






Impact on pregnant/parturient women's health resulting from displacement between residence and health service

Impacto na saúde da gestante/parturiente resultante do deslocamento entre residência e serviço de saúde

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ABSTRACT

Objective: to analyze the impact on pregnant/parturient women's obstetric and neonatal outcomes resulting from displacement between homes and health services. **Methods:** an integrative review was carried out in August 2020 on the following databases: SCOPUS, Web of Science, Cumulative Index to Nursing and Allied Health Literature, Medical Literature Analysis and Retrieval System Online/PubMed, Science Direct and Latin American and Caribbean Health Sciences Literature/Virtual Health Library, using controlled descriptors and keywords. Besides, a quantitative descriptive analysis of the main results was performed using the Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires software. **Results:** the sample resulted in 20 articles. It was evidenced that the mobility of women is hampered by distance between home and health services, precarious transport, and living in socioeconomically disadvantaged places. **Conclusion:** difficulty in mobility is a crucial factor that explains the adverse maternal and neonatal impact.

Descriptors: Health; Health Impact Assessment; Pregnant Women; Health Services; Locomotion.

RESUMO

Objetivo: analisar o impacto relacionado ao deslocamento das gestantes/parturientes entre suas residências e os serviços de saúde no desfecho obstétrico e neonatal. **Métodos:** revisão integrativa, cuja busca foi realizada em agosto de 2020 nas bases: SCOPUS, *Web of Science*, *Cumulative Index to Nursing and Allied Health Literature*, *Medical Literature Analysis and Retrieval System Online/PubMed*, *Science Direct* e *Literatura Latino-Americana e do Caribe em Ciências da Saúde/Biblioteca Virtual em Saúde*, utilizando descritores controlados e palavras-chave. Além disso, foi realizada análise descritiva quantitativa dos principais resultados no software *Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires*. **Resultados:** a amostra resultou em 20 artigos. Foi evidenciado que a mobilidade entre o domicílio e os serviços de saúde é dificultada pela distância, precariedade nos transportes, residência em locais socioeconomicamente desfavorecidos, dentre outros. **Conclusão:** a dificuldade na mobilidade é um fator chave que explica o impacto negativo materno e neonatal.

Descritores: Saúde; Avaliação do Impacto na Saúde; Gestantes; Serviços de Saúde; Locomoção.

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Introduction

The pregnancy-puerperium cycle brings with it biopsychosocial changes and, for this reason, health professionals must accompany pregnant, parturient, and puerperal women. This is considered a fundamental condition to protect and prevent adverse events related to maternal and child health, allowing the identification and management of timely clinical procedures on the risk factors that impact mothers and their babies⁽¹⁾. Access to health care is an essential factor in assisting the mother-child dyad, and several determinants must be considered, including availability, acceptability, financial accessibility, and geographical accessibility⁽²⁾.

In this study, geographic accessibility is emphasized, as research on the geographical proximity of women's homes to health services is considered an important factor for favorable obstetric and neonatal outcomes⁽³⁾.

In literature searches, no statistical data were found associated with unfavorable conditions related to geographic accessibility, which evidences a gap in the knowledge of how geographic access to health services impact obstetric and neonatal outcomes.

Thus, the study is relevant to the extent that it is deemed necessary to deepen whether maternal and neonatal health outcomes are more favorable when attributed to geographic access and consequent improvement concerning the displacement between homes and health services. Therefore, the study's objective was to analyze the impact on pregnant/parturient women's obstetric and neonatal outcomes resulting from displacement between homes and health services.

Methods

This is an integrative literature review conducted in five steps: question formulation, literature search for primary studies, study evaluation, analysis, and

reporting⁽⁴⁾. This method was considered the most appropriate for exploring the existing literature available from scientific sources. Besides that, to support the data analysis, the IRAMUTEQ software was used allowing different processing and statistical analysis of texts⁽⁵⁾. From the texts selected for analysis, IRAMUTEQ makes an association enabling the grouping of statistically significant words for the studied context.

For the processing of data, a word cloud was used, grouped, and organized graphically according to the word frequency, which quickly enable the identification of words from a single file called corpus, which brings together the texts originated from the main results of the selected articles⁽⁵⁾.

From the concern to understand the phenomenon, a guiding question was elaborated using the PICO strategy as follows: participants (P), pregnant and parturient women; interest (I), obstetric and neonatal outcomes; and context (Co), displacement between home and health services. Therefore, the central question for conducting this review was: What is the impact of displacement between homes and health services on pregnant/parturient women's obstetric and neonatal outcomes?

After choosing the theme, the study search was carried out in August 2020 independently and concurrently by two researchers. There was no disagreement among the reviewers regarding the selection of articles. The search was carried out in the following databases: SCOPUS, Web of Science (WOS), Cumulative Index of Nursing and Allied Health Literature (CINAHL), Medical Literature Analysis and Retrieval System Online (MEDLINE) via PubMed, Science Direct, and Latin American and Caribbean Health Sciences Literature (LILACS) via Virtual Health Library (VHL).

An experienced librarian assisted in the construction of the search strategy, which included the following controlled descriptors available in the Medical Subject Headings/Health Sciences Descriptors (MeSH/DeCS): Health Evaluation, Health Impact Assessment, Pregnant Women, Health Services, and Lo-

comotion; and the following keywords: Impact in the health condition, Assessment, Impact assessment, Migration, and Displacement; which were intertwined in different search strategies described below:

SCOPUS: ((TITLE-ABS-KEY (“Pregnant Women”) OR TITLE-ABS-KEY (pregnant woman) OR TITLE-ABS-KEY (pregnant))) AND ((TITLE-ABS-KEY (“Health Evaluation”) OR TITLE-ABS-KEY (impact in the health condition))) AND ((TITLE-ABS-KEY (“Health Impact Assessment”) OR TITLE-ABS-KEY (assessment) OR TITLE-ABS-KEY (impact assessment) OR TITLE-ABS-KEY (health impact))) AND (TITLE-ABS-KEY (“Health Services”)) AND TITLE-ABS-KEY (“Locomotion”) OR TITLE-ABS-KEY (migration) OR TITLE-ABS-KEY (displacement));

Web of Science: TS=(“Pregnant Women” OR “pregnant woman” OR pregnant) AND TS=(“Health Evaluation” OR “impact in the health condition”) AND TS=(“Health Impact Assessment” OR assessment OR “impact assessment” OR “health impact”) AND TS=(“Health Services”) AND TS=(“Locomotion” OR migration OR displacement);

CINAHL: ((MH “Pregnant Women”) OR (“pregnant woman”)) AND ((MH “Health Evaluation”) OR (health)) AND ((MH “Health Impact Assessment”) OR (assessment) OR (“health impact”)) AND (MH “Health Services”) AND ((MH “Locomotion”) OR (displacement));

MEDLINE/PubMed: (((“Pregnant Women”[All Fields] OR (“pregnant”[MeSH Terms] OR “pregnant woman”[All Fields] AND “Health Evaluation”[All Fields]) OR “impact in the health condition”[All Fields] AND “Health impact assessment”[All Fields] OR “impact assessment”[MeSH Terms] AND “Locomotion”[All Fields]) OR displacement[All Fields]) OR migration[MeSH Terms]));

Science Direct: ((“Pregnant Women” OR “pregnant” OR “pregnant woman”) AND (“Health Evaluation” OR “impact in the health condition”) AND (“Health impact assessment” OR “impact assessment”) AND (“Locomotion” OR displacement OR migration));

LILACS/VHL: (tw:((tw:(Gestantes)) OR (tw:(Parturientes)) OR (tw:(“Pregnant women”)) OR (tw:(“Mujeres embarazadas”)))) AND (tw:((tw:((tw:(“Avaliação em saúde”)) OR (tw:(“Impacto nas condições de saúde”)) OR tw:(“Health Evaluation”)) OR tw:(“Evaluación em Salud”)) AND (tw:((tw:((tw:(“Avaliação do Impacto na Saúde”)) OR (tw:(“impacto na saúde”)) OR tw:(“Health Impact Assessment”)) OR tw:(“Evaluación del impacto em la Salud”) AND (tw:((tw:((tw:(Locomoção)) OR (tw:(“deslocamento) OR (tw:(Locomotion)) OR (tw:(Locomoción)))).

The intersection of controlled descriptors and keywords was mediated by the Boolean operators “AND” and “OR”. No search filters or time limitations were used. There was also no manual search in the references of the extracted articles.

Primary articles were included addressing pregnant/parturient women’s geographic access to health services, prenatal care, labor, delivery, and obstetric emergencies. Articles that addressed the quality of care for pregnant/parturient women in health services, letters, conference proceedings, and book chapters were excluded. After applying the inclusion and exclusion criteria, a sample of 20 articles (Figure 1) was obtained, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines⁽⁶⁾.

An instrument was developed by the authors and used as scientific support to extract the relevant data from the articles. This instrument included the articles identification data, the host institution of the study, the type of scientific journal, methodological characteristics of the studies, and primary obstetric and neonatal outcomes.

The data analysis was performed descriptively. The results are presented according to the outcomes revealed in the studies. As this is an integrative review, primarily public domain studies were used, and thus approval from an institutional review board is not needed.

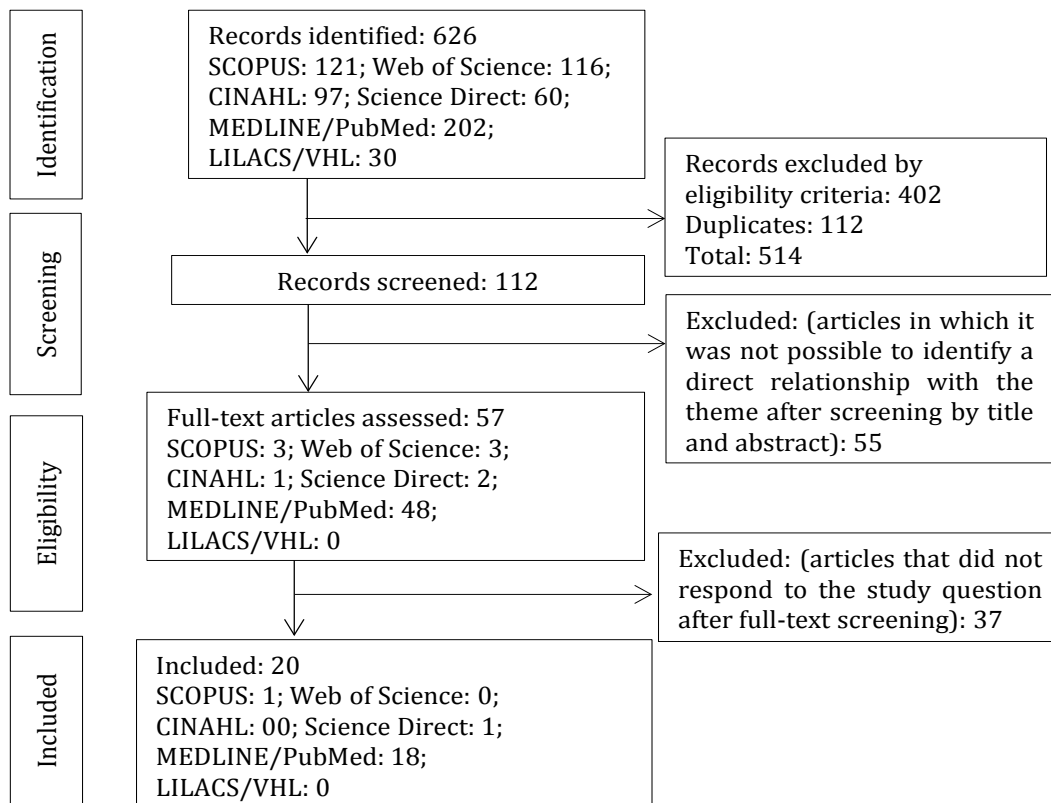


Figure 1 – Flow diagram for study selection, adapted from PRISMA. Fortaleza, CE, Brazil, 2020

Results

The studies that made up this review (Figure 2)⁷⁻²⁶ are related to the mobility of pregnant/parturient women to health services. Interest in this study object predominates in countries with less economic development and rural areas, since 13 studies^(7-8,10-15,18,21-23,26) were carried out in African countries. Recent studies have been carried out in rural areas in Oceania, North America, and Asia^(9,16-17,19-20,24-25). No evidence was found related to South America.

The studies show that mobility between home and health services is hampered by distance, even when considering private transportation. Besides, the precariousness of public transportation, living in socioeconomically disadvantaged places, and low education are factors that hinder the mobility to prenatal care services and hospitals⁽⁷⁻²⁶⁾. Populations living in rural and delta areas (close to rivers) are those

with the most significant mobility limitations, who then have unfavorable outcomes during pregnancy or at the birth^(8-9,12-13,16,18-19,24-25).

The main mobility barriers of pregnant/parturient women to maternal health services are related to distance, resulting in another important factor: travel time (which in obstetrics can be decisive for a timely intervention). Other barriers such as housing, lack of private transport, poor public transport, low income, and low education must be considered, especially in rural populations^(7-9,12-13,16,18,22,24-25).

It is also important to mention that, in addition to the mobility barriers, there are influencers that are related to the knowledge of pregnant women about the importance of performing prenatal care, the benefit of this for a favorable outcome in childbirth, populations living in urban areas (where the distance from the residence to the maternal health service is shorter than in rural areas), high income and schooling, and having a vehicle available to transport^(8-11,13-14,18,20-23).

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Reference	Outcomes
Parkhurst; Ssengooba Uganda 2009 ⁽⁷⁾	Mobility: limited in areas furthest from maternal health services. Barriers: precarious public transportation, distance, maternal health services' internal factors. Clinical outcome/Displacement impact: unsafe births at home.
Gabrysch et al. Zambia 2011 ⁽⁸⁾	Mobility: difficult in the most distant and socioeconomically disadvantaged areas. Barriers: distance, low education, low income, lack of female autonomy. Influencers: family members, knowledge of pregnant women and family members. Clinical outcome/Displacement impact: unsafe births at home, fetal death.
Grzybowski et al. Canada 2011 ⁽⁹⁾	Mobility: precarious mobility for pregnant women living in rural areas. Barriers: travel time, distance. Influencers: living close to maternal health services. Clinical outcome/Displacement impact: perinatal mortality of newborns from mothers living in watersheds, adverse perinatal results.
Gething et al. Ghana 2012 ⁽¹⁰⁾	Mobility: hindered by lack of public transport and distance. Barriers: distance from the residence to health services, in addition to precarious public transport. Clinical outcome/Displacement impact: precarious care for pregnant/parturient women and newborns, with consequent exposure to complications.
Silal et al. South Africa 2012 ⁽¹¹⁾	Mobility: hindered by barriers to accessibility, availability, and acceptability. Barriers: longer travel times, higher costs. Influencers: residing in urban areas. Clinical outcome/Displacement impact: negative interactions between professionals and patients.
Yao et al. Mozambique 2013 ⁽¹²⁾	Mobility: precarious for the most distant areas of maternal health services. Barriers: distance. Clinical outcome/Displacement impact: complications during pregnancy, maternal and fetal death.
Kitui et al. Kenya 2013 ⁽¹³⁾	Mobility: precarious mobility in socioeconomically disadvantaged areas. Barriers: low income, residence in rural areas, distance, travel, lack of transport. Influencers: high income and educational level, residency in urban areas, ethnicity. Clinical outcome/Displacement impact: exposure to pregnancy complications.
Tsawe; Susuman South Africa 2014 ⁽¹⁴⁾	Mobility: precarious mobility in socioeconomically disadvantaged areas. Barriers: Shortage of staff, financial problems, and lack of knowledge. Clinical outcome/Displacement impact: the distance reduced women's trip to maternal health services, leaving them more exposed to prenatal care complications, labor, and delivery.
Okwaraji et al. Ethiopia 2015 ⁽¹⁵⁾	Mobility: facilitated to pregnant women with older age and who had higher education. Barriers: limited transport to pregnant women in rural households. Influencers: education, experience of other pregnancies. Clinical outcome/Displacement impact: difficulties in reaching health services.
Ansari et al. Pakistan 2015 ⁽¹⁶⁾	Mobility: limited in areas furthest from maternal health services. Barriers: travel time, distance, low income, ethnicity, religious discrimination. Influencers: residing in urban areas. Clinical outcome/Displacement impact: high costs due to distance; unsafe births at home, maternal and perinatal complications.
Chong et al. Australia 2015 ⁽¹⁷⁾	Mobility: limited in areas furthest from maternal health services. Barriers: travel time; distance. Clinical outcome/Displacement impact: lower limb edema, delivery complications, fetal death, and increased maternal mortality.
Munguambe et al. Mozambique 2016 ⁽¹⁸⁾	Mobility: limited to transportation, money, and the pregnant woman's decision and/or family. Barriers: distance; low personal/family income; decision-making by pregnant women/family members. Influencers: knowledge about the importance of carrying out prenatal care and of having an antenatal record. Clinical outcome/Displacement impact: poor prenatal care.

(the Figure 2 continue in the next page...)

Reference	Outcomes
Vadrevu; Kanjilal India 2016 ⁽¹⁹⁾	Mobility: public or private transport by sea or land. Barriers: people living in delta regions (close to rivers) have limited access to maternal health services, as they are socioeconomically disadvantaged. Influencers: prenatal care and quality labor and delivery. Clinical outcome/Displacement impact: unsafe births at home, edema, fetal death.
Pancieria et al. Bangladesh 2016 ⁽²⁰⁾	Mobility: difficult in the most distant and socioeconomically disadvantaged areas. Barriers: travel time, distance, low education, and income. Influencers: pregnant women with an educational background; living close to health services. Clinical outcome/Displacement impact: home births without professional assistance.
Sacks et al. Zambia/Uganda 2016 ⁽²¹⁾	Mobility: through cars, motorcycle taxis, or public transport. Barriers: travel time, distance. Influencers: living close to health services. Clinical outcome/Displacement impact: difficulty in accessibility and unsafe births.
Makanga et al. Mozambique 2017 ⁽²²⁾	Mobility: access for pregnant women to maternal health services by public transport or on foot. Barriers: limited access to health services during periods of floods and precipitation. Clinical outcome/Displacement impact: unsafe births, respiratory distress in pregnant women, lower limb edema, decompensated blood pressure, and fetal death.
Chen et al. Tanzania 2017 ⁽²³⁾	Mobility: public or private transportation, or on foot. Barriers: distance and travel time from homes to maternal health services. Influencers: pregnant women who own vehicles. Clinical outcome/Displacement impact: poor prenatal care, home births without professional assistance, increased maternal and perinatal deaths.
Wang et al. Haiti 2017 ⁽²⁴⁾	Mobility: limited in areas furthest from maternal health services. Barriers: rural residences. Influencers: residing in urban areas. Clinical outcome/Displacement impact: home births, with a risk of complications.
Yasuoka et al. Cambodia 2018 ⁽²⁵⁾	Mobility: comparison of the actual distance and the straight line the pregnant woman travels to perform prenatal care. Barriers: travel distance. Influencers: education and knowledge about the recommended frequency for consultations. Clinical outcome/Impact of displacement: only highly educated women and those who live close to maternal health services arrived to perform prenatal care promptly.
Schmitz et al. Uganda 2019 ⁽²⁶⁾	Mobility: public transport, motor vehicles, bicycle, or on foot. Barriers: travel time; distance. Clinical outcome/Displacement impact: the displacement between home and health services has improved in Uganda, decreasing maternal and perinatal deaths.

Figure 2 – Synthesis of the articles included in the integrative review. Fortaleza, CE, Brazil, 2020

With its barriers and influencers, mobility from home to maternal health services affects the clinical outcomes of pregnant/parturient women. Studies show that these outcomes are related to complications during pregnancy, labor, and delivery, often performed unsafely at home and without professional assistance. Besides, clinical changes in pregnant wo-

men, such as respiratory distress, lower limb edema, and decompensated blood pressure, are outcomes of this process. Increases in maternal and fetal deaths are also mentioned and are the most unfavorable outcomes for women, families, and the community⁽⁷⁻²⁶⁾.

Concerning the descriptive and quantitative analysis of this review, Figure 3 displays the word

as a team. These workers are lay members of communities that work for remuneration and generally share ethnicity, language, socioeconomic status, and life experiences with the community members they serve^(22,28).

Variables such as education, maternal age, and personal or family income were significantly associated with travel time to the best quality health unit or the nearest health center^(15,29). The difficulty of mobility in emergency obstetric care is a crucial factor that explains why most births in rural regions still occur at home, without specialized care⁽²⁹⁻³⁰⁾.

The parturients who live in rural areas have to travel to access maternity services, have higher rates of adverse results, and more extended stays of newborns (in days) in neonatal intensive care units⁽²⁷⁾.

The distance measured in a real or straight-line appears as barriers for pregnant/parturient women to access health services^(11,17,25,29). The greater the distance, whether it is real or in a straight line, the greater the likelihood that women will not seek maternal health services and perform childbirth at home assisted by lay people⁽²⁹⁾.

It can also be highlighted that the lack of knowledge and the low quality of maternal health services are barriers and determinants associated with the use of these services. These barriers are related to the lack of inclusion of the media in terms of information related to maternal health services and the importance of such services, scarcity of educational programs aimed at improving the literacy skills of women (especially in rural areas), lack of policies aimed at shaping women's livelihoods, and poor quality maternal health care in rural areas^(14,30).

From another perspective, women regularly seek prenatal care at health facilities. However, some factors prevent them from accessing these facilities promptly, which include social discouragement to reveal early pregnancy, lack of knowledge about the warning signs of pregnancy, poor transportation infrastructure, and fear of maltreatment in health facilities, which causes a discouraging impact for pregnant

women and their partners and, consequently, lack of empowerment⁽³⁰⁾.

Although the studies found in this review are limited to assessing mobility in rural areas, it is understood that mobility may also be impaired in large urban areas and that this compromises health and clinical outcomes.

The quantitative analysis performed from the word cloud showed that the clinical outcome of pregnant/parturient women reflects displacement. Therefore, the mother-child dyad's health is influenced by the woman's mobility between home and maternal health services, the quality of care provided by these services, the influencers related to the area in which the woman inhabits, and her limitations. The word cloud makes it possible to identify co-occurrences between words and their result indicates the connection between them, helping to identify the representation structure.

Although this review does not present data related to the mobility situation of pregnant/parturient women in the Brazilian context (which per se reveals a knowledge gap), the authors dare to reflect that Brazilian cities also have mobility difficulties that deserve to be evaluated, so that measures aimed at minimizing health impacts related to mobility can be implemented ensuring the right to come and go for all citizens.

This study also points out the need for further studies, especially in Brazil, which shows efforts to address the impact of pregnant women's displacement between their homes and maternal health services. Linking data sets using the geographic information system has the potential for future research and can help overcome the neglect of these health system factors in research and policy.

The difficulty in mobility to prenatal and obstetric emergency care is a crucial factor that explains the adverse maternal and neonatal impact that women may experience. Therefore, addressing geographical and quality of access barriers is crucial to increasing the quality of services and decreasing maternal and perinatal mortality.

Conclusion

The study showed that the difficulty of the mobility of pregnant/parturient women from residence to maternal health services is a crucial factor that explains adverse maternal and neonatal impacts including space, transportation, physical, social and economic infrastructure, revealing the impact on the health of the mother-child dyad, demonstrated by mobility barriers and influencers.

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Collaborations

Rodrigues IR and Oriá MOB contributed to the conception, design, analysis, and interpretation of data, writing of the article, relevant critical review of the intellectual content, and approval of the final version of the manuscript to be published. Sales LBF, Gomes MLS, and Moura NS collaborated in the analysis and interpretation of data, writing of the article, and approval of the final version of the manuscript to be published.

References

1. Monte AS, Mendes IC, Oriá MOB, Carvalho FHC, Brown H, Damasceno AKC. Near miss maternal: influencing factors and guidelines for reducing maternal morbidity and mortality. *Rev Rene*. 2018; 19:e3182. doi: <https://dx.doi.org/10.15253/2175-6783.2018193182>
2. Chávez GM, Viegas SMF, Roquini GR, Santos TR. Access, accessibility, and demand at the family health strategy. *Esc Anna Nery*. 2020; 24(4):e20190331. doi:<https://dx.doi.org/10.159/2177-9465-ean-2019-0331>
3. Bloch JR, Cordivano S, Gardner M, Barkin J. Beyond bus fare: deconstructing prenatal care travel among low-income urban mothers through a mix methods GIS study. *Contemp Nurse*. 2018; 54(3):233-45. doi: <http://dx.doi.org/10.1080/10376178.2018.1492349>
4. Whittemore R, Knafl K. The integrative review: updated methodology. *J Adv Nurs*, 2005; 52(5):546-53. doi: <https://dx.doi.org/10.1111/j.1365-2648.2005.03621.x>
5. Camargo BV, Justo AM. IRAMUTEQ: Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires. *Temas Psicol*. 2013; 21(2):513-8. doi: <https://dx.doi.org/10.9788/TP2013.2-16>
6. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA statement. *Phys Ther*. 2009; 89(9):873-80. doi: <https://dx.doi.org/10.1093/ptj/89.9.873>
7. Parkhurst JO, Ssengooba F. Assessing access barriers to maternal health care: measuring bypassing to identify health Centre needs in rural Uganda. *Health Policy Plan*. 2009; 24(5):377-84. doi: <https://dx.doi.org/10.1093/heapol/czp023>
8. Gabrysch S, Cousens S, Cox J, Campbell OMR. The influence of distance and level of care on delivery place in rural Zambia: a study of linked national data in a geographic information system. *PLoS Med*. 2011; 8(1):e1000394. doi: <https://dx.doi.org/10.1371/journal.pmed.1000394>
9. Grzybowski S, Stoll K, Kornelsen J. Distance matters: a population-based study examining access to maternity services for rural women. *BMC Health Serv Res*. 2011; 11:147. doi: <https://dx.doi.org/10.1186/1472-6963-11-147>
10. Gething PW, Johson FA, Frempong-Ainguah F, Nyarko P, Baschieri A, Aboagye P, et al. Geographical access to care at birth in Ghana: a barrier to safe motherhood. *BMC Public Health*. 2012; 12:991. doi: <https://dx.doi.org/10.1186/1471-2458-12-991>

11. Silal SP, Penn-Kekana L, Harris B, Birch S, McIntyre D. Exploring inequalities in access to and use of maternal health services in South Africa. *BMC Health Serv Res.* 2012; 12:120. doi: <https://dx.doi.org/10.1186/1472-6963-12-120>
12. Yao J, Murray AT, Agadjanian V. A geographical perspective on access to sexual and reproductive health care for women in rural Africa. *Soc Sci Med.* 2013; 96(1):60-8. doi: <https://dx.doi.org/10.1016/j.socscimed.2013.07.025>
13. Kitui J, Lewis S, Davey G. Factors influencing place of delivery for women in Kenya: an analysis of the Kenya demographic and health survey, 2008/2009. *BMC Pregnancy Childbirth.* 2013; 13(40):1-10. doi: <https://dx.doi.org/10.1186/1471-2393-13-40>
14. Tsawe M, Susuman AS. Determinants of access to and use of maternal health care services in the Eastern Cape, South Africa: a quantitative and qualitative investigation. *BMC Res Notes.* 2014; 7:723. doi: <https://dx.doi.org/10.1186/1756-0500-7-723>
15. Okwaraji YB, Webb EL, Edmond KM. Barriers in physical access to maternal health services in rural Ethiopia. *BMC Health Serv Res.* 2015; 15:493. doi: <https://dx.doi.org/10.1186/s12913-015-1161-0>
16. Ansari MS, Manzoor R, Siddigui N, Ahmed AM. Access to comprehensive emergency obstetric and newborn care facilities in three rural districts of Sindh province, Pakistan. *Health Res Policy Syst.* 2015; 13(55):57-98. doi: <https://dx.doi.org/10.1186/s12961-015-0042-7>
17. Chong S, Byun R, Jalaludin BB. A feasibility study using geographic access to general practices and routinely collected data in public health and health services research. *Public Health Res Pract.* 2015; 25(4):e2541542. doi: <https://dx.doi.org/10.17061/phrp2541542>
18. Munguambe K, Boene H, Vidler M, Bique C, Sawchuck D, Firoz T, et al. Barriers and facilitators to health care seeking behaviours in pregnancy in rural communities of southern Mozambique. *Reprod Health.* 2016; 13(1):83-97. doi: <https://dx.doi.org/10.1186/s12978-016-0141-0>
19. Vadrevu L, Kanjilal B. Measuring spatial equity and access to maternal health services using enhanced two step floating catchment area method (E2SFCA) – a case study of the Indian Sundarbans. *Int J Equity Health.* 2016; 15:87. doi: <https://dx.doi.org/10.1186/s12939-016-0376-y>
20. Panciera R, Khan A, Rizvi SJR, Ahmed S, Ahmed T, Islam R, et al. The influence of travel time on emergency obstetric care seeking behavior in the urban poor of Bangladesh: a GIS study. *BMC Pregnancy Childbirth.* 2016; 16(1):240. doi: <https://dx.doi.org/10.1186/s12884-016-1032-7>
21. Sacks E, Vail D, Austin-Evelyn K, Greeson D, Atuyambe LM, Macwan'gi M, et al. Factors influencing modes of transport and travel time for obstetric care: a mixed methods study in Zambia and Uganda. *Health Policy Plan.* 2016; 31(3):293-301. doi: <https://dx.doi.org/10.1093/heapol/czv057>
22. Makanga PT, Schuurman N, Sacooc C, Boene HE, Vilanculo F, Vidler M, et al. Seasonal variation in geographical access to maternal health services in regions of southern Mozambique. *Int J Health Geogr.* 2017; 16:1. doi: <https://dx.doi.org/10.1186/s12942-016-0074-4>
23. Chen YN, Schmitz MM, Serbanescu F, Dynes MM, Maro G, Kramer MR. Geographic access modeling of emergency obstetric and neonatal care in Kigoma region, Tanzania: transportation schemes and programmatic implications. *Global Health Sci Pract.* 2017; 5(3):430-45. doi: <https://dx.doi.org/10.9745/GHSP-D-17-00110>
24. Wang W, Winner M, Burgert-Bruckera CR. Limited service availability, readiness, and use of facility-based delivery care in haiti: a study linking health facility data and population data. *Global Health Sci Pract.* 2017; 5(2):244-61. doi: <https://dx.doi.org/10.9745/GHSP-D-16-00311>
25. Yasuoka J, Nanishi K, Kikuchi K, Suzuki S, Ly P, Thavrin B, et al. Barriers for pregnant women living in rural, agricultural villages to accessing antenatal care in Cambodia: a community-based cross-sectional study combined with a geographic information system. *PLoS One.* 2018; 13(3):e0194103. doi: <https://dx.doi.org/10.1371/journal.pone.0194103>
26. Schmitz MM, Serbanescu F, Kamara V, Kraft JM, Cunningham M, Opio G, et al. Did saving mothers, giving life expand timely access to lifesaving care in Uganda? A spatial district-level analysis of travel

- time to emergency obstetric and newborn care. *Global Health Sci Pract.* 2019; 7(1):151-67. doi: <https://dx.doi.org/10.9745/GHSP-D-18-00366>
27. Viegas APB, Carmo RF, Luz ZMP. Fatores que influenciam o acesso aos serviços de saúde na visão de profissionais e usuários de uma unidade básica de referência. *Saúde Soc.* 2015; 24(1):100-12. doi: <https://dx.doi.org/10.1590/S0104-12902015000100008>
28. Maciazeki-Gomes RC, Souza CD, Baggio L, Wachs F. The work of the community health worker from the perspective of popular health education: possibilities and challenges. *Ciênc Saúde Coletiva.* 2016; 21(5):1637-46. doi: <https://dx.doi.org/10.1590/1413-81232015215.17112015>
29. Willey B, Waiswa P, Kajjo D, Munos M, Akuze J, Allen E, et al. Linking data sources for measurement of effective coverage in maternal and newborn health: what do you learn from individual-vs ecological-linking methods? *J Glob Health.* 2018; 8(1):010601. doi: <https://dx.doi.org/10.7189/jogh.08.010601>
30. Lera I, Perez T, Guerrero C, Eguiluz VM, Juiz C. Analysing human mobility patterns of hiking activities through complex network theory. *PLoS One.* 2017; 12(5):e0177712. doi: <https://dx.doi.org/10.1371/journal.pone.0177712>



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