Maternity Waiting Home Interventions as a Strategy for Improving Birth Outcomes: A Scoping Review and Meta-Analysis

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ABSTRACT

**Background and Objective:** Over 300,000 women worldwide die due to pregnancy-related complications annually, with most occurring in developing countries where access to skilled obstetric care is limited. Maternity waiting homes (MWHs) are one intervention designed to increase access to skilled prenatal care in resource-limited settings. MWHs are defined as accommodations at or near a health facility where pregnant women can stay in the final weeks of their pregnancy so they can be easily transferred to the health facility to give birth. While MWHs have existed for decades, evidence regarding their effectiveness in reducing adverse birth outcomes has been mixed. The objective of this study is to comprehensively assess all available MWH research reporting quantitative maternal and childbirth data to determine whether MWHs are an effective maternal health strategy in resource-limited settings.

**Methodology:** We conducted a scoping review and meta-analysis of existing literature on MWHs according to PRISMA guidelines. Descriptive statistics and odds ratios were calculated for the following birth outcomes: maternal mortality, perinatal mortality, and caesarian section. Quantitative analysis was conducted in RStudio and Stata Version 16.

**Results:** One hundred seventy-one records were retrieved from our initial database search, of which 66 were identified as relevant. Only 15 of these records reported quantitative data on the health outcomes of interest and therefore met inclusion criteria for our meta-analysis. All studies reporting maternal mortality demonstrated a protective effect of MWHs (aggregate OR: 0.19 [0.10, 0.40]), as did all studies reporting perinatal mortality (aggregate OR: 0.29 [0.16, 0.53]). Studies reporting caesarian section were more varied and indicated less of a protective effect (aggregate OR: 1.80 [1.18, 2.75]).

**Conclusions:** There is some indication that MWHs are an effective strategy for reducing maternal and perinatal mortality in resource-limited settings. However, our analysis was constrained by the observational design of most prior MWH studies. More rigorous MWH evaluations, ideally in the form of randomized-control trials, are needed to better determine MWH effectiveness.
INTRODUCTION

Over 300,000 women die due to pregnancy-related complications every year, and 99% of these deaths occur in developing countries [1]. The vast majority of maternal deaths are preventable and treatable when women have access to skilled obstetric care, but this is challenging in resource-limited settings. A widely accepted framework for understanding maternal mortality is the three phases of delay model, which describes three main periods where women are likely to die in pregnancy: 1) delay in deciding to seek medical care, 2) delay in reaching a care facility, and 3) delay in receiving care once arriving at a facility [2]. Maternity waiting homes (MWHs) are one intervention aimed at eliminating the phase 2 delay by bringing women closer to facilities for delivery. MWHs go by many names (e.g., maternity waiting areas, antenatal villages), but in general are accommodations at or near a health facility where pregnant women can stay in the final weeks of their pregnancy so they can easily be transferred to the health facility to give birth with a skilled attendant present and with emergency obstetric care available if needed [3].

Although MWHs have existed for decades, literature regarding the effectiveness of MWHs on improving maternal and child health outcomes has been mixed. Several researchers have attempted literature reviews on the topic of MWHs, which are either too narrow in their eligibility criteria or are not comprehensive. In 1996, the World Health Organization (WHO) Safe Motherhood Unit conducted a review of experiences as case studies of MWHs in seven countries [4]. Most studies in this review demonstrated improved health outcomes, but challenges related to record-keeping and data collection in resource-limited settings proved obstructive to quantitative analysis. This made it challenging for the review to assess MWH effectiveness beyond anecdotal evidence. Even so, the WHO review created a framework for implementing MWH interventions with four essential elements and seven steps for establishing new MWHs. Overall, the WHO Safe Motherhood Unit recommended establishing MWHs as part of a comprehensive program to prevent pregnancy-related morbidity and mortality [4].

In an attempt to conduct a more rigorous review, researchers from the Netherlands published a Cochrane review of MWH randomized control trials (RCTs), finding that no RCTs or cluster RCTs had been conducted as of 2012 [5]. The review instead included 9 retrospective cohort studies, but was restricted in its interpretation due to high risk of selection bias. In contrast to the aforementioned WHO review, almost half of the studies included in the Cochrane review found MWHs to be ineffective in improving health outcomes. The authors called on future studies to assess MWH effectiveness using RCTs rather than observational studies.

More recently, two reviews focused on MWH interventions were published in 2017. The first, a scoping review in Maternal and Child Health Journal, focused specifically on newborn outcomes [6]. The authors found that in general, MWHs have positive impacts on newborn morbidity and mortality, but highlighted the need for unbiased research into the effectiveness of MWHs [6]. It should be noted that this review was scoping and not comprehensive, and was limited by excluding maternal health outcomes from analysis [6]. The second MWH review, published in BMC Pregnancy and Childbirth, included 29 studies and focused on qualitative findings of MWH research [7]. While this review did not analyze quantitative data, it provided important insight into the implementation of MWH interventions. The authors emphasized the importance of engaging women and other community members for input and to identify barriers, the quality of MWH facilities, the quality of maternity care provided at the associated health facility, and the financial and operational stability of MWHs [7].

The objective of this literature review and meta-analysis is to comprehensively assess all available research reporting quantitative MWH maternal and childbirth outcome data, aggregate and analyze health outcome measures across studies, and determine whether MWHs are effective at improving maternal and child health outcomes in resource-limited settings.
METHODS

SEARCH STRATEGY AND SELECTION CRITERIA

This scoping review and meta-analysis was conducted in accordance with PRISMA guidelines [8]. The review protocol was registered in PROSPERO (number CRD42018111716). We searched the electronic bibliographic databases PubMed and EMBASE. The search strategy included only terms relating to the intervention. The following terms were searched: “Maternity waiting home,” “maternal waiting home,” “maternity waiting area,” “maternity waiting facility,” “maternity waiting shelters,” and “antenatal village.” Studies were restricted to those that describe an intervention in a low- or middle-income country. There were no language or date restrictions. Studies were excluded if they were literature reviews, not focused on an MWH intervention, or did not report hard outcome data. Database searches were re-run prior to final analysis and further studies were retrieved for inclusion.

DATA SYNTHESIS AND ANALYSIS

A narrative synthesis of both quantitative and qualitative findings from included studies was produced. This synthesis was structured around study design, study population, key findings and implications, and characteristics of the MWH intervention (e.g., cost, admission criteria, facilities, etc.). Quantitative data synthesis was performed by calculating descriptive statistics and odds ratios for the following outcomes: maternal mortality, perinatal mortality/stillbirth, and caesarian section. Maternal mortality is defined as the number of maternal deaths divided by the total number of births per study. Perinatal mortality is defined as the number of perinatal deaths divided by the total number of births per study. Stillbirth, which we used as a proxy for perinatal mortality in studies that do not report perinatal deaths, is defined as the number of stillbirths or intrauterine fetal deaths divided by the total number of births per study. Caesarian section rate is defined as the total number of C-sections divided by the total number of births. Initial quantitative data analysis was performed using RStudio and finalized using Stata Version 16 (StataCorp, College Station, TX). All meta-analysis functions were performed in Stata Version 16.

RESULTS

Our database search yielded 171 records, with 107 remaining after the removal of duplicates. In addition, 10 records were identified from other sources, such as the references of prior reviews. Twelve records were excluded because they were not full-text, 5 articles were excluded because they are reviews, 10 articles were excluded for being off-topic or otherwise too broad, and 24 articles were excluded for lacking health outcome data. This left 66 total articles: 34 articles with quantitative outcome data and 32 articles with qualitative health outcome data (Figure 1). After a rigorous review of these studies, we identified only 15 articles reporting health outcomes of interest: maternal mortality, perinatal mortality or stillbirth, and caesarian section. These 15 studies were selected for inclusion in the final meta-analysis.

All 66 records retrieved were observational. There was great variance in terms of study design, with cohort studies [9–18], cross-sectional studies [19–39], intervention studies [40–50], and unspecified studies included [51–75]. Of the 66 studies, only one mentioned any kind costing analysis of MWHs [47]. Although minimal restrictions were placed on MWH location, each of the 15 studies included in the meta-analysis took place in sub-Saharan Africa (Appendix 1). Among the original 66 studies, most took place in sub-Saharan Africa, Latin America, and Southeast Asia.

Of the 15 studies included in the meta-analysis, 11 reported maternal mortality data (Table 1). Each of these 11 studies demonstrated a lower prevalence of maternal mortality in women who utilized an MWH compared to those who did not (Table 1). Six of the studies reported no maternal deaths in the group of women who utilized an MWH (Table 1). When aggregated, 0.05% of mothers who utilized an MWH died of pregnancy-related complications, compared to 0.6% of mothers who did not utilize an MWH. In a random-effects REML model, the overall odds ratio for maternal mortality was 0.19 [0.10, 0.40] (Figure 2).
Figure 1 PRISMA Diagram demonstrating search strategy and inclusion criteria for the scoping review and meta-analysis.

Table 1 Maternal mortality analysis comparing women who stayed in an MWH prior to giving birth to women who did not stay in an MWH prior to giving birth across 11 observational studies.

<table>
<thead>
<tr>
<th>FIRST AUTHOR</th>
<th>TOTAL N</th>
<th>MWH N</th>
<th>NON-MWH N</th>
<th>MM MWH</th>
<th>MM NON-MWH</th>
<th>PERCENT MATERNAL DEATH</th>
<th>ADJUSTED OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poovan</td>
<td>777</td>
<td>142</td>
<td>635</td>
<td>0</td>
<td>13</td>
<td>0.00%</td>
<td>0.16</td>
</tr>
<tr>
<td>Van Lonkhuijzen</td>
<td>510</td>
<td>218</td>
<td>292</td>
<td>0</td>
<td>1</td>
<td>0.00%</td>
<td>0.44</td>
</tr>
<tr>
<td>Andemichael</td>
<td>1128</td>
<td>862</td>
<td>266</td>
<td>0</td>
<td>5</td>
<td>0.00%</td>
<td>0.03</td>
</tr>
<tr>
<td>Kelly</td>
<td>24148</td>
<td>6805</td>
<td>17343</td>
<td>6</td>
<td>187</td>
<td>0.08%</td>
<td>0.08</td>
</tr>
<tr>
<td>Gaym</td>
<td>4275</td>
<td>902</td>
<td>3373</td>
<td>0</td>
<td>12</td>
<td>0.00%</td>
<td>0.15</td>
</tr>
<tr>
<td>Lori</td>
<td>18044</td>
<td>8477</td>
<td>9567</td>
<td>3</td>
<td>12</td>
<td>0.03%</td>
<td>0.25</td>
</tr>
<tr>
<td>Braat</td>
<td>17679</td>
<td>2784</td>
<td>14895</td>
<td>0</td>
<td>51</td>
<td>0.00%</td>
<td>0.05</td>
</tr>
<tr>
<td>Fogliati</td>
<td>1077</td>
<td>348</td>
<td>729</td>
<td>1</td>
<td>4</td>
<td>0.29%</td>
<td>0.52</td>
</tr>
<tr>
<td>Meshesha</td>
<td>516</td>
<td>86</td>
<td>430</td>
<td>0</td>
<td>1</td>
<td>0.00%</td>
<td>0.23</td>
</tr>
<tr>
<td>Turnwine</td>
<td>1053</td>
<td>280</td>
<td>773</td>
<td>1</td>
<td>3</td>
<td>0.36%</td>
<td>0.91</td>
</tr>
<tr>
<td>Spaans</td>
<td>1041</td>
<td>616</td>
<td>425</td>
<td>1</td>
<td>2</td>
<td>0.16%</td>
<td>0.34</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>70248</td>
<td>21520</td>
<td>48728</td>
<td>12</td>
<td>291</td>
<td>0.05%</td>
<td>0.19</td>
</tr>
</tbody>
</table>

n = number of women enrolled in study; MM = maternal mortality, OR = odds ratio.
Of the studies included in the meta-analysis, 11 reported perinatal mortality or stillbirth (Table 2). Across all included studies, there was a lower prevalence of perinatal mortality or stillbirth in women who utilized an MWH compared to those who did not (Table 2). When aggregated, 1.30% of MWH births resulted in perinatal death, compared to 10.42% of non-MWH births. In a random-effects REML model, the overall odds ratio for perinatal mortality/stillbirth was 0.29 [0.16, 0.53] (Figure 3).

<table>
<thead>
<tr>
<th>FIRST AUTHOR</th>
<th>TOTAL N</th>
<th>MWH N</th>
<th>NON-MWH N</th>
<th>PM MWH</th>
<th>PERCENT PERINATAL DEATH</th>
<th>PM NON-MWH</th>
<th>PERCENT PERINATAL DEATH</th>
<th>ADJUSTED OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poovan*</td>
<td>777</td>
<td>142</td>
<td>635</td>
<td>4</td>
<td>2.82%</td>
<td>161</td>
<td>25.35%</td>
<td>0.09</td>
</tr>
<tr>
<td>Millard</td>
<td>854</td>
<td>502</td>
<td>352</td>
<td>17</td>
<td>3.39%</td>
<td>24</td>
<td>6.82%</td>
<td>0.43</td>
</tr>
<tr>
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<td>17343</td>
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<td>1.76%</td>
<td>3316</td>
<td>19.12%</td>
<td>0.08</td>
</tr>
<tr>
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<td>902</td>
<td>3373</td>
<td>48</td>
<td>5.32%</td>
<td>276</td>
<td>8.18%</td>
<td>0.63</td>
</tr>
<tr>
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<td>8477</td>
<td>9567</td>
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<td>0.28%</td>
<td>60</td>
<td>0.63%</td>
<td>0.45</td>
</tr>
<tr>
<td>Braat*</td>
<td>17679</td>
<td>2784</td>
<td>14895</td>
<td>38</td>
<td>1.36%</td>
<td>1110</td>
<td>7.45%</td>
<td>0.17</td>
</tr>
<tr>
<td>Fogliati</td>
<td>1077</td>
<td>348</td>
<td>729</td>
<td>14</td>
<td>4.02%</td>
<td>41</td>
<td>5.62%</td>
<td>0.70</td>
</tr>
<tr>
<td>Meshesha*</td>
<td>516</td>
<td>86</td>
<td>430</td>
<td>1</td>
<td>1.16%</td>
<td>25</td>
<td>5.81%</td>
<td>0.19</td>
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<tr>
<td>Nigusse</td>
<td>829</td>
<td>323</td>
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<tr>
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<td>1053</td>
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<td>773</td>
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<td>1.07%</td>
<td>16</td>
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<td>0.51</td>
</tr>
<tr>
<td>Singh</td>
<td>141</td>
<td>46</td>
<td>95</td>
<td>0</td>
<td>0.00%</td>
<td>4</td>
<td>4.21%</td>
<td>3.40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>69393</td>
<td>20695</td>
<td>48698</td>
<td>269</td>
<td>1.30%</td>
<td>5076</td>
<td>10.42%</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Table 2 Perinatal mortality analysis comparing women who stayed in an MWH prior to giving birth to women who did not stay in an MWH prior to giving birth across 11 observational studies. n = number of women enrolled in study; PM = perinatal mortality, OR = odds ratio; * Stillbirth used as proxy for perinatal mortality.

Nine of the 15 studies reported number of caesarian sections, 5 of which showed a higher rate of C-sections among MWH users compared to non-users (Table 3). When aggregated 36.2% of women who stayed in an MWH had a C-section, compared to 18.4% of those who did not stay in an MWH. In a random-effects REML model, the overall odds ratio for caesarian section was 1.80 [1.18, 2.75] (Figure 4).
### Table 3: Caesarian Section Analysis

Comparing women who stayed in an MWH prior to giving birth to women who did not stay in an MWH prior to giving birth across 9 observational studies.

<table>
<thead>
<tr>
<th>FIRST AUTHOR</th>
<th>TOTAL N</th>
<th>MWH N</th>
<th>NON-MWH N</th>
<th>C-SECTION MWH</th>
<th>PERCENT C-SECTION MWH</th>
<th>C-SECTION NON-MWH</th>
<th>PERCENT C-SECTION NON-MWH</th>
<th>ADJUSTED OR</th>
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<tr>
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<td>635</td>
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<td>46</td>
<td>13.07%</td>
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</tr>
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<td>674</td>
<td>19.98%</td>
<td>2.50</td>
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<td>14895</td>
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<td>41.13%</td>
<td>2414</td>
<td>16.21%</td>
<td>3.61</td>
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<tr>
<td>Fogliati</td>
<td>1077</td>
<td>348</td>
<td>729</td>
<td>104</td>
<td>29.89%</td>
<td>222</td>
<td>30.45%</td>
<td>0.97</td>
</tr>
<tr>
<td>Meshesha</td>
<td>516</td>
<td>86</td>
<td>430</td>
<td>25</td>
<td>29.07%</td>
<td>55</td>
<td>12.79%</td>
<td>2.79</td>
</tr>
<tr>
<td>Tumwine</td>
<td>1053</td>
<td>280</td>
<td>773</td>
<td>32</td>
<td>11.43%</td>
<td>96</td>
<td>12.42%</td>
<td>0.91</td>
</tr>
<tr>
<td>Getachew</td>
<td>812</td>
<td>406</td>
<td>406</td>
<td>72</td>
<td>17.73%</td>
<td>36</td>
<td>8.87%</td>
<td>2.22</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>12255</strong></td>
<td><strong>38936</strong></td>
<td><strong>4438</strong></td>
<td><strong>36.21%</strong></td>
<td><strong>7151</strong></td>
<td><strong>18.37%</strong></td>
<td><strong>1.80</strong></td>
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</table>

**Figure 3** Forest plot demonstrating effects of MWHs on perinatal mortality or stillbirth across 11 observational studies.

**Figure 4** Forest plot demonstrating effects of MWHs on C-section across 9 observational studies.

Table 3 Caesarian section analysis comparing women who stayed in an MWH prior to giving birth to women who did not stay in an MWH prior to giving birth across 9 observational studies. 

n = number of women enrolled in study; OR = odds ratio.
Of the original 66 articles reviewed, all reported at least some descriptive information about MWHs. These qualitative data included information about the direct cost of staying at an MWH, the admission criteria for an MWH, and whether or not food is provided to women at an MWH (Appendix 2). Twenty-eight studies reported whether there was a direct cost to MWH users, 13 of which did charge women a fee, and 15 of which were free of charge (Table 4). Twenty-one studies reported whether or not there were admission criteria for staying in the MWH, 11 of which specified admission criteria and 10 of which reported no criteria (Table 4). Forty-three studies described the provisions or facilities offered by MWHs. Of these studies, 10 reported the provision of food, 18 reported the presence of toilet and shower facilities, and 15 reported the presence of kitchen facilities (Table 4). Very few studies provided information on how MWHs were owned and operated. Of the studies included in the meta-analysis, three reported the involvement of faith-based organizations in MWH operations, three reported support from their local ministries of health, four reported a community-ownership model supported by external development partners, and the remainder provided no operations information (Appendix 2). Based on these limited results, it appears that most MWHs are operated through either public support or public-private partnerships.

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>ARTICLES RETRIEVED</th>
<th>DIRECT COST</th>
<th>ADMISSION CRITERIA</th>
<th>PROVISIONS AND FACILITIES</th>
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</thead>
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<td></td>
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<td>HIGH RISK</td>
<td>FOOD PROVIDED</td>
</tr>
<tr>
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<td>FREE</td>
<td>FACILITY REFERRAL</td>
<td>TOILET AND SHOWER FACILITIES</td>
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<td>KITCHEN FACILITIES</td>
</tr>
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<td>1</td>
<td>7</td>
<td>3</td>
</tr>
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<td>–</td>
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<td>–</td>
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<tr>
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<tr>
<td>Lao People’s Democratic Republic</td>
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<tr>
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<td>–</td>
<td>1</td>
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<td>–</td>
<td>–</td>
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<td>1</td>
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<td>–</td>
<td>–</td>
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<td>1</td>
</tr>
<tr>
<td>Zimbabwe</td>
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<td>13</td>
<td>15</td>
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DISCUSSION

The results of this meta-analysis indicate that, among the included studies, MWHs are very effective at reducing both maternal mortality and perinatal mortality. This is especially true if MWHs are included as part of a larger, comprehensive maternal health strategy. The overall odds ratios calculated for maternal mortality and perinatal mortality are 0.19 and 0.29 respectively, indicating a strong protective effect of MWHs on birth outcomes. The overall odds ratio of 1.80 for caesarian section was less conclusive, however this could indicate that women who stay in MWHs have better access to emergency obstetric care when pregnancy complications arise. This is in contrast to women admitted directly to the hospital from home, who may be too far along in their labor to undergo C-section upon arrival.

These studies identified several factors that influenced women’s decisions to utilize MWHs. Direct cost and the provision of food were identified as major factors in deciding whether or not to stay at an MWH. Eligibility criteria also played an important, albeit controversial, role in MWH utilization.
The studies included in this meta-analysis were split on the presence of specific admission criteria. In studies reporting admission criteria, commonly cited criteria included current or prior pregnancy complication and substantial distance from a health facility [9, 12–15, 43, 55]. Other studies, however, reported that MWHs were open to all women approaching the end of their pregnancy, regardless of obstetric history or distance from a health facility [10, 11, 19, 20, 41, 42, 51, 54]. While risk-based admission criteria for MWHs make sense, especially if the demand for utilization is high, it should be noted that 15–20% of “low-risk” pregnancies still result in emergency complications [76]. Therefore, the creation of MWH admission criteria based solely on observed risk could prohibit utilization by other women who stand to benefit from MWH services.

LIMITATIONS

A major limitation of this scoping review and meta-analysis is that all of the studies included are observational, leaving them prone to bias. In addition, all of the studies use women who are directly admitted to a hospital for delivery as a comparison group, rather than women who give birth at home. This distinction is important as most rural women in low- and middle-income countries deliver at home. The use of women directly admitted to a hospital as a comparison group has potential to bias the results by overestimating the effect of MWHs on birth outcomes. This is due to the fact that women directly admitted to these hospitals often attempt to give birth at home first, seeking medical care only when complications arise. This makes the comparison group naturally more prone to adverse health outcomes. In future MWH evaluation studies, women who give birth at home may be a more valid comparison group. In addition, C-section may not be an ideal measure of MWH impact for future studies, given that patients requiring C-section are more likely to be accommodated at MWHs and therefore prone to sample selection bias.

Another limitation of this review and meta-analysis is the fact that limited research on MWHs exists. As noted, all 15 of the included studies were observational. Only one randomized control trial has been conducted to determine the efficacy of MWHs on improving birth outcomes [77]. This RCT was ultimately excluded from our meta-analysis because it only reported on the presence or absence of institutional births, and not on specific birth outcomes. Furthermore, only one economic evaluation has been conducted to determine the financial practicality of MWHs [47]. While this costing analysis did find MWHs to be a cost-effective intervention, the study was conducted in rural Liberia and therefore may not be generalizable to other locations [47]. Robust evaluation studies, both impact and economic, are needed to accurately assess the benefits of MWHs on reducing adverse birth outcomes.

CONCLUSION

Overall, there is evidence to suggest that MWH interventions are protective against maternal mortality and perinatal mortality. Although current research on MWH effectiveness is observational and prone to bias, the aggregate effect measures of MWHs on maternal mortality and perinatal mortality are notable. MWH interventions warrant rigorous, unbiased evaluations in the form of RCTs or cluster RCTs. Ideally, future research will cluster-randomize facilities to establish an MWH and match facilities without an MWH as a comparison group. While this would take extensive resources and community support, it would allow researchers to adequately assess MWH effectiveness in low- and middle-income settings. Based on the results of this meta-analysis, low- and middle-income settings should strongly consider including MWHs as part of a comprehensive plan to improve maternal and child health.

ADDITIONAL FILES

The additional files for this article can be found as follows:

- Appendix 1. TMWH Literature Review Summary Table. DOI: https://doi.org/10.5334/aogh.3496.s1
- Appendix 2. MWH Selected Qualitative Characteristics. DOI: https://doi.org/10.5334/aogh.3496.s2
COMPETING INTERESTS
The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS
All authors made significant intellectual contributions to this study through data collection and analysis, manuscript drafting and revision, and approval of the final manuscript. All authors have access to the primary data used in this manuscript.

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