RESEARCHING THE INFLUENCE OF CONTEXUAL FACTORS ON MATERNAL HEALTHCARE UTILISATION IN SUB-SAHARAN AFRICA: A SYSTEMATIC REVIEW OF MULTILEVEL MODELS

Abstract

Introduction

Sub-Saharan Africa still bears the heaviest burden of maternal mortality among the regions of the world, with an estimated 201,000 (66%) women dying annually due to pregnancy and childbirth related complications. Utilisation of maternal healthcare services including antenatal care, skilled delivery and postnatal care contribute to a reduction of maternal and child mortality and morbidity. Factors influencing use of maternal healthcare occur at both the individual and contextual levels. The objective of this study is to systematically examine the evidence regarding the influence of contextual factors on uptake of maternal health care in sub-Saharan Africa.

Materials and Methods

We followed the Centre for Reviews and Dissemination (CRD) guidelines for conducting systematic reviews in healthcare. The process involved searching 16 electronic databases, identifying articles corresponding to the inclusion criteria and selecting them for extraction and analysis. Peer reviewed multilevel studies on maternal healthcare utilisation in sub-Saharan Africa published between 1st January 2000 and 30th June 2018 were selected. Two reviewers independently evaluated each study for inclusion and conflicts were resolved by consensus.

Results

We synthesised 32 studies that met the criteria of inclusion out of a total of 1,954 initial records. Most of the studies were single-country, cross-sectional in nature and involved two-level multilevel logistic regression models. The findings confirm the important role played by structural factors in determining use of available maternal health care services in sub-Saharan Africa. The level of educational attainment status, media exposure, autonomy and access to health facilities within communities are some of the major drivers of maternal health care utilisation.

Conclusions

This review highlights the potential of addressing high-level factors in bolstering maternal health care utilisation in sub-Saharan Africa. Societies that prioritise the betterment of social conditions in communities and deal with the problematic gender norms will have a good chance of improving maternal health care utilisation and reducing maternal and child mortality.

Introduction

Sub-Saharan Africa (SSA) still bears the heaviest burden of maternal mortality, accounting for two thirds of the world estimates [1]. Most maternal dealth occur during childbirth and the first one month of postpartum [2], which makes the pregnancy and childbirth periods crucial for the survival of mothers and new-born babies. SSA records disproportionately high maternal mortality mostly because of sub-optimal performance in not only maternal health service provision but also in the utilisation of those services during pregnancy and childbirth [3].

Evidence shows that maternal healthcare (MHC) services such as antenatal care, skilled delivery care and postnatal check-ups for mothers and babies are some the most important drivers of maternal and child mortality in the world [3-5]. MHC helps provide health information that is necessary for healthy pregnancy outcomes [5]. It also ensures timely management and treatment of complications to minimise maternal deaths [4,6].

Despite the importance of MHC in ensuring the safety of both the mother and child, many women in SSA still face challenges using these key services, where for example, only an estimated 52% of women benefit from skilled care during childbirth [7]. Studies have established a plethora of factors that prevent women from seeking health care during pregnancy and childbirth. These factors are located at different levels, including the individual, heath systems and structural levels. Individual-level socio-economic factors associated with use of maternal healthcare include maternal age [9] mother's education [10], religion [11], family composition [12] wealth [4][10], information availability [13] place of residence [4][7], mothers' occupation [12] health knowledge [14] and decision-making power [15] among others.

At health systems level, factors such as distance to the health facilities [17][18][19], perceived quality of healthcare [18] [20] cost [21], promptness of care [20], availability of medicine, equipment and emergency care [19][20][22] are important in determining maternal healthcare in SSA. While structural-level factors may include gender norms [23], poverty [24], cultural beliefs [7] government share of healthcare spending [25] and Gross National Income per capita [9].

Current research shows that individual socio-economic characteristics, social-cultural characteristics and place of residence are intertwined and have a mutually reinforcing

relationship [9]. This suggests high degrees of dependencies among people living in one geographical area. For example, people with similar socioeconomic status are likely to live in the same community, attract particular health amenities and have shared sociocultural characteristics. Add to this the fact that national, regional and neighbourhood level influences have a high propensity of coexistence [10].

We know that determinants of use of maternal healthcare extend beyond individual socioeconomic status and health systems characteristics [13]. In fact, such lower level determinants of health and healthcare may just be symptoms of 'upstream' structural factors imbedded within local communities and broader social institutions. For example, the influence of women's autonomy and decision-making powers on maternal healthcare operationalised at an individual level have often been discussed within the framework of dominant masculinity ideologies or cultural beliefs in particular spaces [7]. The same may be true with health systems whose dysfunctionality may be a direct consequence of the failure of political and governance systems far removed from their level of operation.

However, despites many studies examining the relationship between structural factors and maternal healthcare utilisation in continental SSA, it is still not clear a) whether structural and area conditions influence maternal healthcare utilisation distinctive of health determinant associated with individual socio-economic status; b) What structural factors are consistently associated with maternal healthcare utilisation and c) What pathways link structural factors and maternal health care utilisation.

Multilevel level models have generally been regarded as 'gold standards' if the objective of the research inquiry is to examine the effects of high-level factors on outcome variables while controlling for individual characteristics because they can determine the magnitude of variance in the outcome variable attributable to factors at each level of operation [13]. Therefore, to delineate the individual and structural influences on maternal healthcare utilisation, we systematically review only multilevel studies that have included socio-economic status at the individual-level. This distinguishes our study from previous reviews[26][7][12][27] which either were not entirely systematic, did not particularly focus on SSA, did not include all the indictors of maternal health care utilisation or did not exclusively target studies using multilevel modelling.

Understanding the nature of structural factors influencing individual women's utilisation of MHC is critical for the implementation of policy strategies aimed at bolstering the use of MHC services especially in low resource countries. This is because structural factors provide a holistic way of looking at determinants of health outcomes. Additionally, they also provide a better platform for theoretical developments aimed at understanding the relationships between the broader social structure and individual characteristics. This approach has the potential to ultimately explain the disproportionate less optimum utilisation of maternal healthcare and high maternal mortality in SSA.

Materials and Methods

As a matter of good practice, this protocol was aligned to the Centre for Reviews and Dissemination (CRD) guidelines for conducting systematic reviews in healthcare [28]. The process involved searching the electronic literature, identifying articles corresponding to the inclusion criteria and selecting them for extraction and analysis. As much as possible, this protocol adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) 2015 statement checklist [29]. The review protocol was registered with PROSPERO.

Inclusion criteria

Types of studies

Although previous studies have used a variety of techniques to examine the relationship between structural factors and health variations, this review searched only for studies utilising multilevel modelling (MLM) designs. MLM designs are relatively new advances in quantitative research methods and best suited to study the relationship between structural conditions and population health because they allow for a simultaneous examination of the impact of individual level and group level variables (together with their interactions) on individual level outcomes [30][31]. They also accommodate an analysis of observations that are correlated or clustered along spatial, non-spatial, or temporal dimensions [32]. The application of MLMs in such data structures helps to remedy both atomistic and ecological fallacies. This is the reason MLM designs were selected for this review. Studies that used any type of MLM techniques and focused on a single or multiple sub-Saharan African countries were eligible for selection.

Publication status

Although the development of MLM designs began in the 1990s, their application in empirical studies in social and health research increased, mainly from the early 2000s onwards. Therefore, studies published in refereed journals between 2000 and January 2017 were included. It was assumed that this period would capture all significant empirical studies applying MLMs in sub-Saharan Africa. Materials published in non-refereed journals, book reviews, unpublished working papers, government reports, qualitative studies, dissertations, published comments, expert opinions, media briefings, editorials and book reviews were excluded. The review included only studies published in the English language.

Participants and setting

The review included studies that were implemented in any sub-Saharan Africa country, as it is defined by the World Bank Group [33], focusing on maternal healthcare utilisation. This review excluded studies which targeted sub-Saharan citizens in the diaspora.

Outcomes

Studies reporting maternal healthcare utilisation as the outcome variable of concern were included in the review. The indicators of maternal healthcare utilisation were restricted to skilled delivery care, antenatal care and use of contraceptive methods.

Determinants

High-level determinants of maternal healthcare utilisation in MLM studies were considered as structural factors and these included factors clustered at the community, regional or national levels. Characteristics such as community socioeconomic status, social norms, social cohesion and national level economic development status, poverty levels and health expenditure were among eligible structural factors.

Information sources

To avoid bias and in order to reflect the multidisciplinary nature of the subject of this review, literature searches were performed across a variety of databases divided into social sciences and health/medical sciences:

Social sciences

- International Bibliography of the Social Sciences (ProQuest)
- Social Science Research Network—SSRN eLibrary
- Science Direct
- ASSIA: Applied Social Sciences Index (ProQuest)
- Sociological Abstracts (ProQuest)
- Google scholar

Health and biomedical sciences

- Ovid, MEDLINE
- Ovid, EMBASE
- PubMed,
- WHO Library Database (WHOLIS),
- African Health line
- African Index Medicus
- Wiley Online Library, (AIM),
- Web of Science,
- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- Scopus

Literature search strategy

This review employed four sets of terms representing the outcome indicator variables, the structural indicator variables, MLM filters and the filter for sub-Saharan African countries in the search strategy. The table below reports an example of the search strategy adopted for this review. The search filter for sub-Saharan African countries was adapted from work by Pienaar, et al [34] who developed it for clinical studies conducted in an African environment. The filter comprised sub-Saharan African country names and truncated terms such as "southern Africa". North African countries and language filters were removed from the original list accordingly.

Example of search strategy

Maternal healthcare indicator terms	"Maternal healthcare" OR "access to healthcare" OR "availability of healthcare" OR "utilisation of healthcare" OR "health service coverage" OR "contraceptive use" OR "skilled birth attendant" OR "skilled delivery care" OR "facility based delivery" OR "antenatal care"
Structural factors	"Structural factors" OR "social determinants " OR "contextual factors" OR "determinants" OR "neighbourhood status" OR "community

	factors" OR "structural violence" OR "social structure" OR "social norms" OR "sociocultural factors" OR "economic development" OR "governance" "gender inequality" OR "predictors" OR "health systems"
Multilevel models filters	"Multilevel" OR " multilevel models" OR "multilevel modelling" OR "MLM" OR " hierarchical models" OR "hierarchical linear models" OR "HLM" "Variance component" OR "Intraclass correlation" OR "ICC" OR "random effects" OR "mixed models" OR "mixed effects"
Filter for African countries	("Africa" OR Africa* OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR Cameroon OR "Canary Islands" OR "Cape Verde" OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Democratic Republic of Congo" OR Djibouti OR "Equatorial Guinea" OR Eritrea OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR "Guinea Bissau" OR "Ivory Coast" OR "Cote d'Ivoire" OR Kenya OR Lesotho OR Liberia OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Mozambique OR Namibia OR Niger OR Nigeria OR Principe OR Reunion OR Rwanda OR "Sao Tome" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR "South Africa" OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR "Western Sahara" OR Zaire OR Zambia OR Zimbabwe OR "Central Africa" OR "Central African" OR "West Africa" OR "West African" OR "Western Africa" OR "Western African" OR "East Africa" OR "East African" OR "Eastern Africa" OR "Eastern African" OR "North Africa" OR "North African" OR "South African" OR "Southern Africa" OR "Southern African" OR "sub Saharan Africa" OR "sub Saharan African" OR "sub-Saharan Africa")

Data extraction and management

A search was conducted databases using the strategy above, to identify potential records for the review. All extracted entries were screened by examining titles and abstracts and all relevant records with potential of meeting the criteria for inclusion were exported to EndNote X7 for data management. Full texts were extracted using the EndNote platform and those, which could not be found, were searched manually through the University library. Full texts were assessed by two independent researchers against the inclusion criteria and disagreements, where there were any, were resolved by consensus. Studies excluded from the review at this stage along with reasons for exclusion were recorded and retained by the researcher. The search also included hand searching reference lists of relevant articles to identify other articles of value.

Records fitting the inclusion criteria were then exported to excel to record the detailed general publication information (author(s), year of publication and type of journal), characteristics of studies (design, population, sample size and procedure, country,

explanatory and outcome variables of concern) and summary results (whether or not structural factors significantly influenced maternal healthcare utilisation and recording the intra-class correlation). The search was conducted on the 16th of April, 2017.

Risks of bias and quality assessment

Poor quality assessment of studies has a considerable negative impact on the results of systematic reviews. As such, this systematic review appraised all studies in accordance with the Quality Assessment Tool for Quantitative Studies developed by the Effective Public Health Practice Project [35]. Accordingly, the assessment considered selection, the appropriateness of study designs, whether or not there were stated confounders, whether there were variables which had been controlled for, whether or not blinding was applied, reliability and validity of data collection tools, the appropriateness of the units of analysis and the type of variables included. The manner in which missing data were resolved was also part of the assessment procedures.

The appraisal rating of the quality of selected studies in all categories was based on three bands: strong (1), moderate (2) and weak (2). Just like the process of data extraction, two reviewers were involved in the quality assessment in the final processes of this review and in cases of disagreement, a third reviewer was enlisted to reach consensus.

In cases of missing data, attempts were made to contact the primary authors of articles concerned. This was done in situations where, for example, study designs, explanatory or outcome variables were unclear or missing. When there was no success in obtaining the missing data, data were reported accordingly and the implication thereof elucidated in the discussion section of the review.

Data analysis and presentation

Heterogeneity in the study population, selected countries, outcomes and the nature of high-level explanatory variables was observed. As such, meta-analysis was not possible for this synthesis. Instead, narrative systematic review was employed as the method of reporting findings. A table was created with six columns to be used to report the name of first author and reference in column 1. Contextual/structural factors that were found to be influencing maternal healthcare after controlling for individual level variables in column 2. Individual factors from adjusted models including contextual factors were reported in column 3. Column 4 reported the Intra-class correlation (ICC) which is an

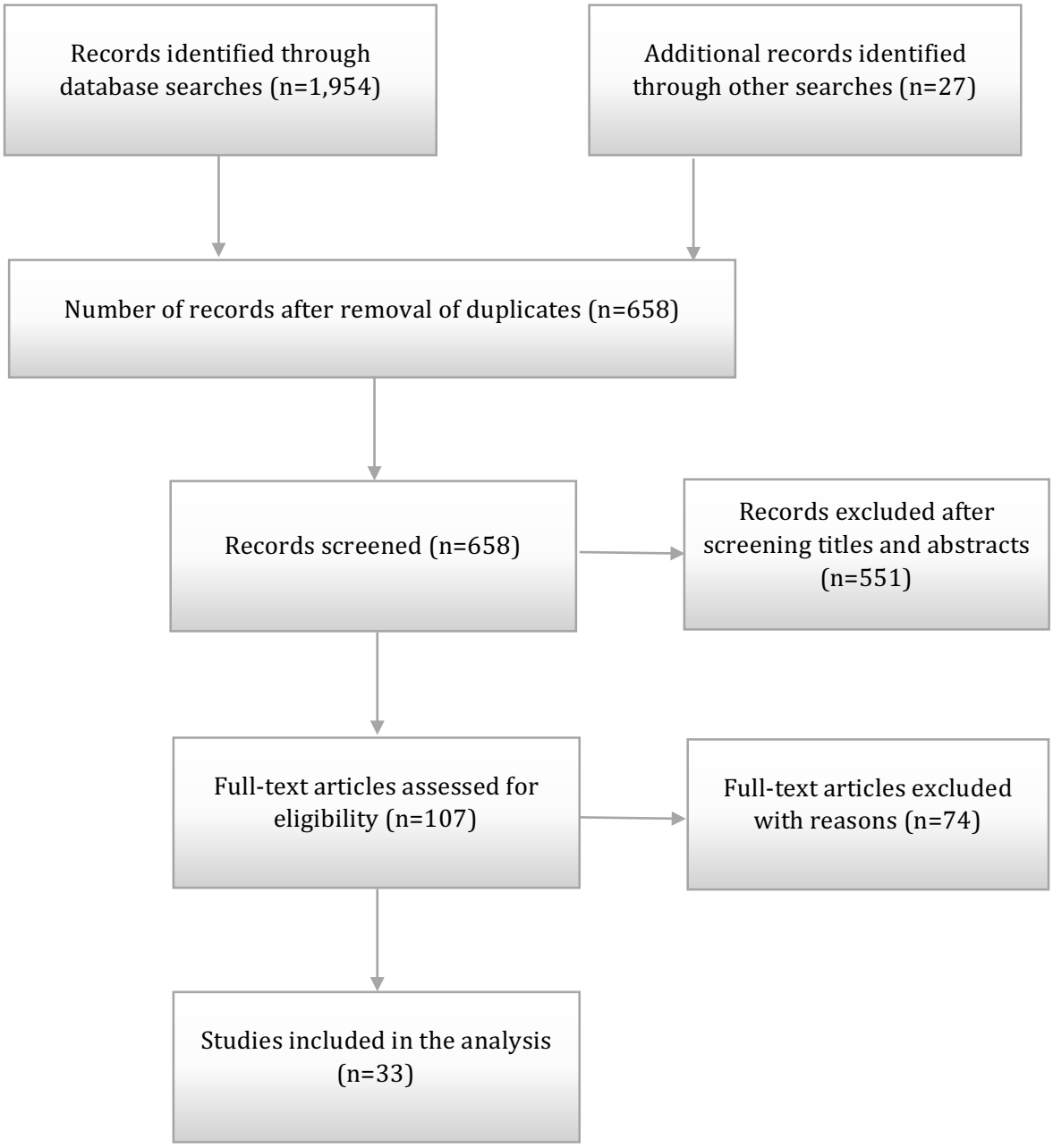
inferential statistic measuring variability within higher-level factors influencing maternal healthcare utilisation. It is used here to determine the importance of contextual factors in relation to individual characteristics in influencing use of maternal health care. Column 5 indicates the nature of the outcome variable investigated in the particular research and the last column shows the direction of significant structural factors in relation to the outcome under consideration.

Results

Search results

The electronic data search process from the research platforms above yielded a total of 1,654 potentially relevant records. Twenty-seven additional records were identified from the reference lists and citation checks of included studies. After searching for duplicates, 996 were discarded and 658 records were screened using titles and abstracts. Following this stage, 551 irrelevant manuscripts were excluded from the review and the remaining 107 records were fully assessed with respect to the illegibility criteria and among these, thirty-nine were selected. The main reason for exclusion was not focusing on sub-Saharan Africa, not using multilevel modelling techniques, using primarily qualitative methods and having an outcome variable other than maternal healthcare. After quality assessment for confounding and appropriate control of variables, six were excluded and the remaining 33 records were eligible for inclusion in the study. The figure below is a flow diagram, which reports the process from article identification to inclusion.

Figure 1. Flow of information through different phases of systematic review



Source: Moher et al, [29].

Study characteristics

Apart from a few entries [36][37][38][39][40], all of the reviewed studies used the Demographic and Health Surveys (DHS) data from a standard survey implemented in more than 91 countries worldwide. The publication by McTavish and others [40] is the only study using the World Health Survey (WHS) and controls for the national level socioeconomic characteristics when investigating the relationship between national female literacy and maternal healthcare use. Table 2 reports the distribution of selected studies across nine sub-Saharan African countries including some cross-national studies, which used a combination of SSA countries as a unit of analysis.

Sample sizes for included studies have a wide range because of heterogeneity in the nature of these studies. Some studies for example only focus on a small population of a rural population [37][41][58] while some others pool data in a cross-national design making the total sample size disproportionately large [40][42][43]. However, all the selected studies have sample sizes adequate to represent populations under investigation.

Table 2. Distribution of studies by county

Country	Count	Percent
Nigeria	6	18.2
Ethiopia	6	18.2
SSA/Africa	5	15.2
Tnzania	4	12.1
Ghana	3	9.1
Mali	2	6.1
Zambia	2	6.1
Mozambique	2	6.1
Kenya	1	3.0
Zimbabwe	1	3.0
South Africa	1	3.0
Total	**33**	**100.0**

Reviewed studies are mainly cross-sectional and utilise mainly multilevel logistic regression analysis with a few making use of multinomial and structural equation regression analysis. The lack of robust data infrastructure in sub-Saharan prohibit the use of more comprehensive analytical techniques such as longitudinal multilevel analysis.

Table 3 reports the results of the systematic review in terms of the study references, factors influencing different indicators of maternal healthcare including both structural/contextual and individual-level factors studied. The ICC and the direction of structural-level influence on maternal healthcare. Table 3 shows that there are different ways in which higher-level factors are constituted in studies applying multilevel modelling in SSA. However, in most studies, these factors are constituted by aggregating individual-level data to represent community characteristics often defined as clusters or PSUs in the case of DHS data [44][45][46][47]. Apart from publications by Balew et al [46] and Ngome and Odimegwu [65], which define higher-level factors as structural determinants and social contexts respectively and focus exclusively on their influence on maternal healthcare. All the other studies seek to investigate the effects of both individual and community-level factors and emphasize the importance of considering factors operating at both levels in policy strategies aimed at addressing maternal healthcare use. Multilevel models are thus applied in order to take care of this two-level hierarchy in the data structures.

Elfstrom and Stephenson [42] is the only publication using three-level modelling techniques in contrast with all the other reviewed studies. Their assumption is that individual actors are nested within households, which, are in turn nested within communities, and they find evidence of that kind of multiple membership. Their analysis shows that community level factors of demographics and fertility norms, gender norms and health knowledge remain significantly associated with contraceptive use even after controlling for both individual and household level factors. This study provides evidence for the importance of multiple membership multiple classification (MMMC) models, which have been propagated elsewhere [66] in order to address the element of inter-individual heterogeneity in health and healthcare.

Table 3 reports several contextual factors that were found to be associated with maternal healthcare after controlling for individual SES. These have been divided into four categories including health systems, relational, socioeconomic and macro-level factors. The most common health systems level includes distance to health facilities [23][47][49], quality of healthcare [44][36], facility capacity[45], antenatal care services [24] and trust

in the health system [60]. The overarching direction of the relationship is that women who live in communities that are proximal to well-performing health systems are more likely to utilise maternal healthcare services.

A host of socioeconomic factors are associated with maternal healthcare utilisation at the structural level and these include religion, media exposure, place of residence, gender norms, access to piped water, poverty women empowerment and average community wealth. Many of these factors have a consisted and predictable relationship with maternal healthcare. It is well known for instance that problematic gender norms hinder women from using maternal healthcare [23][42] and that women from poor backgrounds or otherwise live in poor or disadvantaged areas are less likely to use maternal healthcare services [54][58][46][39].

Relational factors, which mainly result from everyday relationships that women are involved in, also do significantly influence women's decisions to either use maternal healthcare or not. Factors such as husband approval for family planning [13], female autonomy [62], parity [61], number of children per PSU [13] and small family norm [59]. These factors seem to hinge on the nature of relational institutions in SSA in that women who live in areas where their individual freedoms are inhibited, have less likelihood of using maternal healthcare.

There are not many studies which focussed on macro-level factors in this review but one study which did include such factors in the analysis revealed that they have significant influence on use of reproductive healthcare services. McTavish and others [40] investigated the relationship between national female literacy, socioeconomic position and maternal healthcare and they found that the relationship was significant. They controlled for national economic development was also significantly associated with maternal healthcare. This study gives a glimpse on the importance of considering national level and other macro structures in factors when studying individual healthcare outcomes.

To measure the independent variations in maternal healthcare attributable to structural factors, we observed the Intra-class Correlation Coefficients (ICC) for the contextual level factors in models. Reviewed studies have not been consistent in reporting ICC measurements, which indicate the relative importance of contextual factors relative to

individual-level factors in explaining variations in use of maternal healthcare. An important caveat in the results is that the measures of structural factors are not consistent. Some variables are operationalised at different levels in different studies making it difficult to compare the ICC across studies.

However, the ICC results reported in table 3 show that they are averaging 35% indicating that contextual level factors have a substantial independent influence on maternal healthcare. Publications like that of Cau [62] in Mozambique and Ononokpono et al [55] in Nigeria which focus on women's socioeconomic position, empowerment and media exposure show more impact attributed to structural factors than individual characteristics. Other studies which elevate the importance of structural factors include Girmaye [47] and Debelew [58] mainly emphasising the importance of the place of residence and the health system.

We sought to identify theoretical underpinnings that offer explanations on the relationship between structural conditions and maternal healthcare utilisation. Reviewed studies offer little theoretical foundation and no reference to social science theoretical literature is made. Most of the studies try to offer explanations necessitating the observed relationships and the role of the social structure. Adjiwanou and LeGrand [23] for example, offer a sound explanation when they attribute the observed risk factors of gender norms on maternal healthcare in rural sub-Saharan Africa to problematic masculinity ideologies. This is an insightful approach because it gives a broader picture through which the observed relationship in a study could be viewed. However, they do not ground this explanation in a specific theoretical framework to aid explanations of such patterns that may appear in different contexts and which, could later on be tested and validated.

Most of the other studies attribute the observed relationships to the same factors being investigated such as socioeconomic status, lack of women empowerment, the problems in the health system and place of residence. However, many questions remain unexplored. What is it about place of residence for instance, which predisposes women not to attend antenatal care?

The lack of explanatory pathways in studies investigating the relationship between structural factors and maternal healthcare may be due lack of reference to social science

theory. The lack of theoretical foundation in public health research is a problem, which has been identified and acknowledged within social epidemiology and it is a subject of current debate [67].

Table 3. Summary of studies included in the systematic review

Study (Year)	contextual factors for adjusted models	Individual level factors for adjusted models	ICC	Outcome	Direction of structural influence
Adjiwanou 2014[23]	Gender norms, lack of contraceptive use, distance to health facility	Women's education, maternal age, birth order, spouse education	[0.16-0.80]	Skilled birth attendance, 4+ ANC visits and first trimester ANC	Women who live in areas where gender norms are pronounced are less likely to use skilled birth attendants and timely antenatal care in Ghana, Tanzania and Uganda
Chama-Chiliba 2015 [44]	Area of residence, quality of health care	Women status, partner education, household child care burden, quality of ANC received	[0.06, 0.11]	Utilization of antenatal care	Higher quality of healthcare is associated with insufficient ANC visits. In the rural areas this has more explanatory power than individual level factors
Masters 2013 [45]	Facility capacity	Maternal education, household wealth, female autonomy, partner education, parity	----	Maternal healthcare utilisation	Facility capacity as a community level factors is not associated with maternal healthcare utilisation
Balew 2015 [46]	Religion, place of residence and media exposure	Maternal education, household wealth	[0.171, 0.19]	Planning services	Less media exposure, living in rural areas belonging to Islam and other religions lowers the probability of using family planning services at the community level
Girmaye 2016 [47]	Distance to the nearest health provider	Skilled personnel preferred, awareness of providers, media exposure	[0.65]	Skilled antenatal care services	The more the distance to the nearest provider the less the likelihood to use skilled antenatal care
Gage 2016 [48]	Health system, state	Maternal education, place of residence, household wealth	[0.33]	Delivery care utilisation	Women using health systems and in states with supportive quality of MHC have higher likelihood of
Gage 2007 [49]	Transportation, distance to the health facility, community education, prenatal care uptake	Household poverty, lack of money, not having people to go to the hospital with, lack of female health staff, mother education	[0.35]	Use of maternal healthcare	Living closer to other women who used MHC services and having transportation increases the odds of utilising maternal health services. Staying in place with more educated women influences use of MHC
Afulani 2015 [50]	Socioeconomic status	Urban living, higher education, higher wealth, 4+ANC visits, ANC with a doctor, ANC in government hospital, used contraceptives	0.27	Higher quality of antenatal care	Women who live in areas with higher socioeconomic status have better chance of utilising higher quality antenatal care
Elfstrom 2012 [42]	Fertility knowledge, gender norms and inequalities, health knowledge	------	-----	Contraceptive use in Africa	Women living in community with higher fertility knowledge, unproblematic gender norms and have health knowledge are more likely to use modern contraceptives

Kaggwa 2008 [51]	Access to piped water, exposure to family planning messages	Maternal age, household wealth, partner education, women approving family planning	[0.15]	Contraceptive use	After adjusting for individual level factors, none of contextual level factors were associated with contraceptive use in Mali
Akinyemi 2016 [52]	Problems accessing healthcare, lack of money, place and region of residence	Maternal education, partner education, decision making on own health,	[0.23]	Maternity care continuum	Women living in areas where there is less access to healthcare, lack money and located in rural areas are more likely to drop out of maternity care continuum
Ndao-Brumblay 2012 [39]	Distance to health facility, village poverty, road network quality	Age at last child birth, marital status, household wealth index, optimal antenatal visits, parity	[0.36]	Use of health facility for delivery	Contextual level factors were not significant in explaining variations in the use of health facility for delivery
Terye 2016 [53]	Region with an Empty model fit	Media exposure, maternal education, partner education, work status, birth order, marital status	-----	Maternal healthcare	Usage of maternal healthcare vary by region
Dias 2015 [54]	Average community wealth and Social economic position	Female occupation, age, distance to health facility, marital status, religion, education	[0.06]	Women's use of modern Contraceptives	Women's socioeconomic position and average community wealth influence use of use of modern contraceptives
Ononokpono 2015 [55]	Region of residence, community education, poverty, hospital delivery, media exposure	Education, women's autonomy, household wealth, occupation, religion, ethnic origin	[0.66]	Skilled antenatal care	Region, community hospital delivery, poverty and media exposure have strong independent associations with skilled antenatal care
Ononokpono 2014 [56]	Community education, community health facility delivery and ethnic diversity	Maternal age, educational attainment, religion, ethnic origin, occupation, household wealth	[0.42]	Postnatal care	Living in communities with high proportion of educated women, those who had facility delivery, increases the likelihood of postnatal care
Ononokpono 2013 [57]	Community health facility delivery, community poverty	Women occupation, household wealth, women autonomy and region of residence	[0.47]	Maternal healthcare utilisation	Living in community with high facility delivery increases the chance of 4+ ANC visits while community poverty lowers the likelihood of antenatal care visits
Worku 2013 [38]	Signal functions, payment during delivery, obstetric guideline, self-sustained	Birth order, maternal education, preference for skilled provider, previous experience of ANC	[0.19]	Skilled maternal care utilisation	Payment requirement, distance to the facility are important barriers to skilled delivery. Health facility performance was also significantly associated with use of skilled maternal care.
Debelew 2014 [58]	Place of residence, distance from health centre and hospital	Educational status, household wealth, husband occupation, frequency of ANC visits,	[0.55]	Birth preparedness and complication readiness	Living in rural areas and long distance to the hospital increase the likelihood of poor birth preparedness and complication readiness

Babalola 2009 [59]	Place of residence, media exposure, small family norm	Women's Education, socioeconomic status, maternal age, ideal family size	[0.34, 0.40]	Use of maternal healthcare services in Nigeria	Urban residence and community media saturation are strong predictors of use of maternal healthcare services
Mohan 2015 [60]	Trust in the health system, postpartum family planning usage	Women's education, forceps delivery/caesarean section, CHW's help, HIV testing for baby	[0.47]	Postnatal care use at health facility	Living in communities were women have trust in the health system increases the likelihood of postnatal care
Benefo 2010 [37]	Community interpersonal HIV communication, access to condoms, uses no other contraceptives	Age, marital status, knowledge that condoms prevent HIV transmission,	-----	Condom use	Interpersonal communication and access to condoms increases the likelihood of condom use
Stephenson 2006 [13]	Husband approval of family planning, number of children per PSU, community education, community facility delivery	Place of residence, parity, marital status, education, religion, exposure to family planning information, receipt of prenatal care during last pregnancy	[0.27,0.54]	Use of health facilities for childbirth	Living in communities with higher percentage of educated women and high rates of facility delivery and husband approval for family planning methods increases the likelihood of health facility delivery
Stephenson 2008 [61]	Distance to the nearest health facility, education parity, high mean age at marriage and reporting physical violence	Place of residence, maternal age, working outside of home, exposure to HIV/AIDS information, maternal educational attainment	----	Modern contraceptive methods	Women living further away from health facilities were more likely to use contraceptive methods. Living in communities with more educated men than women reduces contraceptive use
Cau 2015 [62]	Exposure to family planning messages, community women empowerment, women autonomy	Parity, maternal age, professional status, education, desired family size, women's autonomy, marital status	[0.50]	Contraceptive use	Living in communities with high percentage of access to information, more empowered and autonomous women increases the odds of using contraceptives.
Yebyo 2015 [24]	Place of residence, women empowerment, education levels, media exposure, ANC visits, distance to health facility	Household wealth, educational attainment, partner education, media exposure and perceived problems with transportation	0.21	Home delivery	Rural women, women living in agrarian communities, poor and those who reported that distance is a problem had higher odds of home delivery. Lower levels of ANC utilisation was also associated with home delivery.
Johnson 2009 [63]	Ecological zone of residence, rural/urban residential status	Household wealth, partner education, ANC Visits, maternal age, religion, birth order, education	----	Place of delivery	Apparent ecological and rural/urban inequalities in place of delivery

Kruk et al 2015 [41]	Village farms cash crops	Education; healthcare utilisation; media exposure; wealth index and birth during harvest season	[0.09,0.24]	Home delivery	Farming of cash crop in a village reduces the probability of home delivery
Kruk 2010 [36]	Community perception of the quality of local health system	Enrolled in community health insurance, parity, health beliefs, perceptions of a health system	[0.34]	Facility delivery	Positive perceptions of doctor and nurse skills and inversely negative perception of traditional birth attend skills increases the likelihood of facility delivery
Magadi 2000 [64]	Distance to health facility	Region, socioeconomic status, marital status, proceeding birth interval, Frequency and timing of antenatal visits	[0.03, 0.04]	Antenatal care	Use of maternal healthcare is infrequent for unwanted and mistimed pregnancies
Magadi 2003 [43]	inequality of in health in urban SSA	Educational level, maternal age, birth order, area of residence	----	maternal health care in SSA	Inequalities in the urban poor is more pounced in maternal health of the urban poor are more pronounced in countries where maternal healthcare is relatively good
McTavish 2010 [40]	National female literacy	Individual age, education, urbanicity and household income, marital/cohabitation status	-----	Use maternal health care	Mothers residing in countries with high levels of female literacy were more likely to use maternal health care
Ngome 2014 [65]	Provincial level of access to healthcare, education, number of children per women	Media access, parity	-----	use of modern contraceptives	Lack of access to healthcare, more children per women and having higher education are associated with less use of modern contraceptives in a province

Discussion

This systematic review used multilevel models in sub-Saharan Africa to study the influence of structural factors on maternal healthcare utilisation. Our synthesis involved 32 studies that met the criteria and controlled for a few individual-level SES factors. Previous reviews focused on different indicators of maternal healthcare, did not particularly look at SSA or did not specifically target multilevel models [7][12][26][27].

Selected studies reflected substantial heterogeneity in terms of structural factors and outcome variables examined. Structural factors are defined as community-level factors and are mainly studied through two-level modelling techniques apart from one study that uses a three-level multilevel model. Structural/contextual factors found to be commonly associated with maternal healthcare relate to the operations of the health system, socioeconomic status of women, nature of relationships and macro elements within communities and countries.

The health system factors indicate that women who live in areas that are proximal to health facilities, provide good quality healthcare, have full antenatal care coverage and where more people trust in the health system [17][18][19][20][21], have a higher propensity to use the use maternal healthcare. This phenomenon may not be a function of health systems per se but that of the "upstream" structural factors such as the dysfunctionality in the political and governance systems whose level of operation are far removed from the health systems. This could be because healthcare delivery capacity is considerably less in developing countries compared to developed countries. This may result from low health expenditure per capita, which in 2015, was approximately $37 in low-income countries compared to around $518 and $5,251 in upper middle-income countries and higher income countries respectively [16]. Consequently, the health professional to population ratio also less impressive as it stands at 0.2 for physicians and 1.2 for nurses and mid wives in SSA countries, while the corresponding figures for the developed countries are 2.9 and 8.6 per thousand population [16]. These phenomena may account for the suboptimal performance of health systems in SSA.

Urban residence or living in a areas with more educated and wealthy women could enhance the propensity of using maternal health care [43][24][56][54]. Urban residence and high socioeconomic status are usually associated with good health outcomes because on one hand, better amenities are usually found in urban areas. On the other hand, wealth

and educated people are likely to live in urban areas and afford health insurance or out-of-pocket payments for health care [68][69][70].

Media exposure, gender norms, parity, female autonomy and national female literacy are a function of community gender relations and broader macro-structural underpinnings of society. Women are more likely to use maternal health care if they live in communities with high media saturation, unproblematic gender norms, more female autonomy and countries with higher female literacy [40][62][59][55]. Media saturations allows better access to information on the importance of antenatal care, facility delivery and postnatal check-ups for mothers and babies. Problematic gender norms and lack of female autonomy are functions of patriarchal systems, which privileges men with power over women and subordinates the status of women [71]. Accordingly, gender division of labour in patriarchal societies is often such that pregnancy and childbirth responsibilities are assigned to women without accompanying social status or access to resources. Thus making it difficult for them to use available maternal health care services.

The systematic review provides substantial evidence regarding the contribution of structural factors to maternal healthcare utilisation through the observed ICC measures. Although the study shows mixed results on discriminatory variations in maternal health care at both individual and structural levels, this should be considered in the context of broader literature which suggests that individual level factors are often "symptoms" of much more "upstream" structural factors. The relationship between individual socioeconomic factors and maternal health care use therefore, could be heavily moderated by community and much more high-level factors.

The strength of this review lies in the fact that it is the first systematic review of literature on multilevel models studying maternal healthcare in SSA. The comprehensiveness of the literature search spanning all relevant databases has given the possibility of reviewing all the relevant literature to date in order enhance our understanding of the relationships between structural factors and maternal healthcare in sub-Saharan Africa. The inclusion of the ICC measures helps to discriminate the relative difference in the magnitude of influence between structural conditions and individual characteristics on maternal health care utilisation.

The limitations of the study includes the fact that most of the studies selected for this review are cross-sectional and relied on household surveys. There are a considerable problems associated with cross-sectional data and major among them is failure to provide evidence for causality. Caution should therefore, be exercised when interpreting the findings of the review and applying the results for policy frameworks. The lack of longitudinal studies in SSA exacerbates this problem.

The review has only focussed on quantitative studies and thus underlying reasons behind observable phenomena, which are characteristics of qualitative research/studies, has been missed in this review. Additionally, the review only focussed on studies conducted in the English language, which means that there is potential for studies reported in languages other than English to have been missed consequently.

The review restricted itself only to published literature. With the poor publishing culture in SSA, it is probable that there could be a considerable number of studies in the grey literature, which could have added value to this review.

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