Connecting with friends neighborhood through telephone	0.793			
"There is someone who can console me when I'm stressed"	0.696			
Social participation (Structural bridging)				
Participate in cultural events/festivals/trips.				-0.775
Visit the city or the market				-0.955
"People in this neighborhood face a problem, I would join"				-1.042
Social contribution (bonding and bridging)				
Work for yourself or someone else for pay			0.978	
Take responsibilities at home			1.002	
Take responsibilities for social activities in the neighborhood			0.847	
Teach young ones			0.88	
Help a poor family			0.995	
Look after other children			0.706	

Extraction Method: Maximum Likelihood.
Rotation Method: Oblimin with Kaiser Normalization.[a]
a. Rotation converged in 10 iterations.

391

392 *Reliability*

393 The total scale demonstrated high internal reliability (Cronbach's alpha; 0.94) with each

394 factor's internal reliability ranging from 0.92 -0.94. In test retest reliability the ICC was

395 0.71 for the total scale (structural bonding 0.73; structural bridging 0.67; social

396 contribution 0.80 and cognitive bonding 0.67).

397

398

399 **Discussion**

400

401 To our knowledge LSCAT-MH is the only tool available to date, specifically

402 measuring the social capital of women during pregnancy in LIMC. It will facilitate

403 capturing social determinants of, and outcomes of interventions aimed at improving,

404 maternal health.

405

406 The psychometric strength of LSCAT-MH as a tool of measurement of social capital

407 should be high as we adhered to strict and comprehensive procedures in tool

408 development.[21,22] The scale demonstartes high content validity, structural validity,

409 construct validity, concurrent validity, internal consistency and reliability while it was

410 observed that not all of these properties are mentioned in most of the tools that measure

411 social capital. Importantly the cultural adaptation and the adaptation of the tool for

412 pregnancy was based on in-depth qualitative observations and interviews which is

413 rarely adhered to in development of tools for social capital in literature. LSCAT-MH

414 does not stand alone as "another new tool" which has been a burden to measurement of

415 social capital. It exerts refinement of already developed tools (SCAT, A-SCAT and SA-

416   SCAT) by experts in the field, which is essential in approaching towards a gold standard

417   measure.[30]

418

419   The dimensions extracted (Neighborhood networks, domestic and neighborhood

420   cohesion, social contribution and social participation) collate with the accepted

421   dimensions of social capital (Table 2). In addition to distinguishing structural from

422   cognitive social capital, extraction also distinguishes between bonding and bridging

423   (structural) social capital. We think that the four-factor model extracted in LSCAT-MH

424   validation is more robust to other tools as it exerts above different dimensions. Our

425   recent systematic review indicates that social trust, sense of belonging, social cohesion,

426   social support and group membership as the most associated constructs of social capital

427   to health.[15] During the long procedure of its development LSCAT-MH has been able

428   to retain all above constructs within the tool. We retained group membership as a single

429   item for the integrity of the concept and as it had favorable endorsement value.

430

431   Social contribution is a relatively novel construct that we included in the tool, which

432   emerged as a separate factor and distributed adequate internal consistency and

433   reliability with the other constructs. It might show similarity to "perceived social

434   responsibility" assessed in few tools.[31] We argue that it is an important aspect of

435   social capital concept as denoted by "mutual benefit"[4] in development of its notion

436   while most tools tend to measure the one-way process ("what people get"). This will

437   also read "maternal social capital" which is unique from general population but

438   consistent with women in all types of communities in the developing world. In EFA,

439   the four items on social support did not come together as in routinely known

440   dimensions. They fall into different factors structural and cognitive (but both bonding)

441   and implies with the real-life reflections that were observed. Instrumental and financial

442   support reflected the cognitive nature of domestic and neighborhood cohesion

443   indicating that it is a sort of a perceived capital gained from the surrounding. While

444   emotional and informational support was seen as structural. The qualitative studies

445   indicate that "getting or giving emotional support" was not habitual in the home and

446   the surrounding neighborhood. It was perceived as a "different act" away from the

447   routine in these contexts.

448

449   Internal consistency of LSCAT-MH (0.92-0.94) was high compared to other social

450   capital tools (0.5-0.86) [15]. Reliability is not reported in any of the SCAT tools. Test

451   retest reliability is assessed in very few occasions (0.5)[32] in tool development for

452   social capital.

453

454   We expected and observed a negative correlation between social capital and mental

455   health in accordance with current evidence.[33] The direction and magnitude of

456   association suggest credibility of the tool.[22] In literature studies on social capital and

457   mental health rarely demonstrate correlation with smaller sample sizes as in this study.

458   Usually they only present as associations between different quantiles of the social

459   capital score and EPDS positiveness[34] as a correlation is difficult to demonstrate

460   unless rigorous measurements were done. We believe that the LSCAT -MH is a better

461   tool because it was able to demonstrate a significant negative correlation.

462

463   `In the cognitive validation process, it was noted that the respondents felt that the

464   adjectival scale is more applicable and the cognitive process was easier. This is a very

465   crucial point in formulation of tools.   The tool development standards do not

466   differentiate the two scales in terms of outcome or applicability. However, we think

467   that the likert scale demand the respondent to make a decision regarding agreement to

468   a statement and it includes a neutral position in the middle which is embarrassing for

469   some statements which makes the scale less applicable and difficult to understand. The

470   adjectival scale directly asks about the perception and is easily and quckly understood

471   by the respondent. There might be a cultural and language factor as well which works

472   in favor of selecting the adjectival scale.

473   Whether social capital is formative or reflective, and whether EFA vs CFA is

474   the ideal as there's a large qualitative component reflecting the different constructs,

475   would be an argument in this tool development process [35]. We would argue that the

476   study is reflective within a broader formative frame where the first order is reflective

477   (latent variables) and the second order is formative (Social capital as a whole) as

478   described as the Type 2 model described by Javis et al 2003 [36]. In social capital which

479   is known to be a multifaceted concept, a total score is generated for measurement

480   purposes which is invariably formative in nature. But we think that the latent variables

481   identified are reflective and would have different reflections on health. We conducted

482   prior qualitative studies because the social capital in pregnancy is not described in

483   literature. We wanted to identify the full scope of social capital, starting from zero

484   which led to the in-depth inductive qualitative design. But as social capital do have a

485   framework or already known dimensions, we grouped our findings of the qualitative

486   study according to the available knowledge framework. Here the constructs like social

487   contribution that emerged new were added to the framework. Although we categorized

488   what we found about social capital in pregnancy into known dimensions, at many

489   instances we observed that the real life verbatim in the qualitative study deviate from

490   the known dimensions which can be explained only by the reflective nature within the

491 context and in pregnancy. Therefore, we think that the already confirmed framework

492 that we used to categorize the constructs is slightly different from the latent variables

493 identified in the EFA. It is only after having these variables that we were able to see the

494 importance of the reflective nature of social capital in pregnancy. Certainly as the next

495 step in validation it is recommended to perform CFA using the identified latent

496 variables in a different sample of pregnant women which is the most appropriate

497 procedure.

498

499 Although we adhered to standard procedures in tool development there are several

500 limitations. The tool was culturally adapted for semi-urban-rural community in Sri

501 Lanka. Any tool on social capital will need cultural adaptation to the context and the

502 theme under study when used in a different setting. Group membership, trust in other

503 services and trust in different types of health service provision may play a role in

504 communities with higher disparities in services. Any of these can be incorporated to

505 the tool if necessary. Cross-cultural validation was not performed in different countries

506 though the tool was able to differentiate between three different types of communities.

507 Although the initial qualitative studies and the cognitive validation were performed in

508 communities with different educational backgrounds, the educational level of the study

509 population for construct validity is relatively high and the district possess satisfactory

510 maternal health services. However, the educational levels in the current population

511 simulate the national values for Sri Lanka. Therefore, the application of the tool to

512 contexts with poor literacy and health services might need contextual adaptation.

513 Criterion validity was not assessed, as there is no gold standard tool.

514 Responsiveness[22] could not be assessed as social capital does not seem to change

515 over a reasonable time period during pregnancy and as we did not perform a

516 longitudinal study. Due to the same fact we are unable to talk about the predictive

517 validity although one could argue that in hypothesis testing we assess whether social

518 capital during pregnancy could predict the mental health status at the time of data

519 collection.

520

521 Availability of a measurement tool for social capital in pregnant women fulfills the

522 prerequisite to "measure and understand" the relationship of social capital to maternal

523 health and would help in "assessment of its impact".[37] It would enhance future

524 studies on social determinants governing maternal health in both local and global

525 settings and especially in LMICs where 90% of maternal mortality occurs. As we have

526 tested the reliability and validity of the social capital tool during pregnancy in a

527 systematic manner, we believe that LSCAT-MH helps to better measure social capital

528 in pregnancy, and thus, it will help policy makers to better evaluate social

529 circumstances, and to identify which specific aspects can be improved. Thus this study

530 carries an important link between research, policy and practice and will help in their

531 strengthening.

532

533 Longitudinal studies should be carried out to evaluate how social capital could predict

534 and affect health during pregnancy and its outcome.

535

536 **Conclusion**

537 LSCAT-MH is a valid reliable tool to measure social capital during pregnancy in semi-

538 urban to rural populations of Sri Lanka as a model LMICs. Cultural adaptations are

539 recommended in using different cultural settings in other LMICs.

540

541   **List of abbreviations**

542

543   LMICs   Low and Middle Income Countries

544   A-SCAT   Adapted Social capital Assessment Tool

545   COSMIN   COnsenses – based Standards for the selection of health Measurement

546   INstruments

547   EPDS   Edinburgh Postpartum depression Scale

548   LSCAT-MH   Low and middle income countries Social Capital Assessment Tool for

549   Maternal Health

550   CSDH   Commission for Social Determinants of Health

551   SCAT   Social Capital Assessment Tool

552   SASCAT   Short version of Adapted Social capital Assessment tool

553   PHNS   Public Health Nursing Sister

554   PHM   Public Health Midwife

555   EFA   Exploratory Factor Analysis

556   CFA   Confirmatory factor Analysis

557   IRT   Item Response Theory

558   DHS   Demographic and Health Survey

559   MOH   Medical Officer of Health

560   NPE   Nuwaragam Palatha East

561   NPC   Nuwaragam Palatha Central

562

563

564   **Declarations**

Ethics approval and consent to participate

565 **Ethics approval and consent to participate**

566 Informed written consent was obtained by all the participants prior to data collection.

567 Ethical clearance was obtained by the Ethics Review Committee, Faculty of Medicine

568 and Allied Sciences, Rajarata University of Sri lanka.

569

570 **Consent for publication**

571 Consent for publication was obtained by all participants prior to the study.

572

573 **Availability of data and material**

574 The datasets used and/or analyzed during the current study are available from the

575 corresponding author on reasonable request.

576

577 **Competing interests**

578 We have no competing interests.

579

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583

584 **Author contributions**

585 TCA, SBA, NG and SS contributed to the conception and design of the study. TAL

586 and SPDKS and TCA contributed to acquisition, tool validation and analysis of data.

587 TCA, SBA, SS and NG contributed in interpretation of data and manuscript

588 preparation. All authors have read and agreed on the final manuscript. All authors

589 agreed to be accountable for all aspects of work.

590

597

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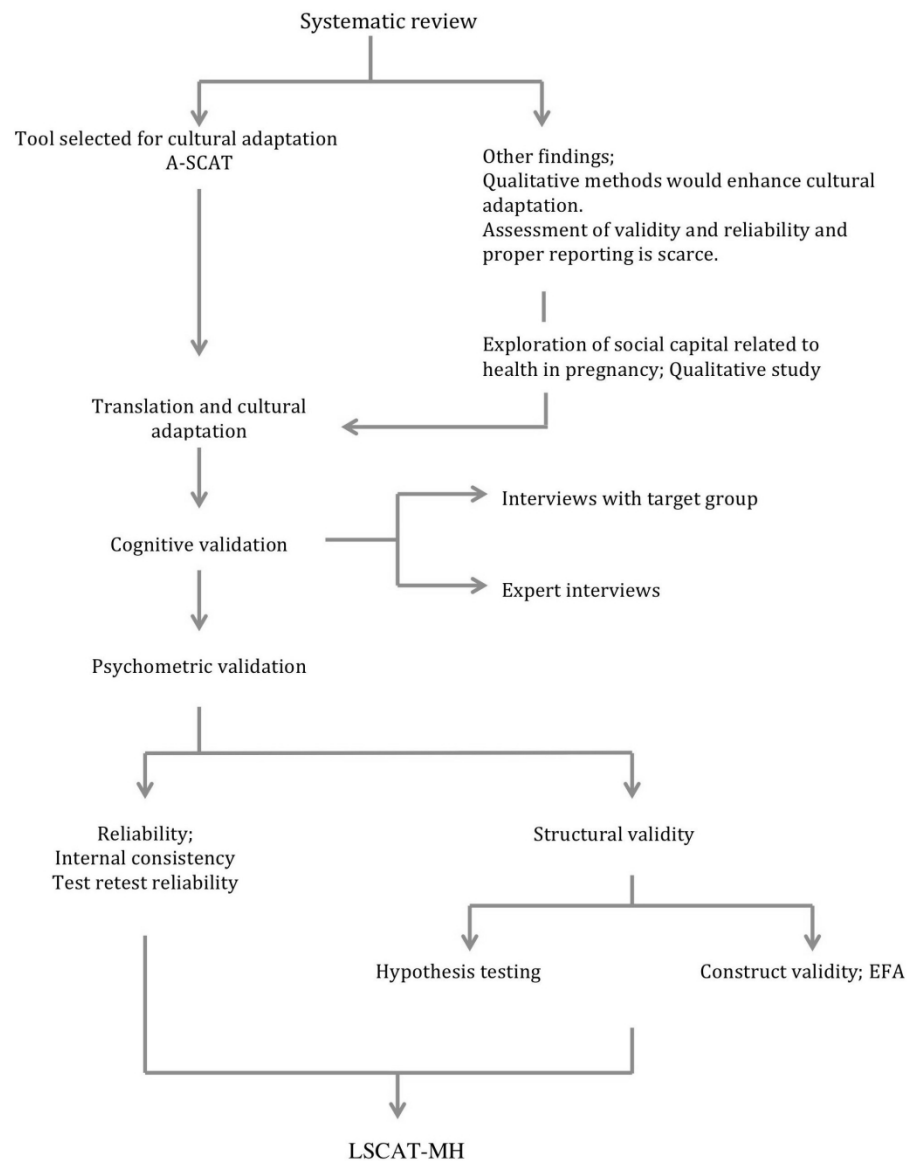664   doi:10.1093/acprof:oso/9780199231881.001.0001

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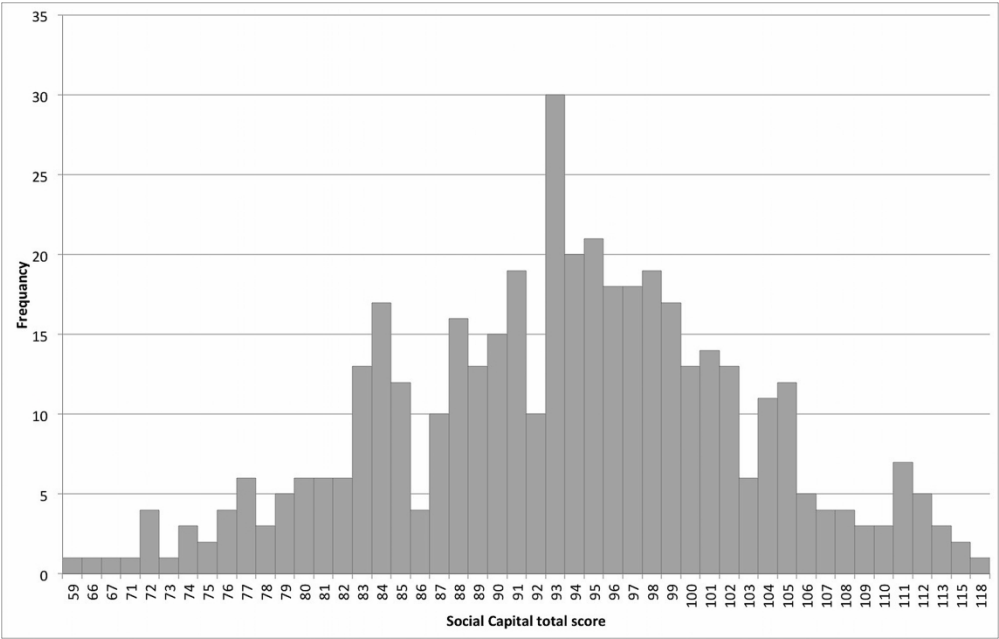689   [pii]10.1016/j.socscimed.2005.06.050

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711   **Figure legends**

712   Figure1: Development flow chart of LSCAT-MH

713   Figure2: Distribution of social capital scores in the study population.
714

715   Figure 3: Scree plot of exploratory factor analysis of social capital in pregnancy.
716

Systematic review

Tool selected for cultural adaptation
A-SCAT

Other findings;
Qualitative methods would enhance cultural
adaptation.
Assessment of validity and reliability and
proper reporting is scarce.

Exploration of social capital related to
health in pregnancy; Qualitative study

Translation and cultural
adaptation

Cognitive validation

Interviews with target group

Expert interviews

Psychometric validation

Reliability;
Internal consistency
Test retest reliability

Structural validity

Hypothesis testing

Construct validity; EFA

LSCAT-MH

175x222mm (300 x 300 DPI)

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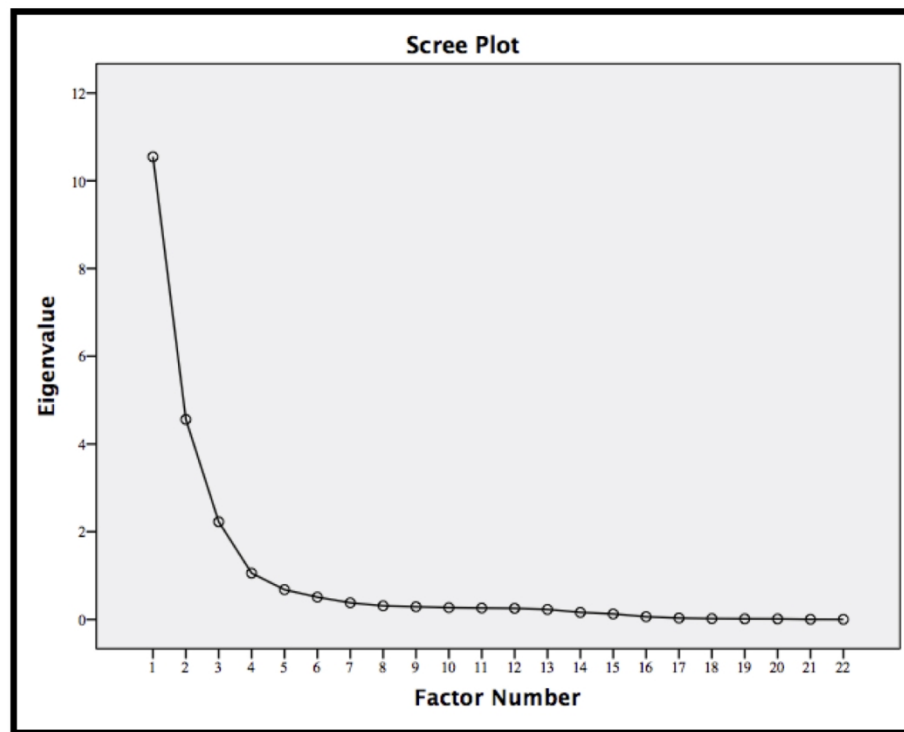44
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Figure 3: Scree plot of exploratory factor analysis of social capital in pregnancy.

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Supplementary material

Social capital constructs excluded due to low endorsement ratio

1. How often does your husband stays with you at home ?
2. "It's a pleasure when my husband stays at home with me"
3. "I receive my husband's love and care very well"
4. "When there is a problem between us I get a chance to discuss about it with my husband"
5. "My family members and I sit and chat together in our leisure"(Explain)
6. "It's a pleasure for me to work together with my family members"
7. "My family members are trust worthy"
8. "I feel lonely in this neighborhood"
9. "People in this neighborhood create problems to me"
10. There's a person to take care of me when I'm ill

Social capital variables removed due to poor correlation

11. People at our home engage in activities together to reduce stress
12. My family members are looking forward to the birth of my child
13. Engaging in religious activities in the neighborhood
14. There's a person who can accompany me to the city if I needed.
15. Meeting friends and relatives outside the neighborhood
16. Other contributions

BMJ Open

Development and validation of the Social Capital Assessment Tool in pregnancy for Maternal health in Low and middle-income countries (LSCAT-MH)

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1 **Development and validation of the Social Capital Assessment Tool in pregnancy**

2 **for Maternal health in Low and middle-income countries (LSCAT-MH)**

3

4 **Authors**

5 Agampodi T. C., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

6 Lanka, Saliyapura,Sri Lanka. Email: thilinichanchala@yahoo.com

7 Agampodi S.B., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

8 Lanka, Saliyapura, Sri Lanka.Email: sunethagampodi@yahoo.com,

9 Glozier N., Brain and Mind Research Institute & Discipline of Psychiatry, Sydney

10 Medical   School, The University of Sydney, Australia.

11 Email: nick.glozier@sydney.edu.au

12 Lelwala T. A., Department of Community Medicine, Faculty of Medicine and Allied

13 Sciences, Rajarata University of Sri Lanka, saliyapura, Sri Lanka.

14 Email: tishi88@gmail.com

15 Sirisena K. D. P. S., Department of Community Medicine, Faculty of Medicine and

16 Allied Sciences, Rajarata University of Sri Lanka, Saliyapura, Sri Lanka.

17 Email: pushsirisena@gmail.com

18 Siribaddana S., Department of Medicine, Faculty of Medicine and Allied Sciences,

19 Rajarata University of Sri Lanka, Email: sisira.siribaddana@gmail.com

20 Corresponding author:

21 Agampodi T. C., Faculty of Medicine and Allied Sciences, Rajarata University of Sri

22 Lanka, Saliyapura,Sri Lanka.

23 Postal address: Department of Community Medicine, Faculty of Medicine and Allied

24 Sciences, Saliyapura, Sri Lanka. 50008

25 Email: thilinichanchala@yahoo.com

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26 **Abstract**

27

28 **Objectives**

29 Social capital which implies "features of social organization, such as trust, norms and

30 networks that can improve the efficiency of society by facilitating coordinated actions"

31 is rarely assessed in relation to maternal health in low and middle-income countries

32 (LMIC). A main reason for this research gap could be the unavailability of a specific

33 tool to measure social capital in pregnancy. The study developed and validated an

34 instrument to measure social capital among pregnant women.

35

36 **Setting**

37 We developed the tool based on World Bank Social Capital Assessment Tool and its

38 adaptations identified as applicable to LMIC from an initial systematic review. The

39 study was conducted in Anuradhapura district in the North central Province of Sri

40 Lanka. Validation process was conducted in urban, rural and resettled communities.

41

42 **Participants**

43 Study participants of the cognitive validation included pregnant women from the three

44 communities, and an expert panel including a social scientist, methodological expert,

45 subject expert, public health officers. The psychometric validation was performed on

46 439 pregnant women permanently residing in the three communities.

47

48 **Results**

49 The 24-item Social Capital Assessment Tool for Maternal Health (LSCAT-MH)

50 demonstrated high internal consistency (Cronbach's alpha; 0.94). Factor analytic

51 methods suggested a 4 factor model of (i) neighborhood networks (structural bonding),

52 (ii) domestic and neighborhood cohesion (cognitive bonding), (iii) social contribution

53 and (iv) social participation (structural bridging). Concurrent validity with antenatal

54 mental ill health was confirmed through a negative correlation with the EPDS. Test

55 retest reliability was high with intra class correlation of 0.71 and a Pearson correlation

56 of 0.83.

57

58 **Conclusion**

59 The LSCAT-MH is a psychometrically valid and reliable tool to measure social capital

60 in pregnancy. Predictive validity was not tested as the study was not a longitudinal

61 follow up.

62

63 **Strengths and limitations of this study**

64 ⇒ **This study describes the development of a tool to measure social capital in**

65 **pregnancy, related to maternal health in LMICs.**

66 ⇒ **The tool development process is comprehensive including a systematic review, an**

67 **in-depth qualitative exploration, cognitive and psychometric validation.**

68 ⇒ **The new tool (LSCAT-MH) possesses adequate reliability, face validity, construct**

69 **validity, concurrent validity and cross-cultural validity.**

70 ⇒ **Predictive validity of the tool should be further tested using longitudinal studies.**

71

72 **Key words: Social capital, maternal health, pregnancy, measurement, antenatal**

73 **depression**

74

Introduction

The global maternal health agenda currently focuses on "obstetric transition", where countries gradually shift from, high to low maternal mortality and fertility and from direct causes to indirect causes of maternal deaths.[1] This phenomenon directs international community to view "social development" as an important aspect in elimination of preventable causes of maternal deaths.[2,3] The observation on social development is yet to be incorporated in to the global movement of maternal health.

Social capital is defined as "features of social organization, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions".[4] It has two major dimensions. Cognitive social capital refers to norms, beliefs and values that determine mutual benefit.[5] Structural social capital refers to externally observable relationships among people.[6] A more recent approach expresses these same dimensions in three distinct forms; "bonding", "bridging"(horizontal) and "linking"(vertical) social capital.[7]

Social capital, a major social determinant of health is scarcely used in relation to maternal health specially in LMICs.[8] In reducing maternal mortality, the global initiatives were aimed on providing basic and emergency obstetric facilities, improving physical wellbeing of mother and the fetus and risk assessment for medical and obstetric problems. Social aspects to health were rarely addressed as more priority was given to the mentioned fields. Few available studies on social capital and maternal health show that high social capital during pregnancy is associated with higher levels of self-rated health,[9] lower levels of postpartum psychosis,[10] and health related behaviors.[11] The qualitative studies indicate that cognitive social capital tend to reduce daily life stressors, increase psycho-social satisfaction and by provide the

100   perception of care during illness, and structural social capital reduces minor ailments

101   in pregnancy, provide care during medical emergencies and illnesses. Together both

102   these dimensions are found to promote mental and physical wellbeing of a pregnant

103   woman [12]. However, methods used to assess maternal social capital quantitatively

104   have ignored the fact that the social capital in pregnancy could be unique (with

105   increased bonding in the micro community, restricted bridging and highlighted linking

106   to health services). This uniqueness is well elaborated in the initial extensive qualitative

107   study we have conducted in the specific community [13] as well as in other quantitative

108   studies done on maternal populations [8].

109   To overcome this challenge, specific tools are required to assess social capital in

110   pregnancy. Numerous approaches have been used to measure social capital though

111   there is no gold standard measure.[14] Our recent systematic review on methods of

112   measurement of social capital in LMICs indicate that only half of the studies used a

113   specific tool and very few culturally adapt and validate them.[15] To date there is no

114   specific tool available to measure social capital of pregnant women. As described by

115   the Commission for Social Determinants of Health (CSDH), "measuring the problem

116   and assessing the impact of action",[16] is integral to incorporate social development

117   as a strategy to reduce maternal mortality.

118

119   The present study aims on development and validation of a tool to measure social

120   capital in relation to maternal health. The study was carried out in Sri Lanka, as a model

121   LMIC which has been exemplary to the world in maternal and child health care

122   provision.

123   **Methods**

124   LSCAT-MH was developed in three main phases (Figure 1). The systematic review to

125   identify the best tools available for LMICs,[15] and a qualitative study among pregnant

126   women and key informants to identify the socio-cultural context of social

127   capital,[12,17] are already published[12,15,17] and briefly described below. This paper

128   presents the contextual adaptation and psychometric evaluation.

129

130   **Prerequisites for tool development**

131   **Systematic review**

132   A systematic review conducted on methods of measurement of social capital and health

133   identified the Adapted Social Capital Assessment Tool (A-SCAT) (Harpham et al

134   2004) ,[14] as one of the most suitable to use in health surveys. *This tool* [18] is adapted

135   from the Social Capital Assessment Tool (SCAT) developed by the World Bank.[19]

136

137   Qualitative exploration of social capital in pregnancy

138   In order to assess the context and composition of social capital in pregnancy, we

139   explored social capital in pregnancy using several qualitative techniques including

140   diaries written by pregnant women (n=41), diary interviews and in-depth interviews

141   with primary health care officers and senior community dwellers (n=16).[17] Ten

142   cognitive and five structural constructs of social capital relevant to pregnancy were

143   identified. Domestic and neighborhood cohesion were strong social constructs during

144   pregnancy. Social contribution was identified as a novel construct. This study revealed

145   that current tools available did not contain the relevant constructs to capture the unique

146   dimensions of social capital in pregnancy and led to this study.

147

148   **Development of LSCAT-MH**

149   We used the methods proposed by Sumathipala and Murray[20] for translation and

150   cross cultural validation of the English version of A-SCAT to Sinhala language, the

151   vernacular in Sri Lanka. The main social capital constructs and descriptors of pregnant

152   women identified by the qualitative study[12] were used to develop LSCAT-MH. This

153   process included three steps;

1.   Making the tool applicable for pregnant women rather than the general public.

155   2.   Adapting it to different social contexts and

156   3.   Changing the item stems to measure individual rather than community social

157   capital.

158   In this procedure, we developed new items (domestic cohesion; social contribution),

159   omitted few (general collective action; socializing, perceived influence; degree of

160   citizenship) and changed the descriptors and item stems based on the qualitative study.

161   **Validation of LSCAT- MH**

162   We conducted both cognitive and psychometric validation based on standard guidelines

163   for tool development[21] including the COnsenses-based Standards for the selection of

164   health Measurement INstruments (COSMIN) checklist.[22]

165   **Cognitive Validation**

166   The intended referential and connotative meanings of items in the A-SCAT were

167   obtained by personally contacting the developers of original A-SCAT and SASCAT

168   (Trudy Hapham and Mary De Silva). These original meanings were refined using the

169   results of the qualitative study and were re-written with the agreement of the local

170   investigators. A selected list of criteria was used in expanded interviews and expert

171   evaluation to judge the appropriateness of the survey questions.[23]

172

173   *Expanded interviews with the target group (pregnant women)*

174   We divided the questionnaire into 4-5 items. In the first step the original question was

175   delivered to the participant to elicit the answer. In the second step, each participant was

176   asked for the perceived meaning of each question. The participants were also asked to

177   explain their thought process as to how they came up with their answer. The perceived

178   meaning was compared with the original intended meaning. Respondent validation was

179   used to confirm whether the respondents perceived the intended meaning or if the

180   question meant something different to them. In the third step the respondents were

181   interviewed on the quality and acceptability of the questionnaire.

182   *Expert evaluation*

183   A panel of experts (n=7, three males and four females) reviewed the culturally adapted

184   version of the study tool. The panel included a native language expert, a social scientist,

185   a methodological expert, a subject expert (community physician) on maternal health, a

186   Public Health Nursing Sister (PHNS) and a Public Health Midwife (PHM). Written

187   comments for each item were collected. The experts were informed of the intended

188   tasks (Table 1).

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191 **Table 1: Intended task and experts involved in content analysis**

Intended task	Expert/resource person
Assess whether all items refer to relevant aspects of the construct to be measured?	Social scientist, subject expert
Assess whether all items are relevant for the study population?	Social scientist, Public Health Nursing Sister (PHNS), Public health Midwife (PHM)
Assessment of whether all items are relevant for the purpose of the measurement instrument?	Subject expert, Methodological expert
Assess whether all items together comprehensively reflect the construct to be measured?	Subject expert, Methodological expert
Assess the methodology of the study	Methodological expert

192

193

194 Data obtained by cognitive validation procedure were reviewed question-by-question

195 basis and modifications were made before progression to formal reliability and validity

196 field tests

197 Reliability

198   i)   Internal consistency (the degree to which items in a single dimension co-

199   vary) was measured using Cronbach's alpha (0-1, 1 indicating greatest

200   internal consistency).

201   ii)   Test-retest reliability was performed in a subsample of 50[21] pregnant

202   women in the second trimester. The gap between two data collection points

203   was two weeks. Intra Class Correlation (ICC) was used to assess the

204   reliability (0-1, 1 indicating the greatest reliability).

205   **Validity**

206   **Face validity** was assessed through the cognitive and expert approaches above

207   **Construct validity**

208   Construct validity evaluates the degree to which the items in a measure assess the

209   construct of interest. In addition to the overlap with the cognitive validity testing above

210   we assessed the structural validity [22] with Exploratory Factor Analysis (EFA) using

211   a maximum likelihood method using Statistical Package for Social Sciences (SPSS).[5]

212   Concurrent validity was evaluated by assessing the correlation of scores with a

213   hypothesized similar construct: Mental health in pregnancy (antenatal anxiety and

214   depression) This was measures using , the Edinburgh Postpartum Depression Scale,

215   expecting a negative correlation .

216   Item endorsement ratio was used to remove the items that had minimum discrimination

217   ability(Only the items with an endorsement ratio of 0.2- 0.8 were included).

218   *Study setting, participants and sample*

219   A cross sectional study was conducted in Anuradhapura district (the largest district) in

220   Sri Lanka. Total population of Anuradhapura is 886,945. In this district more than

221   19,000 pregnant mothers are registered annually for antenatal care.[24] Demographic

222   and Health Survey (DHS) data shows that antenatal care coverage through public health

223   system is 100% and 90% of females in the district have at least entered secondary level

224   education.[25] The maternal mortality ratio of anuradhapura district in 2016 is 38.9 per

225   100000 live births,slightly higher than the national average (33. 8/100000 live births).

226   We purposefully selected three Medical Officer of Health (MOH) areas from the whole

227   district representing urban-semi urban (Nuwaragam Palatha East-NPE), rural

228   (Nuwaragam Palatha Central- NPC) and resettled (Rajanganaya) populations based on

229   the observed differences in social capital in the qualitative study. During July to

230   October 2016 maternal clinics were assigned for data collection according to the

231   population proportion. Eligible pregnant women participate in the study.

232

233   *Sample size for validity testing*

234   Sample size depends on the communalities and overdetermination of the factors.[26]

235   The Overdetermination (Variable: factor ratio) was taken as minimum 6:1 (30 variables

236   , 5 factors). We decided on a sample size of 500 (with a subject: variable ratio of 15:1

237   and a non respondent rate of 10%).[27] The sample size for hypothesis testing of

238   concurrent validity was calculated to accommodate 10 predictors with a minimum

239   expected correlation of 0.1 for each predictor variable, with an effect size of 0.1, an

240   alpha error probability of 0.05, and a power of 0.95. The resultant sample size for

241   hypothesis testing was 254. Adding 10% for non-respondents the total sample size

242   required 267 pregnant women.

243

244 *Data collection*

245 We used a brief questionnaire on socio-demographic and pregnancy related factors,

246 the LSCAT-MH in Sinhala (*interviewer administered*) and the validated Sinhala

247 version of Edinburgh Postpartum Depression Scale (EPDS) (*self-administered*).

248 Trained pre-intern medical officers performed the interview and data collection.

249

250 **Patient and public involvement**

251 This study involved pregnant women, public health officers and senior community

252 dwellers. Their perceptions on social capital in pregnancy was well explored in the

253 qualitative component which was used in the development of culturally adapted items

254 and item response mechanisms for the new tool. The opinion and the experience of

255 Medical Officers of Health were gathered in selecting the communities. Informal

256 discussions as well as in-depth interviews were conducted with public mentioned above

257 to have inputs in designing. Social scientists, subject experts and methodological

258 experts' views were obtained in cognitive validation process. The results of the study

259 will be disseminated at routine public health conferences at divisional, regional and

260 national level.

261

262 **Results**

263 *Cognitive validation of questions and responses*

264 Participants identified "community" as the "area surrounding their residence". Almost

265 all the items were interpreted with the same intended meaning and the thought process

266 was rational in terms of that was expected. We tested the two types of response scales

267 [21]; Likert ("Fully agree, agree, neutral, disagree, fully disagree") with adjectival ("

268   always, often, sometimes, rarely and never"). Respondents unanimously agreed that

269   adjectival scale was more applicable and the cognition process easier.

270

271   *Domestic cohesion*

272   The thought process was very quick and items were deemed relevant for most. The

273   women whose domestic cohesion seemed to be disrupted took additional time to answer

274   often visualizing the situations where it was disrupted while coming to the answer.

275   Some argue whether domestic cohesion should be included in social capital. It is

276   important to mention that the family is the smallest "social structure"[28] of a society.

277   and especially in pregnancy where the "micro community" and bonding social

278   capital"[29] seem to play the major role[12] , the cognitive validation indicated that

279   domestic cohesion should be an integral component of capital that would serve a

280   woman during pregnancy.

281

282   *Neighborhood cognitive social capital*

283   The is included items on sense of belonging, trust and reciprocity, enjoying being with

284   neighbors, perception of love and care and loneliness. Participants who possessed rich

285   bonding and trust readily answered the questions. The participants who selected

286   responses 3-4 took a little more time to answer. When probed they reported that "some

287   people we can trust, but not all". Most of these participants recalled minor incidents

288   which demonstrated a break in trust with the neighborhood. We observed that

289   participants who had less trust, despite reporting high cohesion in other neighborhood

290   cognitive constructs, mentioned that they felt lonely.

291   *Social support*

292   All social support items were very clear to the participants.

293

Neighborhood structural social capital

295 Although we asked for the frequency of engagement in different types of social

296 connections there was difficulty in interpretation. Therefore, we included a statement

297 under these items asking the interviewer to explain.

298

Social contribution

300 Items on social contribution were well understood with an example given. These items

301 had high individual variability.

302

Trust in services

304 Asking about the trust in services did not elicit credible answers except for those

305 assessing public health and specialist car services. When asked about other services

306 participants (especially from rural communities) almost always selected the response

307 "greatly trust". There were two aspects why we thought this answer was not credible.

308 Pregnant women tended to concentrate on self and the immediate micro-community

309 and they had difficulty interpreting or thinking about other services. Secondly they did

310 not have any exposure to services available elsewhere in order to genuinely evaluate

311 the services that they receive.

312

Group membership

314 Although the question was clear, pregnant women had less interest in social groups.

315 When asked, they reported that although before pregnancy they used to attend but now

316 the husband or another family member would attend, almost as though they were

317 excused from attended. It was observed that during pregnancy these thin ties tended to

318 become weaker as the women limited their interaction to only to the immediate

319 surrounding. However, it was observed that preference to attend committees varied

320 across different communities, the most common being the funeral committee.

321 Expert evaluation confirmed the relevance and comprehensiveness of the tool.

322

323 *Endorsement ratio*

324 Although we included 40 variables representing social capital only the 30 items with

325 an endorsement ratio between 0.2 - 0.8 were selected for the psychometric

326 validation.[21] (Supplementary material)

327

328 *Psychometric Evaluation*

329 *Description of the study sample* Of the 472 pregnant women who participated in the

330 study, 439 provided complete data. (Table 2). The mean social capital score for this

331 sample was 92.4 with a SD=8.83 (Figure2). The percentage of missing values was 6.5%

332 for social capital and 8.2% for EPDS and was managed using pair-wise (in hypothesis

333 testing) and list-wise deletion (in EFA and total scores).

334 **Table 2: Characteristics of the study sample**

Characteristic		Count	%
Age	<20 years	24	5.50
	20-35 years	373	85.00
	>35 years	42	9.50
Family type	Nuclear	237	50.5
	Extended	232	49.5
Family income	< 2$/day	13	2.8
	2-2.99$/day	17	3.6
	3-4.99$/day	55	11.7
	5-9.99$/day	356	75.7
	10$ or more	26	5.5

Parity	1	169	37.10
	2	175	38.50
	3 or more	111	24.40
Gestational age	<14 weeks	103	22.20
	14-28 weeks	180	38.80
	>28 weeks	181	39.00
Highest level of education	Upto grade five or less	6	1.30
	Upto grade 10	113	24.20
	Passed O/L	184	39.50
	Passed A/L	129	27.70
	University education	34	7.30
Population type	Urban- semi urban	208	45.10
	Rural	128	27.80
	Resettled	89	19.30
	Other	36	7.80

335

336

337

Construct validity

339   In factor analysis with maximum likelihood ratio and Oblimin rotation, the Keiser-

340   Meyer-Olkin value was 0.92. Bartlett's Test of sphericity reached statistical

341   significance supporting the factorability of the correlation matrix. These tests confirm

342   that the data set is suitable for factor analysis to be conducted. Inspection of the scree

343   plot revealed a clear break after the 4th factor (Figure3). Parallel analysis also revealed

344   four factors, explaining a cumulative variance of 83.5%. These were termed informal

345   neighborhood networks (structural bonding), domestic and neighborhood cohesion

346   (cognitive bonding), social contribution (bonding and bridging) and Social

347   participation (bridging) (Table3). Group membership and trust on health services were

348 not included in factor analysis as they contained only a single item each and from the

349 cognitive testing appeared of little relevance to his group.

350

351 *Concurrent Validity*

352 We found a weak negative (-.269) but significant (p=0.000) correlation between social

353 capital and mental health in pregnancy.

354

355 *Cross-cultural validity*

356 The mean social capital score was significantly different (p<0.001) between the three

357 different contexts with the lowest social capital reported in the urban/semi urban

358 population of NPE MOH area (mean 90.3, SD+/-9.2). Highest social capital was

359 reported in NPC, a rural community (mean 95.2, SD +/- 7.8). The resettled population

360 at Rajanganaya had a total score of 92.7 with a SD of +/- 8.5The different findings

361 confirmed the descriptions of social capital elicited in the qualitative studies.

362 **Table 3: Social capital dimensions extracted in EFA**

	Factor			
	1	**2**	**3**	**4**
Domestic and neighborhood cohesion (cognitive bonding)				
"There are times when me and my husband" argue and quarrel		-0.409		
"family members argue and quarrel"		-0.59		
"People in this neighborhood treat me as their own"		-0.878		
"I feel loved and cared for by my neighbors"		-0.879		
"I enjoy spending time with my neighbors"		-0.878		
"In this neighborhood, we help each other with our needs"		-0.694		
"In general my neighbors are trustworthy		-0.651		
"There is someone who can help me with my household chores"		-0.797		
"In emergency, there is someone who can help me financially"		-0.691		
Informal social networks (structural bonding)				
"There is someone who I can consult information / knowledge.	0.823			
Meeting with friends or relatives in the neighborhood	0.63			
Connecting with friends neighborhood through telephone	0.793			
"There is someone who can console me when I'm stressed"	0.696			
Social participation (Structural bridging)				
Participate in cultural events/festivals/trips.				-0.775
Visit the city or the market				-0.955
"People in this neighborhood face a problem, I would join"				-1.042
Social contribution (bonding and bridging)				
Work for yourself or someone else for pay			0.978	
Take responsibilities at home			1.002	
Take responsibilities for social activities in the neighborhood			0.847	
Teach young ones			0.88	
Help a poor family			0.995	
Look after other children			0.706	

Extraction Method: Maximum Likelihood.
Rotation Method: Oblimin with Kaiser Normalization.[a]
a. Rotation converged in 10 iterations.

363

364 *Reliability*

365 The total scale demonstrated high internal reliability (Cronbach's alpha; 0.94) with each

366 factor's internal reliability ranging from 0.92 -0.94. In test retest reliability the ICC was

367 0.71 for the total scale (structural bonding 0.73; structural bridging 0.67; social

368 contribution 0.80 and cognitive bonding 0.67).

369

370

371 **Discussion**

372

373 To our knowledge LSCAT-MH is the only tool available to date, specifically

374 measuring the social capital of women during pregnancy in LIMC. It will facilitate

375 capturing social determinants of, and outcomes of interventions aimed at improving,

376 maternal health.

377

378 The psychometric strength of LSCAT-MH as a tool of measurement of social capital

379 should be high as we adhered to strict and comprehensive procedures in tool

380 development.[21,22] The scale demonstrates high content validity, structural validity,

381 construct validity, concurrent validity, internal consistency and reliability while it was

382 observed that not all of these properties are mentioned in most of the tools that measure

383 social capital. Importantly the cultural adaptation and the adaptation of the tool for

384 pregnancy was based on in-depth qualitative observations and interviews which is

385 rarely adhered to in development of tools for social capital in literature. LSCAT-MH

386 does not stand alone as "another new tool" which has been a burden to measurement of

387 social capital. It exerts refinement of already developed tools (SCAT, A-SCAT and SA-

388   SCAT) by experts in the field, which is essential in approaching towards a gold standard

389   measure.[30]

390

391   The dimensions extracted (Neighborhood networks, domestic and neighborhood

392   cohesion, social contribution and social participation) collate with the accepted

393   dimensions of social capital (Table 2). In addition to distinguishing structural from

394   cognitive social capital, extraction also distinguishes between bonding and bridging

395   (structural) social capital. We think that the four-factor model extracted in LSCAT-MH

396   validation is more robust to other tools as it exerts above different dimensions. Our

397   recent systematic review indicates that social trust, sense of belonging, social cohesion,

398   social support and group membership as the most associated constructs of social capital

399   to health.[15] During the long procedure of its development LSCAT-MH has been able

400   to retain all above constructs within the tool. We retained group membership as a single

401   item for the integrity of the concept and as it had favorable endorsement value. The tool

402   reflects that social capital in pregnancy in LMICs comprise of more bonding and less

403   bridging dimensions.

404

405   Social contribution is a relatively novel construct that we included in the tool, which

406   emerged as a separate factor and distributed adequate internal consistency and

407   reliability with the other constructs. It might show similarity to "perceived social

408   responsibility" assessed in few tools.[31] We argue that it is an important aspect of

409   social capital concept as denoted by "mutual benefit"[4] in development of its notion

410   while most tools tend to measure the one-way process ("what people get"). This will

411   also read "maternal social capital" which is unique from general population but

412   consistent with women in all types of communities in the developing world. In EFA,

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413   the four items on social support did not come together as in routinely known

414   dimensions. They fall into different factors structural and cognitive (but both bonding)

415   and implies with the real-life reflections that were observed. Instrumental and financial

416   support reflected the cognitive nature of domestic and neighborhood cohesion

417   indicating that it is a sort of a perceived capital gained from the surrounding. While

418   emotional and informational support was seen as structural. The qualitative studies

419   indicate that "getting or giving emotional support" was not habitual in the home and

420   the surrounding neighborhood. It was perceived as a "different act" away from the

421   routine in these contexts.

422

423   Internal consistency of LSCAT-MH (0.92-0.94) was high compared to other social

424   capital tools (0.5-0.86) [15]. Reliability is not reported in any of the SCAT tools. Test

425   retest reliability is assessed in very few occasions (0.5)[32] in tool development for

426   social capital.

427

428   We expected and observed a negative correlation between social capital and mental

429   health in accordance with current evidence.[33] The direction and magnitude of

430   association suggest credibility of the tool.[22] In literature studies on social capital and

431   mental health rarely demonstrate correlation with smaller sample sizes as in this study.

432   Usually they only present as associations between different quantiles of the social

433   capital score and EPDS positiveness[34] as a correlation is difficult to demonstrate

434   unless rigorous measurements were done. We believe that the LSCAT -MH is a better

435   tool because it was able to demonstrate a significant negative correlation.

436

437   `In the cognitive validation process, it was noted that the respondents felt that the

438   adjectival scale is more applicable and the cognitive process was easier. This is a very

439   crucial point in formulation of tools.   The tool development standards do not

440   differentiate the two scales in terms of outcome or applicability. However, we think

441   that the likert scale demand the respondent to make a decision regarding agreement to

442   a statement and it includes a neutral position in the middle which is embarrassing for

443   some statements which makes the scale less applicable and difficult to understand. The

444   adjectival scale directly asks about the perception and is easily and quickly understood

445   by the respondent. There might be a cultural and language factor as well which works

446   in favor of selecting the adjectival scale.

447   Whether social capital is formative or reflective, and whether EFA vs CFA is

448   the ideal as there's a large qualitative component reflecting the different constructs,

449   would be an argument in this tool development process [35]. We would argue that the

450   study is reflective within a broader formative frame where the first order is reflective

451   (latent variables) and the second order is formative (Social capital as a whole) as

452   described as the Type 2 model described by Javis et al 2003 [36]. In social capital which

453   is known to be a multifaceted concept, a total score is generated for measurement

454   purposes which is invariably formative in nature. But we think that the latent variables

455   identified are reflective and would have different reflections on health. We conducted

456   prior qualitative studies because the social capital in pregnancy is not described in

457   literature. We wanted to identify the full scope of social capital, starting from zero

458   which led to the in-depth inductive qualitative design. But as social capital do have a

459   framework or already known dimensions, we grouped our findings of the qualitative

460   study according to the available knowledge framework. Here the constructs like social

461   contribution that emerged new were added to the framework. Although we categorized

462   what we found about social capital in pregnancy into known dimensions, at many

463   instances we observed that the real life verbatim in the qualitative study deviate from

464   the known dimensions which can be explained only by the reflective nature within the

465   context and in pregnancy. Therefore, we think that the already confirmed framework

466   that we used to categorize the constructs is slightly different from the latent variables

467   identified in the EFA. It is only after having these variables that we were able to see the

468   importance of the reflective nature of social capital in pregnancy. Certainly, as the next

469   step in validation it is recommended to perform CFA using the identified latent

470   variables in a different sample of pregnant women which is the most appropriate

471   procedure.

472

473   Although we adhered to standard procedures in tool development there are several

474   limitations. The tool was culturally adapted for semi-urban-rural community in Sri

475   Lanka. Any tool on social capital will need cultural adaptation to the context and the

476   theme under study when used in a different setting. Group membership, trust in other

477   services and trust in different types of health service provision may play a role in

478   communities with higher disparities in services. Any of these can be incorporated to

479   the tool if necessary. Item Response Theory (IRT) tests were not conducted, as the

480   concept as a whole did not fulfill the basic assumptions.[21] However, IRT would

481   have been performed for separate dimensions or we would have used multivariate

482   methods to perform IRT. Cross-cultural validation was not performed in different

483   countries though the tool was able to differentiate between three different types of

484   communities. Although the initial qualitative studies and the cognitive validation were

485   performed in communities with different educational backgrounds, the educational

486   level of the study population for construct validity is relatively high and the district

487   possess satisfactory maternal health services. However, the educational levels in the

488   current population simulate the national values for Sri Lanka. Therefore, the application

489   of the tool to contexts with poor literacy and health services might need contextual

490   adaptation. Criterion validity was not assessed, as there is no gold standard tool.

491   Responsiveness[22] could not be assessed as social capital does not seem to change

492   over a reasonable time period during pregnancy and as we did not perform a

493   longitudinal study. Due to the same fact we are unable to talk about the predictive

494   validity although one could argue that in hypothesis testing we assess whether social

495   capital during pregnancy could predict the mental health status at the time of data

496   collection.

497

498   Availability of a measurement tool for social capital in pregnant women fulfills the

499   prerequisite to "measure and understand" the relationship of social capital to maternal

500   health and would help in "assessment of its impact".[37] It would enhance future

501   studies on social determinants governing maternal health in both local and global

502   settings and especially in LMICs where 90% of maternal mortality occurs. As we have

503   tested the reliability and validity of the social capital tool during pregnancy in a

504   systematic manner, we believe that LSCAT-MH helps to better measure social capital

505   in pregnancy, and thus, it will help policy makers to better evaluate social

506   circumstances, and to identify which specific aspects can be improved. Thus this study

507   carries an important link between research, policy and practice and will help in their

508   strengthening.

509

510 Longitudinal studies should be carried out to evaluate how social capital could predict

511 and affect health during pregnancy and its outcome.

512

513 **Conclusion**

514 LSCAT-MH is a valid reliable tool to measure social capital during pregnancy in semi-

515 urban to rural populations of Sri Lanka as a model LMICs. Cultural adaptations are

516 recommended in using different cultural settings in other LMICs.

517

518 **List of abbreviations**

519

520 LMICs   Low and Middle Income Countries

521 A-SCAT   Adapted Social capital Assessment Tool

522 COSMIN   COnsenses – based Standards for the selection of health Measurement

523   INstruments

524 EPDS   Edinburgh Postpartum depression Scale

525 LSCAT-MH   Low and middle income countries Social Capital Assessment Tool for

526   Maternal Health

527 CSDH   Commission for Social Determinants of Health

528 SCAT   Social Capital Assessment Tool

529 SASCAT   Short version of Adapted Social capital Assessment tool

530 SPSS   Statistical Package for Social Sciences

531 PHNS   Public Health Nursing Sister

532 PHM   Public Health Midwife

533 EFA   Exploratory Factor Analysis

534 CFA   Confirmatory factor Analysis

535 IRT   Item Response Theory

536 DHS   Demographic and Health Survey

537 MOH   Medical Officer of Health

538 NPE   Nuwaragam Palatha East

539 NPC   Nuwaragam Palatha Central

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541

542 **Declarations**

543 **Ethics approval and consent to participate**

544 Informed written consent was obtained by all the participants prior to data collection.

545 Ethical clearance was obtained by the Ethics Review Committee, Faculty of Medicine

546 and Allied Sciences, Rajarata University of Sri lanka.

547

548 **Consent for publication**

549 Consent for publication was obtained by all participants prior to the study.

550

551 **Availability of data and material**

552 The datasets used and/or analyzed during the current study are available from the

553 corresponding author on reasonable request.

554

555 **Competing interests**

556 We have no competing interests.

557

558 **Funding**

561

Author contributions

563   TCA, SBA, NG and SS contributed to the conception and design of the study. TAL

564   and SPDKS and TCA contributed to acquisition, tool validation and analysis of data.

565   TCA, SBA, SS and NG contributed in interpretation of data and manuscript

566   preparation. All authors have read and agreed on the final manuscript. All authors

567   agreed to be accountable for all aspects of work.

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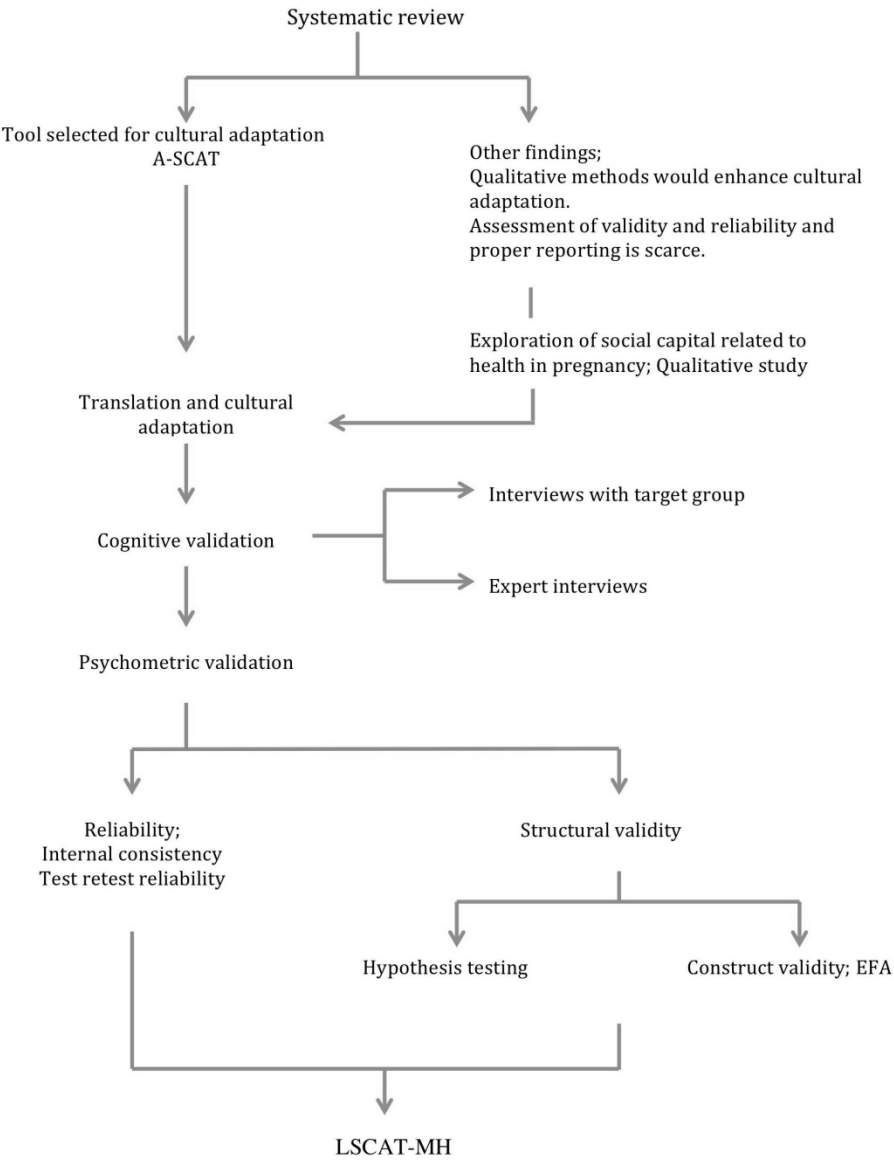687   Determinants of Health. Geneva: : World Health Organization 2008.

689   **Figure legends**

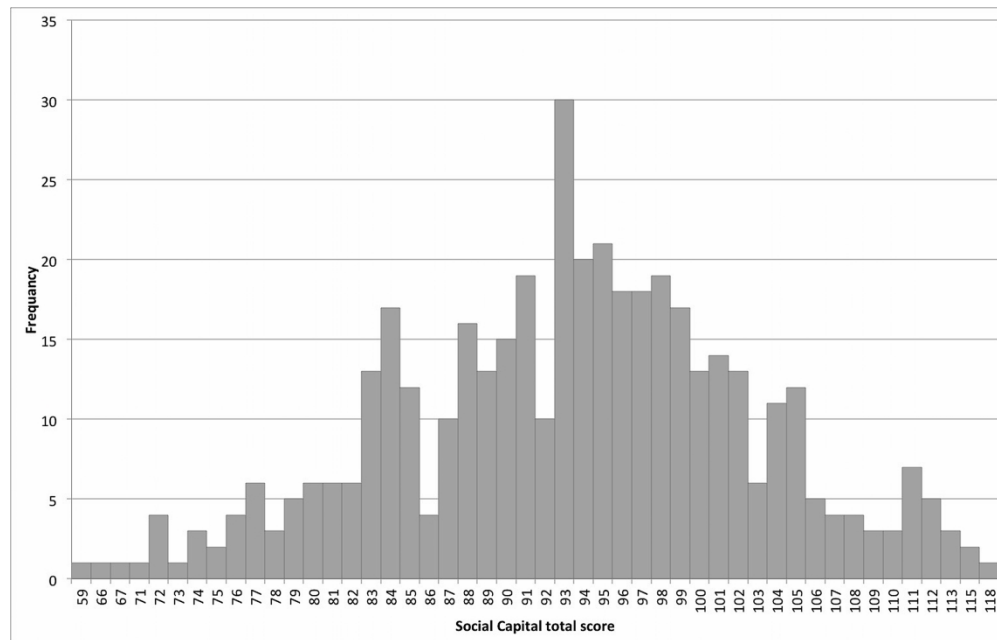690   Figure1: Development flow chart of LSCAT-MH

691   Figure2: Distribution of social capital scores in the study population.

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693   Figure 3: Scree plot of exploratory factor analysis of social capital in pregnancy.

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Systematic review

Tool selected for cultural adaptation
A-SCAT

Other findings;
Qualitative methods would enhance cultural
adaptation.
Assessment of validity and reliability and
proper reporting is scarce.

Exploration of social capital related to
health in pregnancy; Qualitative study

Translation and cultural
adaptation

Cognitive validation

Interviews with target group

Expert interviews

Psychometric validation

Reliability;
Internal consistency
Test retest reliability

Structural validity

Hypothesis testing

Construct validity; EFA

LSCAT-MH

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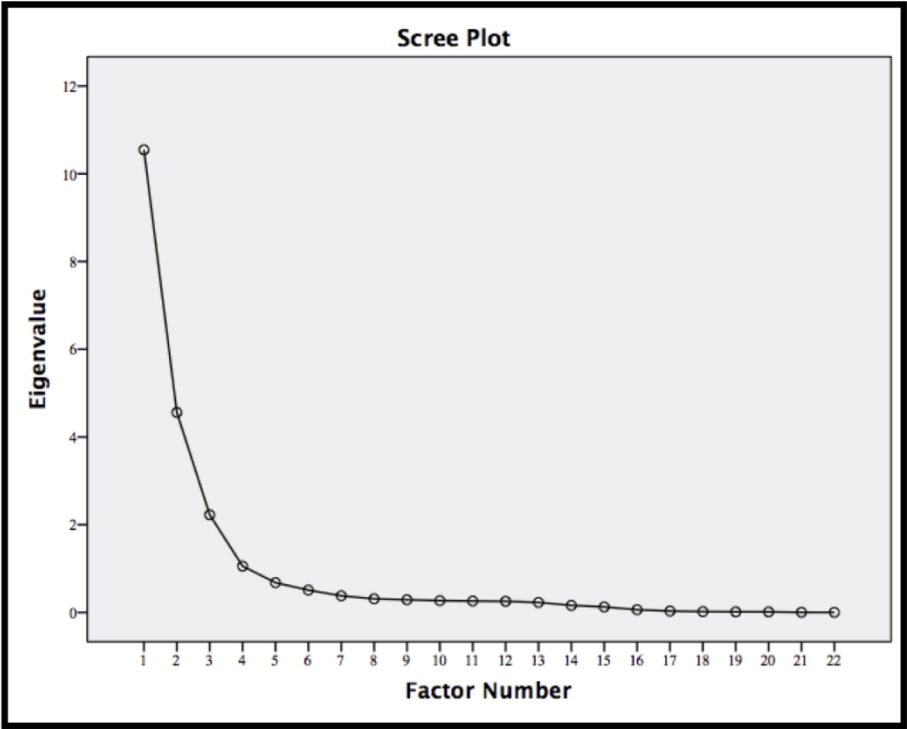51
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Figure 3: Scree plot of exploratory factor analysis of social capital in pregnancy.

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Supplementary material

Social capital constructs excluded due to low endorsement ratio

1. How often does your husband stays with you at home ?
2. "It's a pleasure when my husband stays at home with me"
3. "I receive my husband's love and care very well"
4. "When there is a problem between us I get a chance to discuss about it with my husband"
5. "My family members and I sit and chat together in our leisure"(Explain)
6. "It's a pleasure for me to work together with my family members"
7. "My family members are trust worthy"
8. "I feel lonely in this neighborhood"
9. "People in this neighborhood create problems to me"
10. There's a person to take care of me when I'm ill

Social capital variables removed due to poor correlation

11. People at our home engage in activities together to reduce stress
12. My family members are looking forward to the birth of my child
13. Engaging in religious activities in the neighborhood
14. There's a person who can accompany me to the city if I needed.
15. Meeting friends and relatives outside the neighborhood
16. Other contributions