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Abstract

Objectives: Despite global efforts to increase facility-based (FB) delivery, 90% of women in rural Ethiopia deliver at home without a skilled birth attendant. Men have an important role in increasing FB deliveries, but this is largely unexplored. This study aimed to determine differences between the facility-based delivery care attributes preferred by women and men, and whether poverty or household decision-making are associated with choice to deliver in a facility.

Setting and Participants: We conducted a cross-sectional discrete choice experiment in 109 randomly selected households in rural Ethiopia in September-October 2015. We interviewed women, who were pregnant or who had a child < 2 years old, and their male partners.

Results: Both women and men preferred health facilities where medications and supplies were available (OR=3.08 (2.03 to 4.67), $p<0.001$; OR=2.68 (1.79 to 4.02), $p<0.001$), a support person was allowed in the delivery room (OR=1.69 (1.37 to 2.07), $p<0.001$; OR=1.74 (1.42 to 2.14), $p<0.001$), delivery cost was low (OR=1.15 (1.12 to 1.18), $p<0.001$; OR=1.14 (1.11 to 1.17), $p<0.001$), and doctors performed the delivery. Women valued free ambulance service (OR=1.37 (1.09 to 1.70), $p=0.006$), while men favored nearby facilities (OR=1.09 (1.06 to 1.13), $p<0.001$) with friendly providers (OR=1.30 (1.03 to 1.64), $p=0.030$). Men are disproportionately involved in making household decisions (X^2 (1, N=216)= 72.18, $p<.001$), including decisions to seek health care (X^2 (1, N=216)= 55.39, $p<.001$), yet men were often unaware of their partners' prenatal care attendance (X^2 (1, N=215)= 82.59, $p<.001$).

Conclusions: The Ethiopian government and health facilities could increase facility births in rural areas by responding to both women's and men's delivery service preferences and considering men's influence on delivery service choices.

Article Summary

Strength and limitations of this study

- First known Discrete Choice Experiment to test preferences of both women and men around choice of facility-based birth services.
- Acknowledges role men play in making delivery decisions for their families
- Tests preferences predicted by the Three Delays model and based on literature to influence use of childbirth services
- Limited generalizability due to difference in wealth between study sample and general population

Background/Rationale

Maternal mortality rate in Ethiopia decreased from 871 deaths/100,000 live births in 2000 to 676/100,000 in 2011,[1] but still remains above the 75% Millennium Development Goal (MDG) target reduction (218).[2] Neonatal mortality rate (NMR) has remained relatively unchanged since 2005 (39 deaths/1000 live births)[1] despite Ethiopia having achieved the MDG for infant mortality in 2013.[2] More than 90% of rural women deliver at home, a known barrier to reducing maternal and neonatal mortality.[1]

Recommendations for reducing maternal and neonatal mortality focus on skilled birth attendants (SBA) conducting delivery and referral care availability for emergencies.[3] While the SBA definition does not preclude home delivery, conditions in many developing countries make skilled birth attendance synonymous with facility-based birth (FB). If women are not delivering at facilities, they do not have access to emergency interventions.

The expanded three delays model[4] describes delays in receiving facility-based emergency and preventative delivery services: 1) Deciding to seek care; 2) Reaching the health facility; and 3) Receiving appropriate treatment. This study is primarily concerned with deciding to seek care. The decision to seek care may be influenced by sociocultural factors, perceived benefits and needs, perceived economic and physical accessibility, and perceived quality of care.

Despite government efforts to improve facility based deliveries by increasing health facility numbers and training health staff in Emergency Obstetric and Neonatal Care services provision, home delivery remains a strong tradition in Ethiopia. In Peru, where home births were similarly common, community members and providers identified facility-level changes that would make childbirth services more culturally acceptable and convenient to families. Changes that were both safe and acceptable to patients were instituted. Between 1999 and 2007, FB

increased from 6% to 83% in targeted rural communities.[5] Ethiopian health facilities need to understand factors underlying delivery place choice to establish policies that respond to families' preferences.

A 54-study literature review examined factors associated with delivery location in Ethiopia's unique cultural context. Changeable facility-level factors included cultural, perceived benefits and needs, economic, and physical barriers. Cultural barriers to FB identified in qualitative studies were examinations by male providers;[6,7] cultural norms that emphasize support from family and friends during delivery;[7–16] and medical culture that allows mistreatment of pregnant women by providers.[6–8,11,13] Conversely, facilities offering delivery by higher level providers[11,14,16,17] and which were consistently stocked with medications and supplies were appreciated.[11,17]

Quantitative measures of cultural factors include women's autonomy and involvement in deciding where to deliver. Women's autonomy was not generally found to be associated with FB.[18–22] However, women involved in deciding where to deliver were more likely to have FBs.[8,10,23–27]

Perceived benefits and need for FB may be influenced by access to mass media, ANC use, and previous FB. FB may be more common among families who own radios and/or TVs,[10,28,29] but more frequently no association was found.[23,27–32] ANC use, which may both increase knowledge of perceived benefits and need for FB, and increase comfort with facility staff, was frequently,[8,21,25,27,32–41] but not always,[19,23,42–44] associated with FB. Previous experience with FB varied in its association with FB from positive[34,43] to negative[37] to no association.[23]

Although the Three Delays model shows perceived, rather than actual, economic accessibility predicts care-seeking behavior, most Ethiopian studies measure economic

accessibility as mother's occupation,[10,18–20,27,30,31,36,38,39,45,46] husband's occupation,[25,27,29,31,39,42,45,46] monthly income, [10,19,23,25,30,34,39,47] or wealth quintile.[18,24,26,28,32,33,40,41,45]

As with economic accessibility, physical accessibility to health facilities is most often measured as actual, rather than perceived, accessibility. Women living in urban areas are more likely to have FBs.[8,18,20–25,28–33,37–39,42–45,47] Less time to reach facilities[24,37,43,45] and closer distance[10,28,30] were associated with FB, but associations between time to facility[30,34,42] and distance[30,31,37,45,48] with FB were not always significant. Transportation availability increased FB likelihood.[30]

Several weaknesses in research methodology limit interpretation of Ethiopian studies. First, research participants were almost exclusively women, yet male partners often make decisions about delivery location. Second, cultural practices identified in qualitative studies as barriers to FB have not been included in quantitative studies. Third, descriptive studies that base data collection on the Ethiopian Demographic and Health Survey (EDHS) limit new knowledge generation by asking the same questions in the same way. A discrete choice experiment (DCE) conducted in rural, southwest Ethiopia overcame this weakness. Women who had delivered in the last five years were asked to choose between two hypothetical facilities with varying distance, provider type, provider attitude, drug and medical equipment availability, transportation availability, and cost attributes,[49] thus identifying women's priorities in the context of multiple factors.

We collected data from both women and men and used DCE methodology to elicit preferences for delivery service attributes, specifically, allowing support persons in the delivery room, provider gender, distance, provider type, provider attitude, drug and medical equipment

availability, free transportation availability, and delivery cost. Our study aims were to determine: (a) the combination of facility-based delivery care attributes preferred by women and men, (b) whether gender differences exist in attribute preferences; and (c) whether poverty levels or household decision-making involvement are associated with facility choice.

Methods

Research Design

This cross-sectional DCE had three parts: household survey, individual surveys of men and women, and DCE task set. Questions in household and individual surveys were drawn from the EDHS.

DCE Study Design

Respondents were shown pictures of two facilities (Figure 1) and asked to imagine they were deciding where they would deliver their next baby. They were asked to choose between Facility A, Facility B, or Neither Facility. Facility A and B were described using a script.

Table 1 lists attributes and levels included in the experimental design and were selected to produce a reasonable number of scenarios to test with respondents.[50–52] Given that all attributes had either two or five levels, ten tasks were required for attribute level balance. Pilot-testing with local women and men indicated ten tasks did not cause respondent fatigue.

Quality of care was represented by medications and supplies' availability, provider attitude, and provider type. Support persons and provider gender tested cultural preferences. Perceived accessibility was represented by cost, distance to facility, and free ambulance availability.

Design decisions. A d-efficient design (d-error = 0.3) that allows for smaller sample size, while still estimating attributes at a statistically significant level,[52] was produced based on prior probabilities using nGene software.[53]

Sample Size. A sample size of mean=36,820, median=314, ranging from minimum=8 to maximum=5,162,097 was calculated by nGene to detect statistically significant differences between women and men. The large sample size reflects the degree of uncertainty in the priors.[54]

Given the logistical impossibility of collecting a large sample for this pilot study, J. Rose (personal communication, May 20, 2015) recommended 100 respondents for each group (women and men) based on expected improved statistical properties of basing the design on prior parameters. Assuming a 20% non-response rate, 120 households were selected, representing 240 respondents.

Subjects and Setting

The target population was women and their male partners in two rural *kebeles* defined by the most recent census (2007)[55] in Sidama zone, Southern Nations, Nationalities and People's region, Ethiopia. *Kebeles* are the smallest administrative unit in Ethiopia. Inclusion criteria were women and men who were expecting a child or had a child less than two years old. Eligible participants were excluded if unable to answer questions due to mental or physical disabilities. Informed consent and household interviews were conducted in participants' homes in October 2015.

Sample plan

Health Extension Workers (HEWs) from two *kebeles* listed eligible households using clinic and home visit records. Households were randomly selected by assigning each household a random number using the Excel random number generator and then sorting numerically.

Informed consent procedures

Informed oral consent was obtained before the survey. Research ethics committees at Hawassa University in Ethiopia and University of California San Francisco gave approval. Common River, a local non-governmental organization, facilitated logistical arrangements with community participants.

Validity and reliability.

Validity. EDHS questionnaires were adapted for this study, thus building upon EDHS' strong validity[56–65]. Demographic, health, education and living standard variables were collected. Additional EDHS questions were used to assess participation in decision-making, mass media exposure, danger signs knowledge, ANC use, and delivery history.

Attributes and levels for this DCE study were based on review of Ethiopian literature and the three delays model[66] and were refined during informant interviews and survey pilot testing to discern which attributes and levels were valid in this setting.[51] Pictures drawn by a local artist were used to ensure understanding in this low literacy population and were pre-tested with a local women's group and male staff at a local NGO.

Reliability. Experienced data collectors, fluent in both Amharic and Sidaminya (local language) were trained using a written protocol to ask questions in a standardized manner. Study materials were translated into Amharic and back-translated into English by local and professional translators. Questionnaires were pre-tested for clarity to ensure interviewers and participants easily understood questions. Questionnaires were reviewed daily for completeness; when errors were found, interviewers were asked for clarification.

To reduce socially desirable answers and response bias, interviewer and respondent genders were matched, interviewers were trained to be non-judgmental, privacy was ensured,

and sensitive questions were asked later in the interview after respondent's trust had been gained. To reduce non-response bias, households were revisited up to three times to contact eligible participants.

Multi-dimensional Poverty Index. The Multi-dimensional Poverty Index (MPI) attempts to capture in one number poverty aspects not captured by income-based poverty measures.[67] The MPI combines deprivations at household level in education, health and living standard. [68] The deprivation score is calculated by summing ten component weighted scores in three indicator areas[69] (Table 2).

Health, education, and living standard indicators were collected to compare the sample population to the national MPI. Malnutrition data could not be collected due to time and cost restraints. In addition, sanitation questions were discarded due to misinterpretation. Therefore, the sample MPI was not directly comparable to the reported national MPI. Instead, individual indicators in the sample were compared to EDHS data. The sample MPI served as a poverty indicator in the analysis.

Household Decision-Making Score. During the EDHS, women are asked about who makes decisions around obtaining health care for themselves, large household purchases, and visits to relatives. Women who make decisions on all three indicators, either solely or jointly with their husbands, are considered to have the highest autonomy. Men are asked about their participation in large household purchases and obtaining health care for themselves.[1] In this study, both women and men were asked about their involvement in decisions regarding obtaining health care for themselves, large household purchases, and visits to relatives.

Data Management and Analysis

Study household characteristics were calculated and compared to the 2011 EDHS of rural households using chi-square and t-tests to determine statistically significant differences. Similar analysis was conducted to describe and compare characteristics and reported pregnancy and delivery care practices of female and male study participants.

We used multilevel mixed-effects logistic regression with QR decomposition. QR decomposition improves convergence when random-effects variance is small.[70] Unlike other models, which assume independence, multilevel models take dependency of multiple observations from single respondents into account.[52] Level 1 included choices made by each respondent; Level 2 included respondent's gender; and Level 3 included household characteristics.

Women's and men's responses were analyzed separately to determine the utility of specific Level 1 attributes for each group and attribute combinations that significantly contributed to facility choice. Adjusted odds ratios were calculated to provide a more intuitive presentation of strength and direction of utility coefficients (e^{β}). Bonferroni method was used to control alpha for multiple comparisons.

A multilevel model was constructed by adding individual and random intercept terms. Level 2 interaction terms, combining attributes with gender, were introduced into the model one by one to test whether women and men differed significantly on preferences for facility characteristics. Predictor interactions with involvement in household decision-making (Level 3) were also tested.

Household poverty level (Level 3) main effect on facility choice was tested by creating a poverty variable. First, household deprivation percent was calculated using MPI deprivation indicators. Next, a dichotomous variable, poverty, was created to divide households into those

with percent deprivation greater than or equal to 33.3%, the definition for multidimensional poverty, and those who were not multidimensionally poor. In addition to adding poverty to the model to test the effect on facility choice, the interaction between poverty and gender was also tested to determine whether multidimensional poverty effected women and men differently.

Akaike's information criterion (AIC) was estimated and likelihood-ratio (LR) tests were conducted to test improvement in model fit. A decrease in AIC with a significant likelihood-ratio test indicates improvement in model fit.

Data were entered in RedCap using double-entry and analyzed using Stata 14.

Results

Participant Eligibility

Households with children less than two years old (n=356) and households with pregnant women (n=136) were eligible to participate (Figure 2). For 20 households not located due to incomplete addresses, the next randomly selected household was approached. Participation rate for locatable, eligible households was 98%. Household and individual surveys took approximately 5 minutes and the DCE portion took approximately 10 minutes to complete.

Study Participants' Characteristics

Household Characteristics. Study sample household characteristics were compared to household characteristics from the EDHS (Table 3). Study sample participants generally had better living conditions and more access to radios and mobile phones than those in the EDHS sample. However, a significantly greater percent of study sample households lacked land and livestock.

Female and Male Participants' Characteristics. Ninety-seven percent of women and 99% of men were from Sidama (Table 4). All women and 96% of men were Protestant. Women were significantly younger and less educated than their husbands. Men had greater exposure to mass media and participated more in household decisions. Men were significantly more likely (p<0.001) to believe their wife had received prenatal care during their pregnancy (89.8%) than women reported having done so (29.0%).

DCE Results

Women's preferences. Women's odds of choosing to deliver at a facility were 3.08 (2.03 to 4.67) times greater if medications and supplies were always available; 1.69 (1.37 to 2.07) times greater if support persons were allowed in delivery room; 1.37 (1.09 to 1.70) times greater if a free ambulance was available; and 1.15 (1.12 to 1.18) times greater for every 50-birr (US $2.50) reduction in cost (Table 5).

Provider type was significant using the Wald test (p< 0.0001) followed by Bonferroni-protected multiple comparisons. Women were 1.86 (1.23 to 2.80) times more likely to prefer delivery by HEWs than male nurses; 1.45 (1.09 to 1.93) times more likely to prefer male doctors to female doctors; 1.71 (1.27 to 2.29) times more likely to prefer female doctors to male nurses; 1.95 (1.44 to 2.62) times more likely to prefer male doctors to female nurses; and 2.47 (1.84 to 3.32) times more likely to prefer male doctors to male nurses.

Men's preferences. For men (Table 6), odds of choosing a facility were 2.68 (1.79 to 4.02) times greater when medications and supplies are always available; 1.74 (1.42 to 2.14) times greater when a support person is allowed in delivery room; 1.30 (1.03 to 1.64) times greater when provider smiles and listens well; 1.09 (1.06 to 1.13) times greater for each 15-minute reduction in walking distance; and 1.14 (1.11, to 1.17) times greater for every 50-birr reduction

in cost.

Provider type was significant overall using the Bonferroni Omnibus test (p<.0001). Men were 1.89 (1.29 to 2.78) times more likely to prefer their wives be delivered by HEWs than female nurses; 1.95 (1.30 to 2.95) times as likely to prefer delivery by HEWs to male nurses; 1.39 (1.02 to 1.89) times as likely to prefer female doctors to female nurses; 1.44 (1.07 to 1.92) times as likely to prefer female doctors to male nurses; 1.41 (1.05 to 1.90) times as likely to prefer male doctors to female nurses; and 1.46 (1.09 to 1.95) times as likely to prefer male doctors to male nurses.

Significant differences between predictors of women and men's choices

Only distance, provider type, and ambulance cost were significantly different between women and men. Women's odds of selecting a facility increased 1.08 times for every 15-minutes' increase in distance compared to men (1.03 to 1.14; *p*=.001). Women were 1.70 (1.15 to 2.52; *p*=0.009) times more likely than men to prefer male doctors to male nurses; and 1.36 (1.05 to 1.75; *p*=0.012) times more likely to prefer a facility with free ambulance service. AIC decreased from the Level 1 model (5551) to a Level 2 model adding Gender at level 2 (5536) and the LR was significant ($X^2(10) = 28.54$, p=0.0002) indicating improved model fit with the addition of significant cross-level interactions.

Decision-making

While Table 4 illustrated significant differences between women and men's involvement in decision-making, decision-making involvement did not significantly influence facility choice, whether measured as none vs. any (*p*=0.496); involved in healthcare decisions for self vs. not involved (*p*=0.653); involved in healthcare decisions for self vs. not involved, women vs. men

(p=0.189); number of decisions involved in (continuous) (p=0.930); or number of decisions involved in (categorical) (p=0.133).

Poverty and facility choice

Multidimensionally poor and not multidimensionally poor households did not differ in facility choice (p=0.170), nor was percent household deprivation a significant indicator (p = 0.055). In addition, facility choice did not differ between women and men based on household deprivation (p = 0.672).

Discussion

DCE Preferences

In this study, both women and men placed the highest value on health facilities that always had medications and supplies available and allowed support persons into the delivery room. Women's facility choice was also influenced by free ambulance availability and low cost, while men were more likely to choose nearer, less expensive delivery services with friendly providers.

In contrast, in a DCE in rural Ethiopia, Kruk, Paczkowski, et al.[49] found women preferred high quality delivery services such as available drugs and medical equipment, doctors or nurses rather than HEWs, and friendly providers, with lower value placed on accessibility indicators when selecting facilities. Neither support person presence, nor provider gender, was included in their study.

In our study, preferences for provider type were complex. Women generally preferred doctors to nurses, although no significant difference in preference was found between delivery by female doctors or female nurses. Men preferred facilities with doctors to nurses regardless of gender. Nurse's gender did not affect women's facility preference, but male doctors were

selected over female doctors. While preference for more highly skilled providers noted by Kruk, Paczkowski, et al.[49] generally held between doctors and nurses; HEWs were either preferred or chosen equally to doctors and nurses.

Interpreting Findings within The Three Delays Model: Implications for Services and Research

Perceived quality of care. In our study, reliable medications and supplies' availability was the strongest facility choice indicator for both women and men. This important element of the Three Delays model's perceived quality of care[4,71] has been reported by other researchers.[6,15,17,49] Government and facility administrators should prioritize supply chain management when making budget allocations. A study comparing actual and perceived stocks of medications and supplies' impact on FB rates and cost analysis of lives saved through improving supply chains would add further information on this intervention's effectiveness.

Provider attitude was a significant facility choice predictor for men, but not women. However, no significant difference was found between women and men's facility choice based on provider attitude. Qualitative researchers have reported mistreatment by staff, ranging from yelling to physical abuse, made women distrustful of health facilities.[6–8,11,14] Roro et al.[13] reported this was true for men also. Lack of significance of provider attitude for women in this study may result from considering this aspect of care in the context of other variables, which were more important. It may also be that women in this area have had little experience with unfriendly providers, so they are not concerned with this attribute.

Both women and men valued doctors more than nurses, but preferred or were neutral on selecting facilities with HEWs compared to more skilled providers. While appreciation of skilled providers is not uncommon, [8,9,11,14,16,30] preference for HEWs is surprising as HEWs' ability to

perform safe deliveries has been questioned.[7,13–15] This preference may reflect the desire to be delivered by someone they know, or greater flexibility by HEWs in allowing support persons to be present in the delivery room. Our findings suggest inherent trust in providers, who understand the cultural context and needs, is more important than procedural skill and knowledge.

The apparent preference for HEWs and doctors over nurses is concerning. Nurses offer the lowest cost solution to providing skilled care in most developing countries. Research is needed to better understand why nurses were least preferred and how to address this issue, as it could have implications for women's health outcomes and workforce training.

Cultural factors. Cultural preference for being surrounded by family and friends during delivery[7–12,14–16] was voiced by both women and men. Excluding support persons from the delivery room is incompatible with cultural norms and is likely to decrease FB uptake.[72] A cluster-randomized controlled trial comparing facilities implementing family-centered delivery policies with those that are not could test this finding.

Preference for male over female providers contradicts reports in qualitative literature.[7,8,15,23] One explanation for this difference may lie in the study design. When asked directly about provider gender preferences, respondents may say they are ashamed to be delivered by a man.[6,7,23] However, when given more complex scenarios, underlying biases, such as sexism, may have greater influence on respondent choices, leading them to choose male providers as being more qualified.

Perceived accessibility. Both women and men preferred lower cost services. However, distance and free ambulance availability had mixed influences on facility choice with women preferring facilities with free ambulance service, while men were more influenced by distance. Other Ethiopian research has shown either no effect[31,34,35,42,48] or increases in FB when facilities

are closer.[10,21,24,30,37,43,45] Women may prioritize free ambulance service due to greater concern for their own comfort as other free transportation, such as riding in animal carts or being carried on stretchers, are very uncomfortable.[11,13,44]

Perceived Benefits and Needs. We found men are primarily involved in making household decisions, including decisions about whether their wives seek health care. Yet, 90% of men believed their wives had attended ANC during their pregnancy, while only 29% of women reported doing so. Educating men on home delivery's potential dangers and FB's benefits could potentially increase families choosing FB. Barry, et al.[45] showed women who attended two or more family education meetings on maternal health with family members were nearly twice as likely to deliver with SBAs or HEWs compared to women who attended fewer than two meetings, but no difference for women who attended alone. Intervention studies involving partners or other family support in maternal education are needed.

Limitations

Generalizability. Based on household characteristics, our study population appears wealthier than the 2011 rural Ethiopian population. However, Ethiopia's economy has experienced 10.8% average growth from 2003/04 to 2013/14.[74] Therefore, other rural areas in Ethiopia may have also experienced similar improvements in living standards.

The household list used to select participants may have been incomplete and/or over-represented families who lived near health posts or who attended clinic. This may limit generalizability.

Missing variables. The ability to recognize emergencies may influence the decision of where to deliver.[71] The original study plan included a DCE in which respondents were asked where they would deliver if they believed the mother or baby's life was in danger. This portion

was dropped due to interview length. In addition, the perceived need measure, which the three delays model predicts influences decisions to seek care, was not included in the analysis due to discrepancies in interpreting the danger signs' questions.

Conclusion

This study makes a unique contribution to the literature as the first known DCE to test both women and men's preferences in choosing facility birth services. Including men acknowledged the role men play in making decisions for their families either alone or in collaboration with their partner. Women and men were found to agree on preferring facilities that always had medications and supplies available and allowed support persons in the delivery room.

Author Contributions

1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

Nancy K. Beam, Gezahegn Bekele Dadi, Sally H. Rankin, Sandra Weiss, Bruce Cooper, and Lisa Thompson participated in the conception of the study

Nancy K. Beam and Gezahegn Bekele Dadi participated in the acquisition of the data.

Nancy K. Beam designed the DCE

Bruce Cooper and Nancy K. Beam participated in the analysis and interpretation of the data

2. All authors participated in drafting the work or revising it critically for important intellectual content; AND

3. All authors gave final approval of the version to be published; AND

4. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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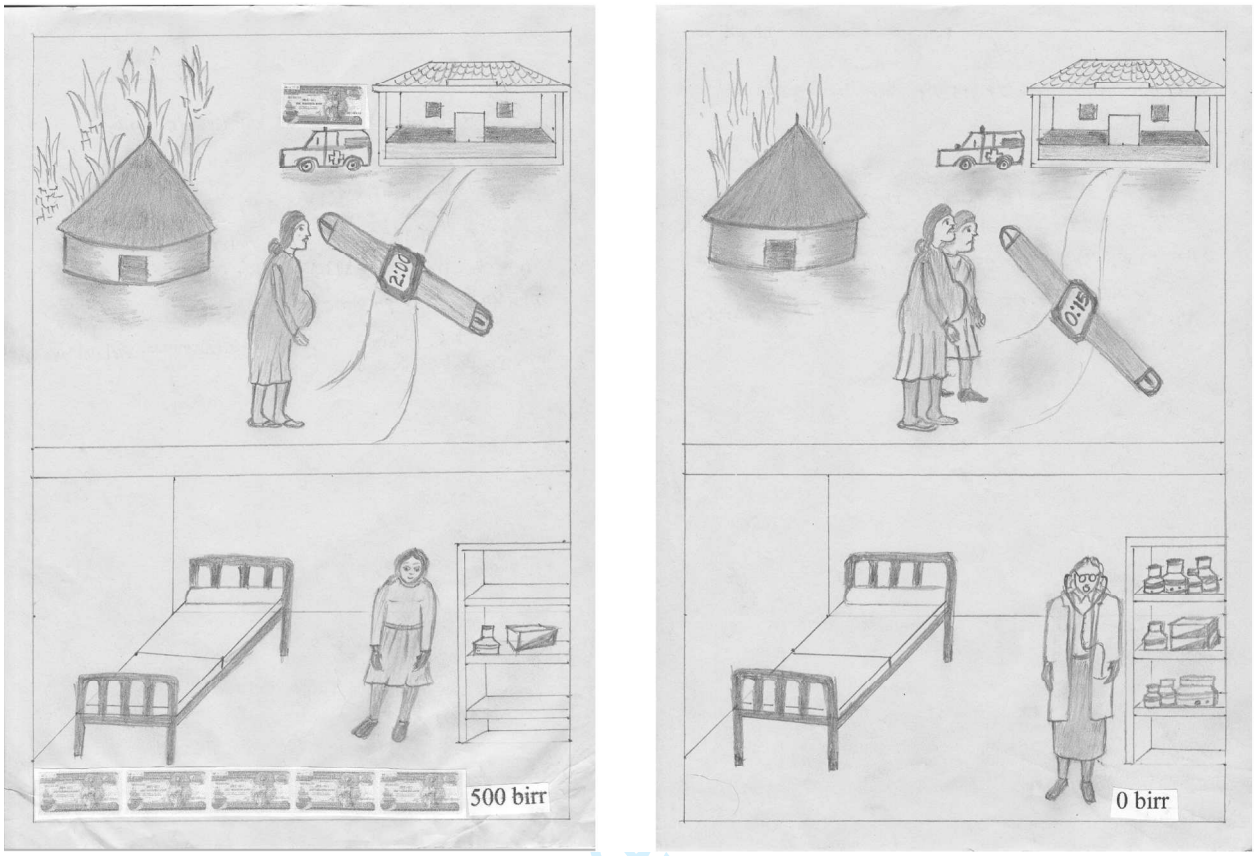

Figure 1: Sample Task Set for Discrete Choice Experiment

Table 1. *Attributes and Levels for Discrete Choice Experiment*

Attribute	Levels
Distance to health facility	30 minutes 1 hour 1½ hours 2 hours 3 hours
Type of provider	Female doctor Male doctor Female nurse Male nurse Health extension worker
Provider attitude	Provider smiles, is kind and respectful, speaks softly Provider does not smile, uses a harsh tone, harsh language
Availability of medication and supplies	Drugs and medical equipment always available Drugs and medical equipment not always available
Availability of free transport	Free ambulance available Free ambulance not available
Support persons	Family and friends allowed in delivery room Family and friends not allowed in delivery room
Cost (Cost of user charges, labor-related supplies, and non-ambulance transportation)	No cost 50 Ethiopian birr[a] 100 Ethiopian birr 200 Ethiopian birr 300 Ethiopian birr

[a]Approximately 20 birr/US$1

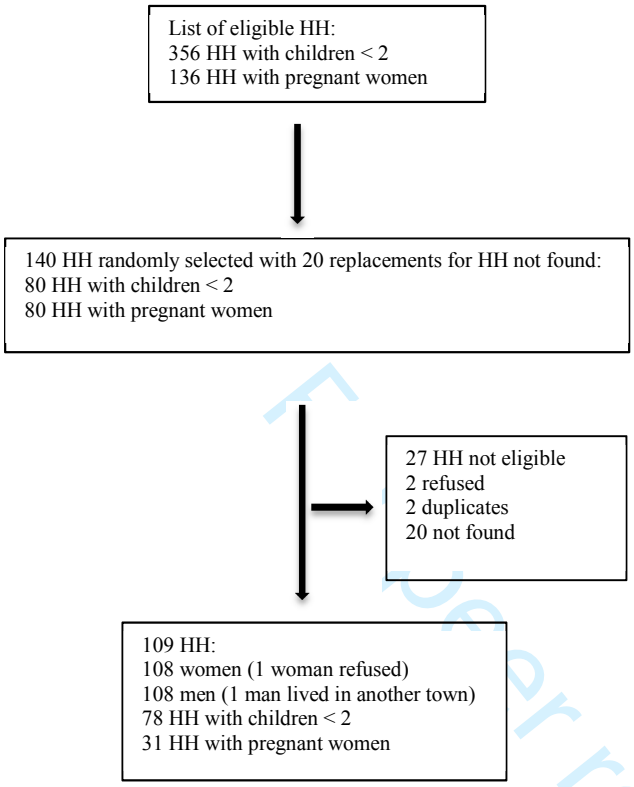

Figure 2: Study Flow Diagram

Table 2. *The Multi-dimensional Poverty Index (MPI) Deprivation Score Indicators*

Definition	**Weights (%)**
Health	
A household member is malnourished	16.7
A child has died in the last 5 years	16.7
Education	
No one in the household has completed at least 6 years of school	16.7
A school-age child (7-15) is not enrolled in school	16.7
Living standard	
No electricity	5.6
No access to clean drinking water or source of clean drinking water > 30 minute walk	5.6
Household lacks improved sanitation, or shares with other households	5.6
Dirty cooking fuel is used (dung, wood, or charcoal)	5.6
Household has a dirt, sand or dung floor	5.6
Household does not own a radio, TV, or telephone, and does not own a means of transportation (bike, motorbike, care, truck, animal cart, motorboat) or a means of livelihood (refrigerator, arable land, livestock)	5.6

Table 3. *Characteristics of households in Sidama Zone, SNNPR sample compared to EDHS rural subsam*ple

Variable	Study Sample[a] (n=109)	EDHS 2011 (n=11,590)	p-value
Household size, mean (SD)	5.4 (2.1)	4.9	p<.05
Living Conditions			
Use solid fuel for cooking[b]	109 (100)	11474 (99.0)	ns
Dirt or dung floor	81 (74.3)	11068 (95.5)	p<.001
Non-improved drinking water[c]	21 (19.27)	6734 (58.1)	p<.001
Walk ≥ 30 minutes to drinking water	61 (56.0)	7232 (62.4)	p<.001
No electricity	78 (71.6)	11034 (95.2)	p<.001
Access to Information			
No radio	50 (45.9)	7684 (66.3)	p<.001
No mobile phone	35 (32.1)	10,106 (87.2)	p<.001
No landline	109 (100)	11,567 (99.8)	ns
No television	107 (98.2)	11463 (98.9)	ns
Access to Transportation			
No bicycle	108 (99.1)	11428 (98.6)	ns
No motorcycle	107 (98.2)	11578 (99.9)	p<.001
No vehicle	109 (100)	11578 (99.9)	ns
No animal cart	108 (99.1)	11463 (98.9)	ns
Means of Livelihood			
No refrigerator	109 (100)	11520 (99.4)	ns
No agricultural land	25 (22.9)	1414 (12.2)	p<.001
No livestock	40 (36.7)	1217 (10.5)	p<.001

Note. Results presented as # (%) unless otherwise specified. [a]Study sample had no missing data except: Dirt or dung floor – 10 missing; owns land: 25 don't know. [b]Includes wood, charcoal, straw/shrubs/grass, agricultural crops, and animal dung. [c]Includes piped into dwelling, piped to yard/plot, public tap/standpipe, borehole, protected well, protected spring, rainwater, bottled water.

Table 4. *Characteristics of female and male study participants in Sidama Zone, SNNPR, Ethiopia*

Characteristic	Study Sample [a]		
	Women (n=108)	Men (n=108)	p-value
Age, mean (SD)	24.7 (4.6)	32.1 (8.5)	t= -7.85 (211), p<.001
Percent who never attended school	14 (13.0)	2 (1.9)	X^2 (1, N=215)= 9.72, p<.05
Years of education, mean (SD)	5.5 (3.5) (n= 93)	6.8 (3.3) (n= 106)	t = -2.75(197), p<.05
Mass media exposure			
Never reads paper	93 (86.1)	50 (46.3)	X^2 (1, N=216)= 38.26, p<.001
Never listens to radio	81 (75.0)	28 (25.9)	X^2 (1, N=216)= 52.02, p<.001
Never watches TV	99 (91.7)	36 (33.3)	X^2 (1, N=216)= 78.40, p<.001
No mass media exposure at least once/week	72 (66.7)	57 (52.8)	X^2 (1, N=216)= 4.33, p<.05
Involved in decisions about:			
Seeking health care for self[b]	48 (44.4)	99 (91.7)	X^2 (1, N=216)= 55.39, p<.001
Respondent alone	4 (3.7)	23 (21.3)	
Partner or someone else	60 (55.6)	9 (8.3)	
Jointly with spouse	44 (40.7)	76 (70.4)	
Major household purchases[b]	66 (61.1)	106 (98.1)	X^2 (1, N=216)= 45.67, p<.001
Respondent alone	7 (6.5)	14 (13.0)	
Partner or someone else	42 (38.9)	2 (1.8)	
Jointly with spouse	59 (54.6)	92 (85.2)	
Visiting friends and family[b]	84 (77.8)	103 (95.4)	X^2 (1, N=216)= 14.38, p<.001
Respondent alone	26 (24.1)	22 (20.4)	
Partner or someone else	24 (22.2)	5 (4.7)	
Jointly with spouse	58 (53.7)	81 (75.0)	
Full decision-making capacity[c]	35 (32.4)	96 (88.9)	X^2 (1, N=216)= 72.18, p<.001
Participated in none of the 3 decisions	18 (16.7)	1 (0.9)	X^2 (1, N=216)= 16.68, p<.001
Pregnancy and Delivery Care Characteristics[d]			
Prenatal care during last or current pregnancy	31 (29.0)	97 (89.8)	X^2 (1, N=215)= 82.59, p<.001
Place of last delivery			
Home[e]	51 (65.4)	46 (59.7)	X^2 (1, N=155)= .53, p= ns
Health facility	27 (34.6)	31 (40.3)	X^2 (1, N=155)= .53, p= ns
Delivered by a skilled birth attendant	25 (23.2)	30 (27.8)	X^2 (1, N=216)= .61, p= ns

Note. Data is n (%) unless otherwise specified. [a]Study sample had no missing data except: Women: Age-2; Years of education-15; Prenatal-1; Men: Age-1; Years of education-2. [b]Alone or jointly with spouse. [c]Defined as participating in making decisions about healthcare, major household purchases, and visits to family or relatives alone or jointly with spouse. [d]Women and men were asked these questions separately. [e]Home includes participant's home or another home.

Table 5

Results from mixed-effects logistic regression model for utility of attributes of health facilities for delivery, reported for 108 women[a] from Sidama zone, SNNPR, Ethiopia

Variable	Odds Ratio	p-value	95% CI	
Meds and supplies				
Always available	3.08	**0.000**	2.03	4.67
Support person				
Allowed in delivery room	1.69	**0.000**	1.37	2.07
Ambulance				
Free	1.37	**0.006**	1.09	1.70
Cost (per 50 birr decrease)	1.15	**0.000**	1.12	1.18
Provider				
Female doctor vs HEW	0.92	0.702	0.59	1.42
Male doctor vs HEW	1.33	0.169	0.89	1.99
Female nurse vs HEW	0.68	0.050	0.47	1.00
Male nurse vs HEW	0.54	**0.003**	0.36	0.81
Female doctor vs male doctor	0.69	**0.011**	0.52	0.92
Female doctor vs female nurse	1.34	0.064	0.98	1.84
Female doctor vs male nurse	1.71	**0.000**	1.27	2.29
Male doctor vs female nurse	1.95	**0.000**	1.44	2.62
Male doctor vs male nurse	2.47	**0.000**	1.84	3.32
Female nurse vs male nurse	0.68	0.120	0.94	1.71
Attitude				
Smiles, listens	1.24	0.075	0.98	1.56
Distance (per 15 minute decrease in walking time)	0.99	0.383	0.86	1.05

Note. AIC decreased from 2960 (null) to 2762 (Level1). Likelihood ratio (LR) chi2(10)=218.30, p<0.0001 [a]21 missing responses and 99 neither responses out of 3240 options

Table 6

Results from mixed-effects logistic regression model for utility of attributes of health facilities for delivery, reported for 108 men from Sidama zone, SNNPR, Ethiopia

Variable	OR	p-value	95% CI	
Meds and supplies				
Always available	2.68	**0.000**	1.79	4.02
Support person				
Allowed in delivery room	1.74	**0.000**	1.42	2.14
Attitude				
Smiles, listens	1.30	**0.030**	1.03	1.64
Distance(per 15 minute decrease in walking time)	1.09	**0.000**	1.06	1.13
Cost (per 50 birr decrease)	1.14	**0.000**	1.11	1.17
Provider				
Female doctor vs HEW	0.74	0.169	0.47	1.14
Male doctor vs HEW	0.75	0.155	0.50	1.12
Female nurse vs HEW	0.53	**0.001**	0.36	0.78
Male nurse vs HEW	0.51	**0.001**	0.34	0.77
Female doctor vs male doctor	0.99	0.929	0.74	1.31
Female doctor vs female nurse	1.39	**0.035**	1.02	1.89
Female doctor vs male nurse	1.44	**0.014**	1.07	1.92
Male doctor vs female nurse	1.41	**0.022**	1.05	1.90
Male doctor vs male nurse	1.46	**0.012**	1.09	1.95
Female nurse vs male nurse	1.03	0.832	0.77	2.94
Ambulance				
Free	0.95	0.679	0.76	1.19

Note. AIC decreased from 2960 (null) to 2781 (Level 1). Likelihood ratio (LR) chi2(10)=234.49, p<0.0001 [a]No missing responses and 37 neither responses out of 3240 options

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract pp. 1 and 3	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
p. 6 Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
p. 9 Objectives	3	State specific objectives, including any prespecified hypotheses
Methods – p. 9		
Study design – p. 9	4	Present key elements of study design early in the paper
Setting – p. 10	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants – p. 10	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables – p.9	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement – p.9	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias – p. 11	9	Describe any efforts to address potential sources of bias
Study size – p. 10	10	Explain how the study size was arrived at
Quantitative variables – p. 13	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods – p. 13	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants – p. 14	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data – p. 14	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data – p. 15	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results – p. 15	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results – p. 17	18	Summarise key results with reference to study objectives
Limitations – p. 20	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation – p. 20	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability – p. 20	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding – p. 2	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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A discrete choice experiment to determine facility-based delivery services desired by women and men in rural Ethiopia

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Contributorship Statement

1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

Nancy K. Beam, Gezahegn Bekele Dadi, Sally H. Rankin, Sandra Weiss, Bruce Cooper, and Lisa Thompson participated in the conception of the study

Nancy K. Beam and Gezahegn Bekele Dadi participated in the acquisition of the data.

Nancy K. Beam designed the DCE

Bruce Cooper and Nancy K. Beam participated in the analysis and interpretation of the data

2. All authors participated in drafting the work or revising it critically for important intellectual content; AND

3. All authors gave final approval of the version to be published; AND

4. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Abstract

Objectives: Despite global efforts to increase facility-based delivery (FBD), 90% of women in rural Ethiopia deliver at home without a skilled birth attendant. Men have an important role in increasing FBD due to their decision-making power, but this is largely unexplored. This study aimed to determine the FBD care attributes preferred by women and men, and whether poverty or household decision-making are associated with choice to deliver in a facility.

Setting and Participants: We conducted a cross-sectional discrete choice experiment in 109 randomly selected households in rural Ethiopia in September-October 2015. We interviewed women who were pregnant or who had a child < 2 years old and their male partners.

Results: Both women and men preferred health facilities where medications and supplies were available (OR=3.08; 95% CI, 2.03-4.67); (OR=2.68; 95% CI, 1.79-4.02), a support person was allowed in the delivery room (OR=1.69; 95% CI, 1.37-2.07); (OR=1.74; 95% CI, 1.42-2.14), and delivery cost was low (OR=1.15 95% CI, 1.12-1.18); OR=1.14 (95% CI, 1.11-1.17). Women valued free ambulance service (OR=1.37; 95% CI, 1.09-1.70), while men favored nearby facilities (OR=1.09; 95% CI, 1.06-1.13) with friendly providers (OR=1.30; 95% CI, 1.03-1.64). Provider preferences were complex. Neither women nor men preferred female doctors to health extension workers (HEW) (OR=0.92; 95% CI, 0.59-1.42); (OR=0.74; 95% CI, 0.47-1.14), male doctors to HEW (OR=1.33; 95% CI, 0.89-1.99); (OR=0.75; 95% CI, 0.50-1.12), or female over male nurses (OR=0.68; 95% CI, 0.94-1.71); (OR=1.03; 95% CI, 0.77-2.94). While both women and men preferred male nurses to HEW (OR=1.86; 95% CI, 1.23-2.80); (OR=1.95; 95% CI, 1.30-2.95), men (OR=1.89; 95% CI, 1.29-2.78), but not women (OR=1.47; 95% CI, 1.00-2.13) preferred HEW to female nurses. Both women and men preferred female doctors to male nurses

(OR=1.71; 95% CI, 1.27-2.29); (OR=1.44; 95% CI, 1.07-1.92), male doctors to female nurses (OR=1.95; 95% CI, 1.44-2.62); (OR=1.41; 95% CI, 1.05-1.90), and male doctors to male nurses (OR=2.47; 95% CI, 1.84-3.32); (OR=1.46; 95% CI, 1.09-1.95), while only women preferred male doctors to female doctors (OR=1.45; 95% CI, 1.09-1.93); (OR=1.01; 95% CI, 0.76-1.35) and only men preferred female nurses to female doctors (OR=1.34; 95% CI, 0.98-1.84); (OR=1.39; 95% CI, 1.02-1.89). Men are disproportionately involved in making household decisions (X^2 (1, N=216)=72.18, p<.001), including decisions to seek health care (X^2 (1, N=216)= 55.39, p<.001), yet men were often unaware of their partners' prenatal care attendance (X^2 (1, N=215)= 82.59, p<.001).

Conclusion: Women's and men's preferences may influence delivery service choices. Considering these choices is one way the Ethiopian government and health facilities may encourage FBD in rural areas.

Article Summary

Strength and limitations of this study

- First known Discrete Choice Experiment to test preferences of both women and men around choice of facility-based delivery services.
- Acknowledges role men play in making delivery decisions for their families
- Tests preferences predicted by the Three Delays model and based on literature to influence use of delivery services
- Limited generalizability due to difference in wealth between study sample and general population

Background/Rationale

Maternal mortality ratio in Ethiopia decreased from 871 deaths/100,000 live births in 2000 to 676/100,000 in 2011,[1] but still remains above the 75% Millennium Development Goal (MDG) target reduction (218).[2] Neonatal mortality rate has remained relatively unchanged since 2005 (39 deaths/1000 live births)[1] despite Ethiopia having achieved the MDG for infant mortality in 2013.[2] More than 90% of rural women deliver at home, a known barrier to reducing maternal and neonatal mortality.[1]

Recommendations for reducing maternal and neonatal mortality focus on skilled birth attendants (SBA) conducting delivery and referral care availability for emergencies.[3] While the SBA definition does not preclude home delivery[4], conditions in many developing countries make skilled birth attendance synonymous with facility-based delivery (FBD). If women are not delivering at facilities, they do not have access to emergency interventions.[5]

Despite government efforts to improve FBD by increasing health facility numbers and training health staff in Emergency Obstetric and Neonatal Care services provision[6], home delivery remains a strong tradition in Ethiopia.[7,8] In Peru, where home deliveries were similarly common, community members and providers identified FBD changes that would make FBD services more culturally acceptable and convenient to families. Changes that were both safe and acceptable to patients were instituted. Between 1999 and 2007, FBD increased from 6% to 83% in targeted rural communities.[9] Kenya's program to increase dialogue between communities and health services increased FBD in the rural community by 6.1%.[10] Community mobilization increased FBD by 30% in Burkina Faso.[11] No studies were found that tested community directed facility-based interventions to improve FBD in Ethiopia. An increased understanding of factors underlying delivery place choice may help Ethiopian health facilities to better respond to

families' preferences.

The expanded three delays model[12] describes delays in receiving emergency and preventative FBD services: 1) Deciding to seek care; 2) Reaching the health facility; and 3) Receiving appropriate treatment. The decision to seek care may be influenced by sociocultural factors, perceived benefits and needs, perceived economic and physical accessibility, and perceived quality of care. A literature review including 54 studies examined factors associated with delivery location in Ethiopia's unique cultural context. Changeable FBD factors included cultural barriers, perceived benefits and barriers, economic accessibility, and physical accessibility. Cultural barriers to FBD identified in qualitative studies were examinations by male providers;[13,14] facility rules limiting support from family and friends during delivery;[8,14–22] and medical culture that allows mistreatment of pregnant women by providers.[13–15,18,20] Conversely, facilities offering delivery by higher level providers[18,21–23] and which were consistently stocked with medications and supplies were appreciated.[18,23] Quantitative measures of cultural factors include women's autonomy and involvement in deciding where to deliver. Women's autonomy was not generally found to be associated with FBD.[24–28] However, women involved in deciding where to deliver were more likely to have FBDs.[15,17,29–33]

Perceived benefits and need for FBD may be influenced by access to mass media, antenatal care (ANC) use, and previous FBD. FBD may be more common among families who own radios and/or TVs,[17,34,35] but more frequently no association was found.[29,33–38] ANC use, which may both increase knowledge of perceived benefits and need for FBD, and increase comfort with facility staff, was frequently,[15,27,31,33,38–47] but not always,[25,29,48–50] associated with FBD. Previous experience with FBD varied in its association with FBD from positive[40,49] to negative[43] to no association.[29]

Although the Three Delays model shows perceived, rather than actual, economic accessibility predicts care-seeking behavior, most Ethiopian studies measure economic accessibility as mother's occupation,[17,24–26,33,36,37,42,44,45,51,52] husband's occupation,[31,33,35,37,45,48,51,52] monthly income, [17,25,29,31,36,40,45,53] or wealth quintile.[24,30,32,34,38,39,46,47,52]

As with economic accessibility, physical accessibility to health facilities is most often measured as actual, rather than perceived, accessibility. Women living in urban areas are more likely to have FBDs.[15,24,26–31,34–39,43–45,48–50,52,53] Less time to reach facilities[30,43,49,52] and closer distance[17,34,36] were associated with FBD, but associations between time to facility[36,40,48] and distance[36,37,43,52,54] with FBD were not always significant. Transportation availability increased FBD likelihood.[36]

Several weaknesses in research methodology limit interpretation of Ethiopian studies. First, research participants were almost exclusively women, yet male partners often make household decisions[55–57] including delivery location.[58] Second, cultural practices identified in qualitative studies as barriers to FBD have not been included in quantitative studies. Third, descriptive studies that base data collection on the Ethiopian Demographic and Health Survey (EDHS) limit new knowledge generation by asking the same questions in the same way. A discrete choice experiment (DCE) conducted by Kruk, Paczkowski, et al.in rural Ethiopia overcame this weakness. Women who had delivered in the last five years were asked to choose between two hypothetical facilities with varying distance, provider type, provider attitude, drug and medical equipment availability, transportation availability, and cost attributes,[59] thus identifying women's priorities in the context of multiple factors.

We collected data from both women and men and used DCE methodology to elicit

preferences for delivery service attributes, specifically, allowing support persons in the delivery room, provider gender, distance, provider type, provider attitude, drug and medical equipment availability, free transportation availability, and delivery cost. Our study aims were to determine: (a) the FBD care attributes preferred by women and men, (b) whether gender differences exist in attribute preferences; and (c) whether poverty levels or household decision-making involvement are associated with facility choice.

Methods

Research Design

This cross-sectional DCE had three parts: household survey, individual surveys of men and women, and DCE task set. Questions in household and individual surveys were drawn from the EDHS.

DCE Study Design

Respondents were shown pictures of two facilities (Figure 1) and asked to imagine they were deciding where they would deliver their next baby. They were asked to choose between Facility A, Facility B, or Neither Facility. Facility A and B were described using a script.

Table 1 lists attributes and levels included in the experimental design and were selected to produce a reasonable number of scenarios to test with respondents.[60–62] Given that all attributes had either two or five levels, ten tasks were required for attribute level balance. Pilot-testing with local women and men indicated ten tasks did not cause respondent fatigue.

Quality of care was represented by medications and supplies' availability, provider attitude, and provider type. Presence of support persons in the delivery room and provider gender tested cultural preferences. Perceived accessibility was represented by cost, distance to facility, and free ambulance availability.

Design decisions. A d-efficient design (d-error = 0.3) that allows for smaller sample size, while still estimating attributes at a statistically significant level,[62] was produced based on prior probabilities established through a review of the literature[63] using nGene software.[64]

Sample Size. A sample size of mean=36,820, median=314, ranging from minimum=8 to maximum=5,162,097 was calculated by nGene to detect statistically significant differences between women and men. Examining the equation for sample size provides an explanation for the wide range:

$N_k = (T_{k2} * se_{k2}) / beta_k$

where N_k is the sample size, T_{k2} is the t-ratio required for significance, se_{k2} is the standard error for the prior parameter, and $beta_k$ is the prior parameter. Therefore, as beta approaches zero, the sample size needed to detect statistical difference increases.

Several of the priors range from -1 to 1, reflecting the degree of uncertainty in the priors, which in turn results in a large sample size requirement (J. Rose, personal communication, August 18, 2015).[65]

Given the logistical impossibility of collecting a large sample for this pilot study, J. Rose (personal communication, May 20, 2015) recommended 100 respondents for each group (women and men) based on expected improved statistical properties of basing the design on prior parameters. Assuming a 20% non-response rate, 120 households were selected, representing 240 respondents.

Subjects and Setting

The target population was women and their male partners in two rural *kebeles* defined by the most recent census (2007)[66] in Sidama zone, Southern Nations, Nationalities and People's region, Ethiopia. *Kebeles* are the smallest administrative unit in Ethiopia. Inclusion criteria were

women and men who were expecting a child or had a child less than two years old. Eligible participants were excluded if unable to answer questions due to mental or physical disabilities. Informed consent and household interviews were conducted in participants' homes in October 2015.

Sample plan

Health Extension Workers (HEWs) from two *kebeles* listed eligible households using clinic and home visit records. Households were randomly selected by assigning each household a random number using the Excel random number generator and then sorting numerically.

Informed consent procedures

Informed oral consent was obtained before the survey. Research ethics committees at Hawassa University in Ethiopia and University of California San Francisco gave approval. Common River, a local non-governmental organization, facilitated logistical arrangements with community participants.

Validity and reliability.

Validity. Questions from the EDHS were used for this study, thus building upon EDHS' strong validity[67–76]. Demographic, health, education and living standard variables were collected. Additional EDHS questions were used to assess participation in decision-making, mass media exposure, danger signs knowledge, ANC use, and delivery history.

Attributes and levels for this DCE study were based on review of Ethiopian literature and the three delays model[77] and were refined during informant interviews and survey pilot testing to discern which attributes and levels were valid in this setting.[61] Pictures drawn by a local artist were used to ensure understanding in this low literacy population and were pre-tested with a local women's group and male staff at a local nonprofit.

***Reliability*.** Experienced data collectors, fluent in both Amharic and Sidaminya (local language) were trained using a written protocol to ask questions in a standardized manner. Study materials were translated into Amharic and Sidaminya and back-translated into English by local and professional translators. Questionnaires were pre-tested for clarity to ensure interviewers and participants easily understood questions. In addition to pre-testing with male and female community members that took place during the translation and testing of the DCE pictures, the entire instrument was pre-tested during a day of field-testing. Pre-testing was conducted at households that had not been selected as part of the sample. Approximately twelve men and twelve women participated in pre-testing. Questionnaires were reviewed daily for completeness; when errors were found, interviewers were asked for clarification.

To reduce socially desirable answers and response bias, interviewer and respondent genders were matched, interviewers were trained to be non-judgmental, privacy was ensured, and sensitive questions were asked later in the interview after respondent's trust had been gained. To reduce non-response bias, households were revisited up to three times to contact eligible participants.

Multi-dimensional Poverty Index. The Multi-dimensional Poverty Index (MPI) attempts to capture in one number poverty aspects not captured by income-based poverty measures.[78] The MPI combines deprivations at household level in education, health and living standard. [79] The deprivation score is calculated by summing ten component weighted scores in three indicator areas[80] (Table 2).

Health, education, and living standard indicators were collected to compare the sample population to the national MPI. Malnutrition data could not be collected due to time and cost restraints. In addition, sanitation questions were discarded due to misinterpretation. Therefore,

the sample MPI was not directly comparable to the reported national MPI. Instead, individual indicators in the sample were compared to EDHS data. The sample MPI served as a poverty indicator in the analysis.

Household Decision-Making Score. During the EDHS, women are asked about who makes decisions around obtaining health care for themselves, large household purchases, and visits to relatives. Women who make decisions on all three indicators, either solely or jointly with their husbands, are considered to have the highest autonomy. Men are asked about their participation in large household purchases and obtaining health care for themselves.[1] In this study, both women and men were asked about their involvement in decisions regarding obtaining health care for themselves, large household purchases, and visits to relatives.

Data Management and Analysis

Study household characteristics were calculated and compared to the 2011 EDHS of rural households using chi-square and t-tests to determine statistically significant differences. Similar analysis was conducted to describe and compare characteristics and reported pregnancy and delivery care practices of female and male study participants.

We used multilevel mixed-effects logistic regression with QR decomposition. QR decomposition improves convergence when random-effects variance is small.[81] Unlike other models, which assume independence, multilevel models take dependency of multiple observations from single respondents into account.[62] Level 1 included choices made by each respondent; Level 2 included respondent's gender; and Level 3 included household characteristics.

The analysis was conducted in four parts, which are described in more detail below. First, separate multi-variate analyses of women's and men's data was conducted to determine their

preferences. Second, the data was combined, and gender was introduced as a Level 2 variable to determine whether a statistical difference existed between women and men's preferences. Third, a Level 2 analysis of various decision-making measures were tested to determine their effect on facility choice. Finally, the effect of household poverty on preferences was tested in a Level 3 analysis.

Women's and men's responses were analyzed separately to determine the utility of specific Level 1 attributes for each group that significantly contributed to facility choice. Adjusted odds ratios were calculated to provide a more intuitive presentation of strength and direction of utility coefficients (e^{β}). Bonferroni method was used to control alpha for multiple comparisons.

A multilevel model was constructed by adding individual and random intercept terms. Level 2 interaction terms, combining attributes with gender, were introduced into the model one by one to test whether women and men differed significantly on preferences for facility characteristics. Predictor interactions with involvement in household decision-making (Level 2) were also tested.

Household poverty level (Level 3) main effect on facility choice was tested by creating a poverty variable. First, household deprivation percent was calculated using MPI deprivation indicators using reweighted variables to reflect use of fewer variables. Next, a dichotomous variable, poverty, was created to divide households into those with percent deprivation greater than or equal to 33.3%, the definition for multidimensional poverty, and those who were not multidimensionally poor. In addition to adding poverty to the model to test the effect on facility choice, the interaction between poverty and gender was also tested to determine whether multidimensional poverty effected women and men differently.

Akaike's information criterion (AIC) was estimated and likelihood-ratio (LR) tests were conducted to test improvement in model fit. A decrease in AIC with a significant LR test indicates improvement in model fit.

Data were double-entered in REDCap (Research Electronic Data Capture), a secure web-based program for managing surveys and databases[82] and analyzed using Stata 14[83].

Results

Participant Eligibility

Households with children less than two years old (n=356) and households with pregnant women (n=136) were eligible to participate (Figure 2). For 20 households not located due to incomplete addresses, the next randomly selected household was approached. Participation rate for locatable, eligible households was 98%. Household and individual surveys took approximately 5 minutes and the DCE portion took approximately 10 minutes to complete.

Study Participants' Characteristics

Household Characteristics. Study sample household characteristics were compared to household characteristics from the EDHS (Table 3). Study sample participants generally had better living conditions and more access to radios and mobile phones than those in the EDHS sample. However, a significantly greater percent of study sample households lacked land and livestock.

Female and Male Participants' Characteristics. Ninety-seven percent of women and 99% of men were from Sidama. All women and 96% of men were Protestant. Women were on average 7 years younger and had one year less education than their husbands had. Men had two to three times more exposure to mass media and participated more in household decisions compared to

women. Men were more likely to believe their wife had received prenatal care during their pregnancy (89.8%) than women reported having done so (29.0%) (Table 4).

DCE Results

Women's preferences. Women's odds of choosing to deliver at a facility were 3.08 (2.03 to 4.67) times greater if medications and supplies were always available; 1.69 (1.37 to 2.07) times greater if support persons were allowed in delivery room; 1.37 (1.09 to 1.70) times greater if a free ambulance was available; and 1.15 (1.12 to 1.18) times greater for every 50-birr (US $2.50) reduction in cost (Table 5).

Provider type was significant using the Wald test ($p< 0.0001$) followed by Bonferroni-protected multiple comparisons. Women were 1.86 (1.23 to 2.80) times more likely to prefer delivery by HEWs than male nurses; 1.45 (1.09 to 1.93) times more likely to prefer male doctors to female doctors; 1.71 (1.27 to 2.29) times more likely to prefer female doctors to male nurses; 1.95 (1.44 to 2.62) times more likely to prefer male doctors to female nurses; and 2.47 (1.84 to 3.32) times more likely to prefer male doctors to male nurses.

Men's preferences. For men (Table 6), odds of choosing a facility were 2.68 (1.79 to 4.02) times greater when medications and supplies are always available; 1.74 (1.42 to 2.14) times greater when a support person is allowed in delivery room; 1.30 (1.03 to 1.64) times greater when provider smiles and listens well; 1.09 (1.06 to 1.13) times greater for each 15-minute reduction in walking distance; and 1.14 (1.11, to 1.17) times greater for every 50-birr reduction in cost.

Provider type was significant overall using the Bonferroni Omnibus test ($p<.0001$). Men were 1.89 (1.29 to 2.78) times more likely to prefer their wives be delivered by HEWs than female nurses; 1.95 (1.30 to 2.95) times as likely to prefer delivery by HEWs to male nurses;

1.39 (1.02 to 1.89) times as likely to prefer female doctors to female nurses; 1.44 (1.07 to 1.92) times as likely to prefer female doctors to male nurses; 1.41 (1.05 to 1.90) times as likely to prefer male doctors to female nurses; and 1.46 (1.09 to 1.95) times as likely to prefer male doctors to male nurses.

Significant differences between predictors of women and men's choices

Only distance, provider type, and ambulance cost were significantly different between women and men. Women's odds of selecting a facility increased 1.08 times for every 15-minutes' increase in distance compared to men (1.03 to 1.14). Women were 1.70 (1.15 to 2.52) times more likely than men to prefer male doctors to male nurses; and 1.36 (1.05 to 1.75) times more likely to prefer a facility with free ambulance service. AIC decreased from the Level 1 model (5551) to a Level 2 model adding Gender at level 2 (5536) and the LR was significant ($X^2(10) = 28.54$, p=0.0002) indicating improved model fit with the addition of significant cross-level interactions.

Decision-making

While Table 4 illustrated significant differences between women and men's involvement in decision-making, decision-making involvement did not significantly influence facility choice, whether measured as none vs. any (p=0.496); involved in healthcare decisions for self vs. not involved (p=0.653); involved in healthcare decisions for self vs. not involved, women vs. men (p=0.189); number of decisions involved in (continuous) (p=0.930); or number of decisions involved in (categorical) (p=0.133).

Poverty and facility choice

Facility choice did not differ between multidimensionally poor and not multidimensionally poor households (p=0.170), but facility choice was associated weakly with

percent household deprivation (p = 0.055). In addition, facility choice did not differ between women and men based on household deprivation (p = 0.672).

Discussion

DCE Preferences

In this study, both women and men placed the highest value on health facilities that always had medications and supplies available and allowed support persons into the delivery room. Women's facility choice was also influenced by free ambulance availability and low cost, while men were more likely to choose nearer, less expensive delivery services with friendly providers.

In contrast, in a DCE in rural Ethiopia, Kruk, Paczkowski, et al.[59] found women preferred high quality delivery services such as available drugs and medical equipment, doctors or nurses rather than HEWs, and friendly providers, with lower value placed on accessibility indicators when selecting facilities. Neither support person presence, nor provider gender, was included in their study.

In our study, preferences for provider type were complex. In order to have a reasonable number of scenarios, provider type and gender were linked in the study design, making provider preferences difficult to interpret. Women generally preferred doctors to nurses, although no significant difference in preference was found between delivery by female doctors or female nurses. Men preferred facilities with doctors to nurses regardless of gender. Nurse's gender did not affect women's facility preference, but male doctors were selected over female doctors. While preference for more highly skilled providers noted by Kruk, Paczkowski, et al.[59] generally held between doctors and nurses; HEWs were either preferred or chosen equally to doctors and nurses.

Interpreting Findings within The Three Delays Model: Implications for Services and Research

Perceived quality of care. In our study, reliable medications and supplies' availability was the strongest facility choice indicator for both women and men. This important element of the Three Delays model's perceived quality of care[12,84] has been reported by other researchers.[8,13,23,59] Government and facility administrators should prioritize supply chain management when making budget allocations. A study comparing actual and perceived stocks of medications and supplies' impact on FBD rates and cost analysis of lives saved through improving supply chains would add further information on this intervention's effectiveness.

Provider attitude was a significant facility choice predictor for men, but not women. However, no significant difference was found between women and men's facility choice based on provider attitude. Qualitative researchers have reported mistreatment by staff, ranging from yelling to physical abuse, made women distrustful of health facilities.[13–15,18,21] Roro et al.[20] reported this was true for men also. Lack of significance of provider attitude for women in this study may result from considering this aspect of care in the context of other variables, which were more important. It may also be that women in this area have had little experience with unfriendly providers, so they are not concerned with this attribute.

Both women and men valued doctors more than nurses, but preferred or were neutral on selecting facilities with HEWs compared to more skilled providers. While appreciation of skilled providers is not uncommon, [15,16,18,21,22,36] preference for HEWs is surprising as HEWs' ability to perform safe deliveries has been questioned.[8,14,20,21] This preference may reflect the desire to be delivered by someone they know, or greater flexibility by HEWs in accommodating cultural birth practices[85] such as allowing support persons to be present in the delivery room. Both

women and men may be more comfortable with HEWs who are local women,[85,86] and provide antenatal and postnatal services,[86] trusting them to refer mothers in emergencies.[86] Our findings suggest inherent trust in providers, who understand the cultural context and needs, is more important than procedural skill and knowledge.

The apparent preference for HEWs and doctors over nurses is concerning. Nurses offer the lowest cost solution to providing skilled care in most developing countries. Research is needed to better understand why nurses were least preferred and how to address this issue, as it could have implications for women's health outcomes and workforce training.

Cultural factors. Cultural preference for being surrounded by family and friends during delivery[8,14–19,21,22] was voiced by both women and men. Excluding support persons from the delivery room is incompatible with cultural norms and is likely to decrease FBD uptake.[87] A cluster-randomized controlled trial comparing facilities implementing family-centered delivery policies with those that are not could test this finding.

Preference for male over female providers contradicts reports in qualitative literature.[8,14,15,29] One explanation for this difference may lie in the study design. When asked directly about provider gender preferences, respondents may say they are ashamed to be delivered by a man.[13,14,29] However, when given more complex scenarios, underlying biases, such as sexism, may have greater influence on respondent choices, leading them to choose male providers as being more qualified.

Perceived accessibility. Both women and men preferred lower cost services. However, distance and free ambulance availability had mixed influences on facility choice with women preferring facilities with free ambulance service, while men were more influenced by distance. Other Ethiopian research has shown either no effect[37,40,41,48,54] or increases in FBD when

facilities are closer.[17,27,30,36,43,49,52] Women may prioritize free ambulance service due to greater concern for their own comfort as other free transportation, such as riding in animal carts or being carried on stretchers, are very uncomfortable.[18,20,50] At the community meeting held at the completion of the study, men complained that ambulances were unavailable for deliveries as has been found in other areas of Ethiopia.[85,88]

Perceived Benefits and Needs. We found men are primarily responsible for making household decisions, including decisions about whether their wives seek health care. Yet, 90% of men believed their wives had attended ANC during their pregnancy, while only 29% of women reported doing so. Educating men on home delivery's potential dangers and FBD's benefits could potentially increase families choosing FBD. Barry, et al[89] showed women who attended two or more family education meetings on maternal health with family members were nearly twice as likely to deliver with SBAs or HEWs compared to women who attended fewer than two meetings, but no difference for women who attended alone. Intervention studies involving partners or other family support in maternal education are needed.

Limitations

Generalizability. Based on household characteristics, our study population appears wealthier than the 2011 rural Ethiopian population. However, Ethiopia's economy has experienced 10.8% average growth from 2003/04 to 2013/14.[90] Therefore, other rural areas in Ethiopia may have also experienced similar improvements in living standards. The high percentage of Protestants in this study may limit generalizability to Orthodox or Moslem communities. Also, much of Sidama has a much higher population density than other areas, such as Afar Region, so distance may be less of a concern for women giving birth in Sidama.

The household list used to select participants came from paper-based registers and patient charts, which made identifying eligible participants difficult. Families who lived near health posts or attended clinic may have been over-represented. Although the health workers were expected to visit every home, staffing limitations make this difficult to accomplish. This may limit generalizability.

Missing variables. The ability to recognize emergencies may influence the decision of where to deliver.[84] The original study plan included a DCE in which respondents were asked where they would deliver if they believed the mother or baby's life was in danger. This portion was dropped due to interview length. In addition, the perceived need measure, which the three delays model predicts influences decisions to seek care, was not included in the analysis due to discrepancies in interpreting the danger signs' questions. Finally, while this study included men, mother-in-laws, traditional birth attendants, and other older women may also influence birth place decisions.[18,19,58]

Conclusion

This study makes a unique contribution to the literature as the first known DCE to test both women and men's preferences in choosing FBD services. Including men acknowledged the role men play in making decisions for their families either alone or in collaboration with their partner. Women and men were found to agree on preferring facilities that always had medications and supplies available and allowed support persons in the delivery room.

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Abbreviations

ANC	Antenatal care
DCE	Discrete choice experiment
EDHS	Ethiopian Demographic and Health Survey
FBD	Facility-based delivery
HEW	Health extension worker
MDG	Millenium Development Goal
MPI	Multi-dimensional Poverty Index
SBA	Skilled birth attendant

Figure 1: Sample Task Set for Discrete Choice Experiment

Figure 2: Study Flow Diagram

Table 1. *Attributes and Levels for Discrete Choice Experiment*

Attribute	Levels
Distance to health facility	30 minutes 1 hour 1½ hours 2 hours 3 hours
Type of provider[a]	Female doctor Male doctor Female nurse Male nurse Female Health extension worker
Provider attitude	Provider smiles, is kind and respectful, speaks softly Provider does not smile, uses a harsh tone, harsh language
Availability of medication and supplies	Drugs and medical equipment always available Drugs and medical equipment not always available
Availability of free transport	Free ambulance available Free ambulance not available
Support persons	Family and friends allowed in delivery room Family and friends not allowed in delivery room
Cost (Cost of user charges, labor-related supplies, and non-ambulance transportation)	No cost 50 Ethiopian birr[b] 100 Ethiopian birr 200 Ethiopian birr 300 Ethiopian birr

[a] Nurse was used to indicate both nurses and midwives on the advice of Ethiopian staff
[b] Approximately 20 birr/US$1

Table 2. *The Multi-dimensional Poverty Index Deprivation Score Indicators*

Definition	**Weights (%)**
Health	
A household member is malnourished	16.7
A child has died in the last 5 years	16.7
Education	
No one in the household has completed at least 6 years of school	16.7
A school-age child (7-15) is not enrolled in school	16.7
Living standard	
No electricity	5.6
No access to clean drinking water or source of clean drinking water > 30 minute walk	5.6
Household lacks improved sanitation, or shares with other households	5.6
Dirty cooking fuel is used (dung, wood, or charcoal)	5.6
Household has a dirt, sand or dung floor	5.6
Household does not own a radio, TV, or telephone, and does not own a means of transportation (bike, motorbike, care, truck, animal cart, motorboat) or a means of livelihood (refrigerator, arable land, livestock)	5.6

Table 3. *Characteristics of households in Sidama Zone, SNNPR sample compared to EDHS rural subsam*ple

Variable	Study Sample[a] (n=109)	EDHS 2011 (n=11,590)	p-value
Household size, mean (SD)	5.4 (2.1)	4.9	p<.05
Living Conditions			
Use solid fuel for cooking[b]	109 (100)	11474 (99.0)	ns
Dirt or dung floor	81 (74.3)	11068 (95.5)	p<.001
Non-improved drinking water[c]	21 (19.27)	6734 (58.1)	p<.001
Walk ≥ 30 minutes to drinking water	61 (56.0)	7232 (62.4)	p<.001
No electricity	78 (71.6)	11034 (95.2)	p<.001
Access to Information			
No radio	50 (45.9)	7684 (66.3)	p<.001
No mobile phone	35 (32.1)	10,106 (87.2)	p<.001
No landline	109 (100)	11,567 (99.8)	ns
No television	107 (98.2)	11463 (98.9)	ns
Access to Transportation			
No bicycle	108 (99.1)	11428 (98.6)	ns
No motorcycle	107 (98.2)	11578 (99.9)	p<.001
No vehicle	109 (100)	11578 (99.9)	ns
No animal cart	108 (99.1)	11463 (98.9)	ns
Means of Livelihood			
No refrigerator	109 (100)	11520 (99.4)	ns
No agricultural land	25 (22.9)	1414 (12.2)	p<.001
No livestock	40 (36.7)	1217 (10.5)	p<.001

Note. Results presented as # (%) unless otherwise specified. [a]Study sample had no missing data except: Dirt or dung floor – 10 missing; owns land: 25 don't know. [b]Includes wood, charcoal, straw/shrubs/grass, agricultural crops, and animal dung. [c]Includes piped into dwelling, piped to yard/plot, public tap/standpipe, borehole, protected well, protected spring, rainwater, bottled water.

Table 4. *Characteristics of female and male study participants in Sidama Zone, SNNPR, Ethiopia*

Characteristic	Study Sample [a]		
	Women (n=108)	Men (n=108)	p-value
Age, mean (SD)	24.7 (4.6)	32.1 (8.5)	t= -7.85 (211), p<.001
Percent who never attended school	14 (13.0)	2 (1.9)	X^2 (1, N=215)= 9.72, p<.05
Years of education, mean (SD)	5.5 (3.5) (n= 93)	6.8 (3.3) (n= 106)	t = -2.75(197), p<.05
Mass media exposure			
Never reads paper	93 (86.1)	50 (46.3)	X^2 (1, N=216)= 38.26, p<.001
Never listens to radio	81 (75.0)	28 (25.9)	X^2 (1, N=216)= 52.02, p<.001
Never watches TV	99 (91.7)	36 (33.3)	X^2 (1, N=216)= 78.40, p<.001
No mass media exposure at least once/week	72 (66.7)	57 (52.8)	X^2 (1, N=216)= 4.33, p<.05
Involved in decisions about:			
Seeking health care for self[b]	48 (44.4)	99 (91.7)	X^2 (1, N=216)= 55.39, p<.001
Respondent alone	4 (3.7)	23 (21.3)	
Partner or someone else	60 (55.6)	9 (8.3)	
Jointly with spouse	44 (40.7)	76 (70.4)	
Major household purchases[b]	66 (61.1)	106 (98.1)	X^2 (1, N=216)= 45.67, p<.001
Respondent alone	7 (6.5)	14 (13.0)	
Partner or someone else	42 (38.9)	2 (1.8)	
Jointly with spouse	59 (54.6)	92 (85.2)	
Visiting friends and family[b]	84 (77.8)	103 (95.4)	X^2 (1, N=216)= 14.38, p<.001
Respondent alone	26 (24.1)	22 (20.4)	
Partner or someone else	24 (22.2)	5 (4.7)	
Jointly with spouse	58 (53.7)	81 (75.0)	
Full decision-making capacity[c]	35 (32.4)	96 (88.9)	X^2 (1, N=216)= 72.18, p<.001
Participated in none of the 3 decisions	18 (16.7)	1 (0.9)	X^2 (1, N=216)= 16.68, p<.001
Pregnancy and Delivery Care Characteristics[d]			
Prenatal care during last or current pregnancy	31 (29.0)	97 (89.8)	X^2 (1, N=215)= 82.59, p<.001
Place of last delivery			
Home[e]	51 (65.4)	46 (59.7)	X^2 (1, N=155)= .53, p= ns
Health facility	27 (34.6)	31 (40.3)	X^2 (1, N=155)= .53, p= ns
Delivered by a skilled birth attendant	25 (23.2)	30 (27.8)	X^2 (1, N=216)= .61, p= ns

Note. Data is n (%) unless otherwise specified. [a]Study sample had no missing data except: Women: Age-2; Years of education-15; Prenatal-1; Men: Age-1; Years of education-2. [b]Alone or jointly with spouse. [c]Defined as participating in making decisions about healthcare, major household purchases, and visits to family or relatives alone or jointly with spouse. [d]Women and men were asked these questions separately. [e]Home includes participant's home or another home.

Table 5

Results from mixed-effects logistic regression model for utility of attributes of health facilities for delivery, reported for 108 women[a] from Sidama zone, SNNPR, Ethiopia

Variable	Odds Ratio	p-value	95% CI	
Meds and supplies				
Always available	3.08	**0.000**	2.03	4.67
Support person				
Allowed in delivery room	1.69	**0.000**	1.37	2.07
Ambulance				
Free	1.37	**0.006**	1.09	1.70
Cost (per 50 birr decrease)	1.15	**0.000**	1.12	1.18
Provider				
Female doctor vs HEW	0.92	0.702	0.59	1.42
Male doctor vs HEW	1.33	0.169	0.89	1.99
Female nurse vs HEW	0.68	0.050	0.47	1.00
Male nurse vs HEW	0.54	**0.003**	0.36	0.81
Female doctor vs male doctor	0.69	**0.011**	0.52	0.92
Female doctor vs female nurse	1.34	0.064	0.98	1.84
Female doctor vs male nurse	1.71	**0.000**	1.27	2.29
Male doctor vs female nurse	1.95	**0.000**	1.44	2.62
Male doctor vs male nurse	2.47	**0.000**	1.84	3.32
Female nurse vs male nurse	0.68	0.120	0.94	1.71
Attitude				
Smiles, listens	1.24	0.075	0.98	1.56
Distance (per 15 minute decrease in walking time)	0.99	0.383	0.86	1.05

Note. AIC decreased from 2960 (null) to 2762 (Level1). Likelihood ratio (LR) chi2(10)=218.30, p<0.0001 [a]21 missing responses and 99 neither responses out of 3240 options

Table 6

Results from mixed-effects logistic regression model for utility of attributes of health facilities for delivery, reported for 108 men from Sidama zone, SNNPR, Ethiopia

Variable	OR	p-value	95% CI	
Meds and supplies				
Always available	2.68	**0.000**	1.79	4.02
Support person				
Allowed in delivery room	1.74	**0.000**	1.42	2.14
Attitude				
Smiles, listens	1.30	**0.030**	1.03	1.64
Distance(per 15 minute decrease in walking time)	1.09	**0.000**	1.06	1.13
Cost (per 50 birr decrease)	1.14	**0.000**	1.11	1.17
Provider				
Female doctor vs HEW	0.74	0.169	0.47	1.14
Male doctor vs HEW	0.75	0.155	0.50	1.12
Female nurse vs HEW	0.53	**0.001**	0.36	0.78
Male nurse vs HEW	0.51	**0.001**	0.34	0.77
Female doctor vs male doctor	0.99	0.929	0.74	1.31
Female doctor vs female nurse	1.39	**0.035**	1.02	1.89
Female doctor vs male nurse	1.44	**0.014**	1.07	1.92
Male doctor vs female nurse	1.41	**0.022**	1.05	1.90
Male doctor vs male nurse	1.46	**0.012**	1.09	1.95
Female nurse vs male nurse	1.03	0.832	0.77	2.94
Ambulance				
Free	0.95	0.679	0.76	1.19

Note. AIC decreased from 2960 (null) to 2781 (Level 1). Likelihood ratio (LR) chi2(10)=234.49, p<0.0001 [a]No missing responses and 37 neither responses out of 3240 options

Figure 1: Sample Task Set for Discrete Choice Experiment‼

165x106mm (300 x 300 DPI)

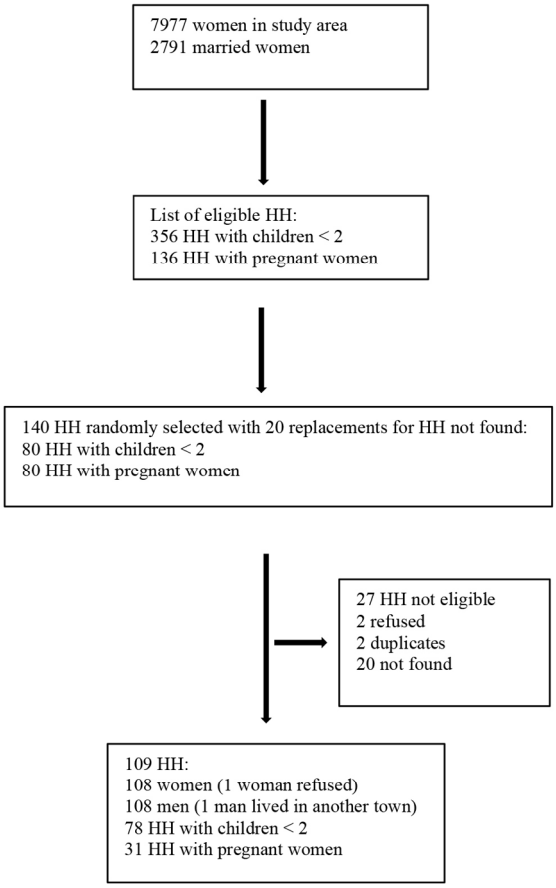

Figure 2: Study Flow Diagram

151x140mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract pp. 1 and 3	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
p. 6 Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
p. 9 Objectives	3	State specific objectives, including any prespecified hypotheses
Methods – p. 9		
Study design – p. 9	4	Present key elements of study design early in the paper
Setting – p. 10	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants – p. 10	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables – p.9	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement – p.9	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias – p. 11	9	Describe any efforts to address potential sources of bias
Study size – p. 10	10	Explain how the study size was arrived at
Quantitative variables – p. 13	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods – p. 13	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants – p. 14	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data – p. 14	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data – p. 15	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results – p. 15	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results – p. 17	18	Summarise key results with reference to study objectives
Limitations – p. 20	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation – p. 20	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability – p. 20	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding – p. 2	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

A discrete choice experiment to determine facility-based delivery services desired by women and men in rural Ethiopia

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Contributorship Statement

1. Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND

Nancy K. Beam, Gezahegn Bekele Dadi, Sally H. Rankin, Sandra Weiss, Bruce Cooper, and Lisa M. Thompson participated in the conception of the study

Nancy K. Beam and Gezahegn Bekele Dadi participated in the acquisition of the data.

Nancy K. Beam designed the DCE

Bruce Cooper and Nancy K. Beam participated in the analysis and interpretation of the data

2. All authors participated in drafting the work or revising it critically for important intellectual content; AND

3. All authors gave final approval of the version to be published; AND

4. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Abstract

Objectives: Despite global efforts to increase facility-based delivery (FBD), 90% of women in rural Ethiopia deliver at home without a skilled birth attendant. Men have an important role in increasing FBD due to their decision-making power, but this is largely unexplored. This study aimed to determine the FBD care attributes preferred by women and men, and whether poverty or household decision-making are associated with choice to deliver in a facility.

Setting and Participants: We conducted a cross-sectional discrete choice experiment in 109 randomly selected households in rural Ethiopia in September-October 2015. We interviewed women who were pregnant or who had a child < 2 years old and their male partners.

Results: Both women and men preferred health facilities where medications and supplies were available (OR=3.08; 95% CI, 2.03-4.67); (OR=2.68; 95% CI, 1.79-4.02), a support person was allowed in the delivery room (OR=1.69; 95% CI, 1.37-2.07); (OR=1.74; 95% CI, 1.42-2.14), and delivery cost was low (OR=1.15 95% CI, 1.12-1.18); OR=1.14 (95% CI, 1.11-1.17). Women valued free ambulance service (OR=1.37; 95% CI, 1.09-1.70), while men favored nearby facilities (OR=1.09; 95% CI, 1.06-1.13) with friendly providers (OR=1.30; 95% CI, 1.03-1.64). Provider preferences were complex. Neither women nor men preferred female doctors to health extension workers (HEW) (OR=0.92; 95% CI, 0.59-1.42); (OR=0.74; 95% CI, 0.47-1.14), male doctors to HEW (OR=1.33; 95% CI, 0.89-1.99); (OR=0.75; 95% CI, 0.50-1.12), or female over male nurses (OR=0.68; 95% CI, 0.94-1.71); (OR=1.03; 95% CI, 0.77-2.94). While both women and men preferred male nurses to HEW (OR=1.86; 95% CI, 1.23-2.80); (OR=1.95; 95% CI, 1.30-2.95), men (OR=1.89; 95% CI, 1.29-2.78), but not women (OR=1.47; 95% CI, 1.00-2.13) preferred HEW to female nurses. Both women and men preferred female doctors to male nurses

(OR=1.71; 95% CI, 1.27-2.29); (OR=1.44; 95% CI, 1.07-1.92), male doctors to female nurses (OR=1.95; 95% CI, 1.44-2.62); (OR=1.41; 95% CI, 1.05-1.90), and male doctors to male nurses (OR=2.47; 95% CI, 1.84-3.32); (OR=1.46; 95% CI, 1.09-1.95), while only women preferred male doctors to female doctors (OR=1.45; 95% CI, 1.09-1.93); (OR=1.01; 95% CI, 0.76-1.35) and only men preferred female nurses to female doctors (OR=1.34; 95% CI, 0.98-1.84); (OR=1.39; 95% CI, 1.02-1.89). Men are disproportionately involved in making household decisions (X^2 (1, N=216)=72.18, p<.001), including decisions to seek health care (X^2 (1, N=216)= 55.39, p<.001), yet men were often unaware of their partners' prenatal care attendance (X^2 (1, N=215)= 82.59, p<.001).

Conclusion: Women's and men's preferences may influence delivery service choices. Considering these choices is one way the Ethiopian government and health facilities may encourage FBD in rural areas.

Article Summary

Strength and limitations of this study

- First known Discrete Choice Experiment to test preferences of both women and men around choice of facility-based delivery services.
- Acknowledges role men play in making delivery decisions for their families
- Tests preferences predicted by the Three Delays model and based on literature to influence use of delivery services
- Limited generalizability due to difference in wealth between study sample and general population

Background/Rationale

Maternal mortality ratio in Ethiopia decreased from 871 deaths/100,000 live births in 2000 to 676/100,000 in 2011,[1] but still remains above the 75% Millennium Development Goal (MDG) target reduction (218).[2] Neonatal mortality rate has remained relatively unchanged since 2005 (39 deaths/1000 live births)[1] despite Ethiopia having achieved the MDG for infant mortality in 2013.[2] More than 90% of rural women deliver at home, a known barrier to reducing maternal and neonatal mortality.[1]

Recommendations for reducing maternal and neonatal mortality focus on skilled birth attendants (SBA) conducting delivery and referral care availability for emergencies.[3] While the SBA definition does not preclude home delivery[4], conditions in many developing countries make skilled birth attendance synonymous with facility-based delivery (FBD). If women are not delivering at facilities, they do not have access to emergency interventions.[5]

Despite government efforts to improve FBD by increasing health facility numbers and training health staff in Emergency Obstetric and Neonatal Care services provision[6], home delivery remains a strong tradition in Ethiopia.[7,8] In a setting where home deliveries were also common, community members and providers identified FBD changes that would make FBD services more culturally acceptable and convenient to families. Changes that were both safe and acceptable to patients were instituted. Between 1999 and 2007, FBD increased from 6% to 83% in targeted rural communities.[9] Kenya's program to increase dialogue between communities and health services increased FBD in the rural community by 6.1%.[10] Community mobilization increased FBD by 30% in Burkina Faso.[11] No studies were found that tested community directed facility-based interventions to improve FBD in Ethiopia. An increased understanding of factors underlying delivery place choice may help Ethiopian health facilities to better respond to

families' preferences.

The expanded three delays model[12] describes delays in receiving emergency and preventative FBD services: 1) Deciding to seek care; 2) Reaching the health facility; and 3) Receiving appropriate treatment. The decision to seek care may be influenced by sociocultural factors, perceived benefits and needs, perceived economic and physical accessibility, and perceived quality of care. A literature review including 54 studies examined factors associated with delivery location in Ethiopia's unique cultural context. Changeable FBD factors included cultural barriers, perceived benefits and barriers, economic accessibility, and physical accessibility. Cultural barriers to FBD identified in qualitative studies were examinations by male providers;[13,14] facility rules limiting support from family and friends during delivery;[8,14–22] and medical culture that allows mistreatment of pregnant women by providers.[13–15,18,20] Conversely, facilities offering delivery by higher level providers[18,21–23] and which were consistently stocked with medications and supplies were appreciated.[18,23] Quantitative measures of cultural factors include women's autonomy and involvement in deciding where to deliver. Women's autonomy was not generally found to be associated with FBD.[24–28] However, women involved in deciding where to deliver were more likely to have FBDs.[15,17,29–33]

Perceived benefits and need for FBD may be influenced by access to mass media, antenatal care (ANC) use, and previous FBD. FBD may be more common among families who own radios and/or TVs,[17,34,35] but more frequently no association was found.[29,33–38] ANC use, which may both increase knowledge of perceived benefits and need for FBD, and increase comfort with facility staff, was frequently,[15,27,31,33,38–47] but not always,[25,29,48–50] associated with FBD. Previous experience with FBD varied in its association with FBD from positive[40,49] to negative[43] to no association.[29]

Although the Three Delays model shows perceived, rather than actual, economic accessibility predicts care-seeking behavior, most Ethiopian studies measure economic accessibility as mother's occupation,[17,24–26,33,36,37,42,44,45,51,52] husband's occupation,[31,33,35,37,45,48,51,52] monthly income, [17,25,29,31,36,40,45,53] or wealth quintile.[24,30,32,34,38,39,46,47,52]

As with economic accessibility, physical accessibility to health facilities is most often measured as actual, rather than perceived, accessibility. Women living in urban areas are more likely to have FBDs.[15,24,26–31,34–39,43–45,48–50,52,53] Less time to reach facilities[30,43,49,52] and closer distance[17,34,36] were associated with FBD, but associations between time to facility[36,40,48] and distance[36,37,43,52,54] with FBD were not always significant. Transportation availability increased FBD likelihood.[36]

Several weaknesses in research methodology limit interpretation of Ethiopian studies. First, research participants were almost exclusively women, yet male partners often make household decisions[55–57] including delivery location.[58] Second, cultural practices identified in qualitative studies as barriers to FBD have not been included in quantitative studies. Third, descriptive studies that base data collection on the Ethiopian Demographic and Health Survey (EDHS) limit new knowledge generation by asking the same questions in the same way. A discrete choice experiment (DCE) conducted by Kruk, Paczkowski, et al.in rural Ethiopia overcame this weakness. Women who had delivered in the last five years were asked to choose between two hypothetical facilities with varying distance, provider type, provider attitude, drug and medical equipment availability, transportation availability, and cost attributes,[59] thus identifying women's priorities in the context of multiple factors.

We collected data from both women and men and used DCE methodology to elicit

preferences for delivery service attributes, specifically, allowing support persons in the delivery room, provider gender, distance, provider type, provider attitude, drug and medical equipment availability, free transportation availability, and delivery cost. Our study aims were to determine: (a) the FBD care attributes preferred by women and men, (b) whether gender differences exist in attribute preferences; and (c) whether poverty levels or household decision-making involvement are associated with facility choice.

Methods

Research Design

This cross-sectional DCE had three parts: household survey, individual surveys of men and women, and DCE task set. Questions in household and individual surveys were drawn from the EDHS.

DCE Study Design

Respondents were shown pictures of two facilities (Figure 1) and asked to imagine they were deciding where they would deliver their next baby. They were asked to choose between Facility A, Facility B, or Neither Facility. Facility A and B were described using a script.

Table 1 lists attributes and levels included in the experimental design and were selected to produce a reasonable number of scenarios to test with respondents.[60–62] Given that all attributes had either two or five levels, ten tasks were required for attribute level balance. Pilot-testing with local women and men indicated ten tasks did not cause respondent fatigue.

Quality of care was represented by medications and supplies' availability, provider attitude, and provider type. Presence of support persons in the delivery room and provider gender tested cultural preferences. Perceived accessibility was represented by cost, distance to facility, and free ambulance availability.

Design decisions. A d-efficient design (d-error = 0.3) that allows for smaller sample size, while still estimating attributes at a statistically significant level,[62] was produced based on prior probabilities established through a review of the literature[63] using nGene software.[64]

Sample Size. A sample size of mean=36,820, median=314, ranging from minimum=8 to maximum=5,162,097 was calculated by nGene to detect statistically significant differences between women and men. Examining the equation for sample size provides an explanation for the wide range:

$N_k = (T_{k2} * se_{k2}) / beta_k$

where N_k is the sample size, T_{k2} is the t-ratio required for significance, se_{k2} is the standard error for the prior parameter, and $beta_k$ is the prior parameter. Therefore, as beta approaches zero, the sample size needed to detect statistical difference increases.

Several of the priors range from -1 to 1, reflecting the degree of uncertainty in the priors, which in turn results in a large sample size requirement (J. Rose, personal communication, August 18, 2015).[65]

Given the logistical impossibility of collecting a large sample for this pilot study, J. Rose (personal communication, May 20, 2015) recommended 100 respondents for each group (women and men) based on expected improved statistical properties of basing the design on prior parameters. Assuming a 20% non-response rate, 120 households were selected, representing 240 respondents.

Subjects and Setting

The target population was women and their male partners in two rural *kebeles* defined by the most recent census (2007)[66] in Sidama zone, Southern Nations, Nationalities and People's region, Ethiopia. *Kebeles* are the smallest administrative unit in Ethiopia. Inclusion criteria were

women and men who were expecting a child or had a child less than two years old. Eligible participants were excluded if unable to answer questions due to mental or physical disabilities. Informed consent and household interviews were conducted in participants' homes in October 2015.

Sample plan

Health Extension Workers (HEWs) from two *kebeles* listed eligible households using clinic and home visit records. Households were randomly selected by assigning each household a random number using the Excel random number generator and then sorting numerically.

Informed consent procedures

Informed oral consent was obtained before the survey. Research ethics committees at Hawassa University in Ethiopia and University of California San Francisco gave approval. Common River, a local non-governmental organization, facilitated logistical arrangements with community participants.

Validity and reliability.

Validity. Questions from the EDHS were used for this study, thus building upon EDHS' strong validity[67–76]. Demographic, health, education and living standard variables were collected. Additional EDHS questions were used to assess participation in decision-making, mass media exposure, danger signs knowledge, ANC use, and delivery history.

Attributes and levels for this DCE study were based on review of Ethiopian literature and the three delays model[77] and were refined during informant interviews and survey pilot testing to discern which attributes and levels were valid in this setting.[61] Pictures drawn by a local artist were used to ensure understanding in this low literacy population and were pre-tested with a local women's group and male staff at a local nonprofit.

***Reliability*.** Experienced data collectors, fluent in both Amharic and Sidaminya (local language) were trained using a written protocol to ask questions in a standardized manner. Study materials were translated into Amharic and Sidaminya and back-translated into English by local and professional translators. Questionnaires were pre-tested for clarity to ensure interviewers and participants easily understood questions. In addition to pre-testing with male and female community members that took place during the translation and testing of the DCE pictures, the entire instrument was pre-tested during a day of field-testing. Pre-testing was conducted at households that had not been selected as part of the sample. Approximately twelve men and twelve women participated in pre-testing. Questionnaires were reviewed daily for completeness; when errors were found, interviewers were asked for clarification.

To reduce socially desirable answers and response bias, interviewer and respondent genders were matched, interviewers were trained to be non-judgmental, privacy was ensured, and sensitive questions were asked later in the interview after respondent's trust had been gained. To reduce non-response bias, households were revisited up to three times to contact eligible participants.

Multi-dimensional Poverty Index. The Multi-dimensional Poverty Index (MPI) attempts to capture in one number poverty aspects not captured by income-based poverty measures.[78] The MPI combines deprivations at household level in education, health and living standard. [79] The deprivation score is calculated by summing ten component weighted scores in three indicator areas[80] (Table 2).

Health, education, and living standard indicators were collected to compare the sample population to the national MPI. Malnutrition data could not be collected due to time and cost restraints. In addition, sanitation questions were discarded due to misinterpretation. Therefore,

the sample MPI was not directly comparable to the reported national MPI. Instead, individual indicators in the sample were compared to EDHS data. The sample MPI served as a poverty indicator in the analysis.

Household Decision-Making Score. During the EDHS, women are asked about who makes decisions around obtaining health care for themselves, large household purchases, and visits to relatives. Women who make decisions on all three indicators, either solely or jointly with their husbands, are considered to have the highest autonomy. Men are asked about their participation in large household purchases and obtaining health care for themselves.[1] In this study, both women and men were asked about their involvement in decisions regarding obtaining health care for themselves, large household purchases, and visits to relatives.

Data Management and Analysis

Study household characteristics were calculated and compared to the 2011 EDHS of rural households using chi-square and t-tests to determine statistically significant differences. Similar analysis was conducted to describe and compare characteristics and reported pregnancy and delivery care practices of female and male study participants.

We used multilevel mixed-effects logistic regression with QR decomposition. QR decomposition improves convergence when random-effects variance is small.[81] Unlike other models, which assume independence, multilevel models take dependency of multiple observations from single respondents into account.[62] Level 1 included choices made by each respondent; Level 2 included respondent's gender; and Level 3 included household characteristics.

The analysis was conducted in four parts, which are described in more detail below. First, separate multi-variate analyses of women's and men's data was conducted to determine their

preferences. Second, the data was combined, and gender was introduced as a Level 2 variable to determine whether a statistical difference existed between women and men's preferences. Third, a Level 2 analysis of various decision-making measures were tested to determine their effect on facility choice. Finally, the effect of household poverty on preferences was tested in a Level 3 analysis.

Women's and men's responses were analyzed separately to determine the utility of specific Level 1 attributes for each group that significantly contributed to facility choice. Adjusted odds ratios were calculated to provide a more intuitive presentation of strength and direction of utility coefficients (e^{β}). Bonferroni method was used to control alpha for multiple comparisons.

A multilevel model was constructed by adding individual and random intercept terms. Level 2 interaction terms, combining attributes with gender, were introduced into the model one by one to test whether women and men differed significantly on preferences for facility characteristics. Predictor interactions with involvement in household decision-making (Level 2) were also tested.

Household poverty level (Level 3) main effect on facility choice was tested by creating a poverty variable. First, household deprivation percent was calculated using MPI deprivation indicators using reweighted variables to reflect use of fewer variables. Next, a dichotomous variable, poverty, was created to divide households into those with percent deprivation greater than or equal to 33.3%, the definition for multidimensional poverty, and those who were not multidimensionally poor. In addition to adding poverty to the model to test the effect on facility choice, the interaction between poverty and gender was also tested to determine whether multidimensional poverty effected women and men differently.

Akaike's information criterion (AIC) was estimated and likelihood-ratio (LR) tests were conducted to test improvement in model fit. A decrease in AIC with a significant LR test indicates improvement in model fit.

Data were double-entered in REDCap (Research Electronic Data Capture), a secure web-based program for managing surveys and databases[82] and analyzed using Stata 14[83].

Results

Participant Eligibility

Households with children less than two years old (n=356) and households with pregnant women (n=136) were eligible to participate (Figure 2). For 20 households not located due to incomplete addresses, the next randomly selected household was approached. Participation rate for locatable, eligible households was 98%. Household and individual surveys took approximately 5 minutes and the DCE portion took approximately 10 minutes to complete.

Study Participants' Characteristics

Household Characteristics. Study sample household characteristics were compared to household characteristics from the EDHS (Table 3). Study sample participants generally had better living conditions and more access to radios and mobile phones than those in the EDHS sample. However, a significantly greater percent of study sample households lacked land and livestock.

Female and Male Participants' Characteristics. Ninety-seven percent of women and 99% of men were from Sidama. All women and 96% of men were Protestant. Women were on average 7 years younger and had one year less education than their husbands had. Men had two to three times more exposure to mass media and participated more in household decisions compared to

women. Men were more likely to believe their wife had received prenatal care during their pregnancy (89.8%) than women reported having done so (29.0%) (Table 4).

DCE Results

Women's preferences. Women's odds of choosing to deliver at a facility were 3.08 (2.03 to 4.67) times greater if medications and supplies were always available; 1.69 (1.37 to 2.07) times greater if support persons were allowed in delivery room; 1.37 (1.09 to 1.70) times greater if a free ambulance was available; and 1.15 (1.12 to 1.18) times greater for every 50-birr (US $2.50) reduction in cost (Table 5).

Provider type was significant using the Wald test ($p< 0.0001$) followed by Bonferroni-protected multiple comparisons. Women were 1.86 (1.23 to 2.80) times more likely to prefer delivery by HEWs than male nurses; 1.45 (1.09 to 1.93) times more likely to prefer male doctors to female doctors; 1.71 (1.27 to 2.29) times more likely to prefer female doctors to male nurses; 1.95 (1.44 to 2.62) times more likely to prefer male doctors to female nurses; and 2.47 (1.84 to 3.32) times more likely to prefer male doctors to male nurses.

Men's preferences. For men (Table 6), odds of choosing a facility were 2.68 (1.79 to 4.02) times greater when medications and supplies are always available; 1.74 (1.42 to 2.14) times greater when a support person is allowed in delivery room; 1.30 (1.03 to 1.64) times greater when provider smiles and listens well; 1.09 (1.06 to 1.13) times greater for each 15-minute reduction in walking distance; and 1.14 (1.11, to 1.17) times greater for every 50-birr reduction in cost.

Provider type was significant overall using the Bonferroni Omnibus test ($p<.0001$). Men were 1.89 (1.29 to 2.78) times more likely to prefer their wives be delivered by HEWs than female nurses; 1.95 (1.30 to 2.95) times as likely to prefer delivery by HEWs to male nurses;

1.39 (1.02 to 1.89) times as likely to prefer female doctors to female nurses; 1.44 (1.07 to 1.92) times as likely to prefer female doctors to male nurses; 1.41 (1.05 to 1.90) times as likely to prefer male doctors to female nurses; and 1.46 (1.09 to 1.95) times as likely to prefer male doctors to male nurses.

Significant differences between predictors of women and men's choices

Only distance, provider type, and ambulance cost were significantly different between women and men. Women's odds of selecting a facility increased 1.08 times for every 15-minutes' increase in distance compared to men (1.03 to 1.14). Women were 1.70 (1.15 to 2.52) times more likely than men to prefer male doctors to male nurses; and 1.36 (1.05 to 1.75) times more likely to prefer a facility with free ambulance service. AIC decreased from the Level 1 model (5551) to a Level 2 model adding Gender at level 2 (5536) and the LR was significant ($X^2(10) = 28.54$, p=0.0002) indicating improved model fit with the addition of significant cross-level interactions.

Decision-making

While Table 4 illustrated significant differences between women and men's involvement in decision-making, decision-making involvement did not significantly influence facility choice, whether measured as none vs. any (p=0.496); involved in healthcare decisions for self vs. not involved (p=0.653); involved in healthcare decisions for self vs. not involved, women vs. men (p=0.189); number of decisions involved in (continuous) (p=0.930); or number of decisions involved in (categorical) (p=0.133).

Poverty and facility choice

Facility choice did not differ between multidimensionally poor and not multidimensionally poor households (p=0.170), but facility choice was associated weakly with

percent household deprivation (p = 0.055). In addition, facility choice did not differ between women and men based on household deprivation (p = 0.672).

Discussion

DCE Preferences

In this study, both women and men placed the highest value on health facilities that always had medications and supplies available and allowed support persons into the delivery room. Women's facility choice was also influenced by free ambulance availability and low cost, while men were more likely to choose nearer, less expensive delivery services with friendly providers.

In contrast, in a DCE in rural Ethiopia, Kruk, Paczkowski, et al.[59] found women preferred high quality delivery services such as available drugs and medical equipment, doctors or nurses rather than HEWs, and friendly providers, with lower value placed on accessibility indicators when selecting facilities. Neither support person presence, nor provider gender, was included in their study.

In our study, preferences for provider type were complex. In order to have a reasonable number of scenarios, provider type and gender were linked in the study design, making provider preferences difficult to interpret. Women generally preferred doctors to nurses, although no significant difference in preference was found between delivery by female doctors or female nurses. Men preferred facilities with doctors to nurses regardless of gender. Nurse's gender did not affect women's facility preference, but male doctors were selected over female doctors. While preference for more highly skilled providers noted by Kruk, Paczkowski, et al.[59] generally held between doctors and nurses; HEWs were either preferred or chosen equally to doctors and nurses.

Interpreting Findings within The Three Delays Model: Implications for Services and Research

Perceived quality of care. In our study, reliable medications and supplies' availability was the strongest facility choice indicator for both women and men. This important element of the Three Delays model's perceived quality of care[12,84] has been reported by other researchers.[8,13,23,59] Government and facility administrators should prioritize supply chain management when making budget allocations. A study comparing actual and perceived stocks of medications and supplies' impact on FBD rates and cost analysis of lives saved through improving supply chains would add further information on this intervention's effectiveness.

Provider attitude was a significant facility choice predictor for men, but not women. However, no significant difference was found between women and men's facility choice based on provider attitude. Qualitative researchers have reported mistreatment by staff, ranging from yelling to physical abuse, made women distrustful of health facilities.[13–15,18,21] Roro et al.[20] reported this was true for men also. Lack of significance of provider attitude for women in this study may result from considering this aspect of care in the context of other variables, which were more important. It may also be that women in this area have had little experience with unfriendly providers, so they are not concerned with this attribute.

Both women and men valued doctors more than nurses, but preferred or were neutral on selecting facilities with HEWs compared to more skilled providers. While appreciation of skilled providers is not uncommon, [15,16,18,21,22,36] HEWs' ability to perform safe deliveries has been questioned.[8,14,20,21] Preference for HEWs may reflect the desire to be delivered by someone they know, or greater flexibility by HEWs in accommodating cultural birth practices[85] such as allowing support persons to be present in the delivery room. Both women and men may be more

comfortable with HEWs who are local women,[85,86] and provide antenatal and postnatal services,[86] trusting them to refer mothers in emergencies.[86] Our findings suggest inherent trust in providers, who understand the cultural context and needs, is more important than procedural skill and knowledge.

The apparent preference for HEWs and doctors over nurses is concerning. Nurses offer the lowest cost solution to providing skilled care in most developing countries. Research is needed to better understand why nurses were least preferred and how to address this issue, as it could have implications for women's health outcomes and workforce training.

Cultural factors. Cultural preference for being surrounded by family and friends during delivery[8,14–19,21,22] was voiced by both women and men. Excluding support persons from the delivery room is incompatible with cultural norms and is likely to decrease FBD uptake.[87] A cluster-randomized controlled trial comparing facilities implementing family-centered delivery policies with those that are not could test this finding.

Preference for male over female providers contradicts reports in qualitative literature.[8,14,15,29] One explanation for this difference may lie in the study design. When asked directly about provider gender preferences, respondents may say they are ashamed to be delivered by a man.[13,14,29] However, when given more complex scenarios, underlying biases, such as sexism, may have greater influence on respondent choices, leading them to choose male providers as being more qualified.

Perceived accessibility. Both women and men preferred lower cost services. However, distance and free ambulance availability had mixed influences on facility choice with women preferring facilities with free ambulance service, while men were more influenced by distance. Other Ethiopian research has shown either no effect[37,40,41,48,54] or increases in FBD when

facilities are closer.[17,27,30,36,43,49,52] Women may prioritize free ambulance service due to greater concern for their own comfort as other free transportation, such as riding in animal carts or being carried on stretchers, are very uncomfortable.[18,20,50] At the community meeting held at the completion of the study, men complained that ambulances were unavailable for deliveries as has been found in other areas of Ethiopia.[85,88]

Perceived Benefits and Needs. We found men are primarily responsible for making household decisions, including decisions about whether their wives seek health care. Yet, 90% of men believed their wives had attended ANC during their pregnancy, while only 29% of women reported doing so. Educating men on home delivery's potential dangers and FBD's benefits could potentially increase families choosing FBD. Barry, et al[89] showed women who attended two or more family education meetings on maternal health with family members were nearly twice as likely to deliver with SBAs or HEWs compared to women who attended fewer than two meetings, but no difference for women who attended alone. Intervention studies involving partners or other family support in maternal education are needed.

Limitations

Generalizability. Based on household characteristics, our study population appears wealthier than the 2011 rural Ethiopian population. However, Ethiopia's economy has experienced 10.8% average growth from 2003/04 to 2013/14.[90] Therefore, other rural areas in Ethiopia may have also experienced similar improvements in living standards. The high percentage of Protestants in this study may limit generalizability to Orthodox or Moslem communities. Also, much of Sidama has a much higher population density than other areas, such as Afar Region, so distance may be less of a concern for women giving birth in Sidama.

The household list used to select participants came from paper-based registers and patient charts, which made identifying eligible participants difficult. Families who lived near health posts or attended clinic may have been over-represented. Although the health workers were expected to visit every home, staffing limitations make this difficult to accomplish. This may limit generalizability.

Missing variables. The ability to recognize emergencies may influence the decision of where to deliver.[84] The original study plan included a DCE in which respondents were asked where they would deliver if they believed the mother or baby's life was in danger. This portion was dropped due to interview length. In addition, the perceived need measure, which the three delays model predicts influences decisions to seek care, was not included in the analysis due to discrepancies in interpreting the danger signs' questions. Finally, while this study included men, mother-in-laws, traditional birth attendants, and other older women may also influence birth place decisions.[18,19,58]

Conclusion

This study makes a unique contribution to the literature as the first known DCE to test both women and men's preferences in choosing FBD services. Including men acknowledged the role men play in making decisions for their families either alone or in collaboration with their partner. Women and men were found to agree on preferring facilities that always had medications and supplies available and allowed support persons in the delivery room. Facilities that respond to these preferences for higher quality and culturally appropriate care may increase FBD uptake.

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Abbreviations

ANC	Antenatal care
DCE	Discrete choice experiment
EDHS	Ethiopian Demographic and Health Survey
FBD	Facility-based delivery
HEW	Health extension worker
MDG	Millenium Development Goal
MPI	Multi-dimensional Poverty Index
SBA	Skilled birth attendant

Figure 1: Sample Task Set for Discrete Choice Experiment

Figure 2: Study Flow Diagram

Table 1. *Attributes and Levels for Discrete Choice Experiment*

Attribute	Levels
Distance to health facility	30 minutes 1 hour 1½ hours 2 hours 3 hours
Type of provider[a]	Female doctor Male doctor Female nurse Male nurse Female Health extension worker
Provider attitude	Provider smiles, is kind and respectful, speaks softly Provider does not smile, uses a harsh tone, harsh language
Availability of medication and supplies	Drugs and medical equipment always available Drugs and medical equipment not always available
Availability of free transport	Free ambulance available Free ambulance not available
Support persons	Family and friends allowed in delivery room Family and friends not allowed in delivery room
Cost (Cost of user charges, labor-related supplies, and non-ambulance transportation)	No cost 50 Ethiopian birr[b] 100 Ethiopian birr 200 Ethiopian birr 300 Ethiopian birr

[a] Nurse was used to indicate both nurses and midwives on the advice of Ethiopian staff as patients generally did not understand the difference between nurses and midwives.
[b] Approximately 20 birr/US$1

Table 2. *The Multi-dimensional Poverty Index Deprivation Score Indicators*

Definition	**Weights (%)**
Health	
A household member is malnourished	16.7
A child has died in the last 5 years	16.7
Education	
No one in the household has completed at least 6 years of school	16.7
A school-age child (7-15) is not enrolled in school	16.7
Living standard	
No electricity	5.6
No access to clean drinking water or source of clean drinking water > 30 minute walk	5.6
Household lacks improved sanitation, or shares with other households	5.6
Dirty cooking fuel is used (dung, wood, or charcoal)	5.6
Household has a dirt, sand or dung floor	5.6
Household does not own a radio, TV, or telephone, and does not own a means of transportation (bike, motorbike, care, truck, animal cart, motorboat) or a means of livelihood (refrigerator, arable land, livestock)	5.6

Table 3. *Characteristics of households in Sidama Zone, SNNPR sample compared to EDHS rural subsam*ple

Variable	Study Sample[a] (n=109)	EDHS 2011 (n=11,590)	p-value
Household size, mean (SD)	5.4 (2.1)	4.9	p<.05
Living Conditions			
Use solid fuel for cooking[b]	109 (100)	11474 (99.0)	ns
Dirt or dung floor	81 (74.3)	11068 (95.5)	p<.001
Non-improved drinking water[c]	21 (19.27)	6734 (58.1)	p<.001
Walk ≥ 30 minutes to drinking water	61 (56.0)	7232 (62.4)	p<.001
No electricity	78 (71.6)	11034 (95.2)	p<.001
Access to Information			
No radio	50 (45.9)	7684 (66.3)	p<.001
No mobile phone	35 (32.1)	10,106 (87.2)	p<.001
No landline	109 (100)	11,567 (99.8)	ns
No television	107 (98.2)	11463 (98.9)	ns
Access to Transportation			
No bicycle	108 (99.1)	11428 (98.6)	ns
No motorcycle	107 (98.2)	11578 (99.9)	p<.001
No vehicle	109 (100)	11578 (99.9)	ns
No animal cart	108 (99.1)	11463 (98.9)	ns
Means of Livelihood			
No refrigerator	109 (100)	11520 (99.4)	ns
No agricultural land	25 (22.9)	1414 (12.2)	p<.001
No livestock	40 (36.7)	1217 (10.5)	p<.001

Note. Results presented as # (%) unless otherwise specified. [a]Study sample had no missing data except: Dirt or dung floor – 10 missing; owns land: 25 don't know. [b]Includes wood, charcoal, straw/shrubs/grass, agricultural crops, and animal dung. [c]Includes piped into dwelling, piped to yard/plot, public tap/standpipe, borehole, protected well, protected spring, rainwater, bottled water.

Table 4. *Characteristics of female and male study participants in Sidama Zone, SNNPR, Ethiopia*

Characteristic	Study Sample [a]		
	Women (n=108)	Men (n=108)	p-value
Age, mean (SD)	24.7 (4.6)	32.1 (8.5)	t= -7.85 (211), p<.001
Percent who never attended school	14 (13.0)	2 (1.9)	X^2 (1, N=215)= 9.72, p<.05
Years of education, mean (SD)	5.5 (3.5) (n= 93)	6.8 (3.3) (n= 106)	t = -2.75(197), p<.05
Mass media exposure			
Never reads paper	93 (86.1)	50 (46.3)	X^2 (1, N=216)= 38.26, p<.001
Never listens to radio	81 (75.0)	28 (25.9)	X^2 (1, N=216)= 52.02, p<.001
Never watches TV	99 (91.7)	36 (33.3)	X^2 (1, N=216)= 78.40, p<.001
No mass media exposure at least once/week	72 (66.7)	57 (52.8)	X^2 (1, N=216)= 4.33, p<.05
Involved in decisions about:			
Seeking health care for self[b]	48 (44.4)	99 (91.7)	X^2 (1, N=216)= 55.39, p<.001
Respondent alone	4 (3.7)	23 (21.3)	
Partner or someone else	60 (55.6)	9 (8.3)	
Jointly with spouse	44 (40.7)	76 (70.4)	
Major household purchases[b]	66 (61.1)	106 (98.1)	X^2 (1, N=216)= 45.67, p<.001
Respondent alone	7 (6.5)	14 (13.0)	
Partner or someone else	42 (38.9)	2 (1.8)	
Jointly with spouse	59 (54.6)	92 (85.2)	
Visiting friends and family[b]	84 (77.8)	103 (95.4)	X^2 (1, N=216)= 14.38, p<.001
Respondent alone	26 (24.1)	22 (20.4)	
Partner or someone else	24 (22.2)	5 (4.7)	
Jointly with spouse	58 (53.7)	81 (75.0)	
Full decision-making capacity[c]	35 (32.4)	96 (88.9)	X^2 (1, N=216)= 72.18, p<.001
Participated in none of the 3 decisions	18 (16.7)	1 (0.9)	X^2 (1, N=216)= 16.68, p<.001
Pregnancy and Delivery Care Characteristics[d]			
Prenatal care during last or current pregnancy	31 (29.0)	97 (89.8)	X^2 (1, N=215)= 82.59, p<.001
Place of last delivery			
Home[e]	51 (65.4)	46 (59.7)	X^2 (1, N=155)= .53, p= ns
Health facility	27 (34.6)	31 (40.3)	X^2 (1, N=155)= .53, p= ns
Delivered by a skilled birth attendant	25 (23.2)	30 (27.8)	X^2 (1, N=216)= .61, p= ns

Note. Data is n (%) unless otherwise specified. [a]Study sample had no missing data except: Women: Age-2; Years of education-15; Prenatal-1; Men: Age-1; Years of education-2. [b]Alone or jointly with spouse. [c]Defined as participating in making decisions about healthcare, major household purchases, and visits to family or relatives alone or jointly with spouse. [d]Women and men were asked these questions separately. [e]Home includes participant's home or another home.

Table 5

Results from mixed-effects logistic regression model for utility of attributes of health facilities for delivery, reported for 108 women[a] from Sidama zone, SNNPR, Ethiopia

Variable	Odds Ratio	p-value	95% CI	
Meds and supplies				
Always available	3.08	**0.000**	2.03	4.67
Support person				
Allowed in delivery room	1.69	**0.000**	1.37	2.07
Ambulance				
Free	1.37	**0.006**	1.09	1.70
Cost (per 50 birr decrease)	1.15	**0.000**	1.12	1.18
Provider				
Female doctor vs HEW	0.92	0.702	0.59	1.42
Male doctor vs HEW	1.33	0.169	0.89	1.99
Female nurse vs HEW	0.68	0.050	0.47	1.00
Male nurse vs HEW	0.54	**0.003**	0.36	0.81
Female doctor vs male doctor	0.69	**0.011**	0.52	0.92
Female doctor vs female nurse	1.34	0.064	0.98	1.84
Female doctor vs male nurse	1.71	**0.000**	1.27	2.29
Male doctor vs female nurse	1.95	**0.000**	1.44	2.62
Male doctor vs male nurse	2.47	**0.000**	1.84	3.32
Female nurse vs male nurse	0.68	0.120	0.94	1.71
Attitude				
Smiles, listens	1.24	0.075	0.98	1.56
Distance (per 15 minute decrease in walking time)	0.99	0.383	0.86	1.05

Note. AIC decreased from 2960 (null) to 2762 (Level1). Likelihood ratio (LR) chi2(10)=218.30, p<0.0001 [a]21 missing responses and 99 neither responses out of 3240 options

Table 6

Results from mixed-effects logistic regression model for utility of attributes of health facilities for delivery, reported for 108 men from Sidama zone, SNNPR, Ethiopia

Variable	OR	p-value	95% CI	
Meds and supplies				
Always available	2.68	**0.000**	1.79	4.02
Support person				
Allowed in delivery room	1.74	**0.000**	1.42	2.14
Attitude				
Smiles, listens	1.30	**0.030**	1.03	1.64
Distance(per 15 minute decrease in walking time)	1.09	**0.000**	1.06	1.13
Cost (per 50 birr decrease)	1.14	**0.000**	1.11	1.17
Provider				
Female doctor vs HEW	0.74	0.169	0.47	1.14
Male doctor vs HEW	0.75	0.155	0.50	1.12
Female nurse vs HEW	0.53	**0.001**	0.36	0.78
Male nurse vs HEW	0.51	**0.001**	0.34	0.77
Female doctor vs male doctor	0.99	0.929	0.74	1.31
Female doctor vs female nurse	1.39	**0.035**	1.02	1.89
Female doctor vs male nurse	1.44	**0.014**	1.07	1.92
Male doctor vs female nurse	1.41	**0.022**	1.05	1.90
Male doctor vs male nurse	1.46	**0.012**	1.09	1.95
Female nurse vs male nurse	1.03	0.832	0.77	2.94
Ambulance				
Free	0.95	0.679	0.76	1.19

Note. AIC decreased from 2960 (null) to 2781 (Level 1). Likelihood ratio (LR) chi2(10)=234.49, p<0.0001 [a]No missing responses and 37 neither responses out of 3240 options

Figure 1: Sample Task Set for Discrete Choice Experiment‼

165x106mm (300 x 300 DPI)

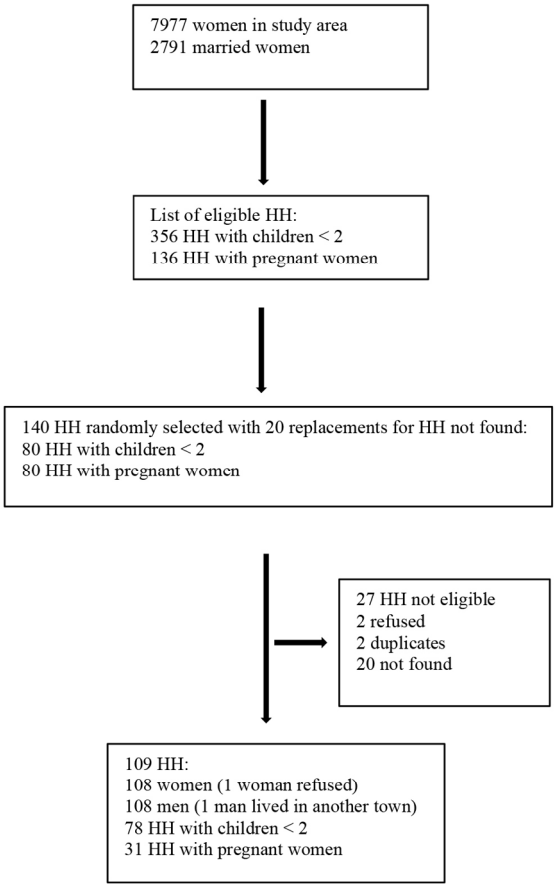

Figure 2: Study Flow Diagram

151x140mm (300 x 300 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract pp. 1 and 3	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
p. 6 Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
p. 9 Objectives	3	State specific objectives, including any prespecified hypotheses
Methods – p. 9		
Study design – p. 9	4	Present key elements of study design early in the paper
Setting – p. 10	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants – p. 10	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables – p.9	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement – p.9	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias – p. 11	9	Describe any efforts to address potential sources of bias
Study size – p. 10	10	Explain how the study size was arrived at
Quantitative variables – p. 13	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods – p. 13	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants – p. 14	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data – p. 14	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data – p. 15	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results – p. 15	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results – p. 17	18	Summarise key results with reference to study objectives
Limitations – p. 20	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation – p. 20	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability – p. 20	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding – p. 2	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.