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Factors influencing modes of transport and travel time for obstetric care: a mixed methods study in Zambia and Uganda

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Abstract

Transportation is an important barrier to accessing obstetric care for many pregnant and postpartum women in low-resource settings, particularly in rural areas. However, little is known about how pregnant women travel to health facilities in these settings. We conducted 1633 exit surveys with women who had a recent facility delivery and 48 focus group discussions with women who had either a home or a facility birth in the past year in eight districts in Uganda and Zambia. Quantitative data were analysed using univariate statistics, and qualitative data were analysed using thematic content analysis techniques. On average, women spent 62–68 min travelling to a clinic for delivery. Very different patterns in modes of transport were observed in the two countries: 91% of Ugandan women employed motorized forms of transportation, while only 57% of women in Zambia did. Motorcycle taxis were the most commonly used in Uganda, while cars, trucks and taxis were the most commonly used mode of transportation in Zambia. Lower-income women were less likely to use motorized modes of transportation: in Zambia, women in the poorest quintile took 94 min to travel to a health facility, compared with 34 for the wealthiest quintile; this difference between quintiles was ~50 min in Uganda. Focus group discussions confirmed that transport is a major challenge due to a number of factors we categorized as the 'three A's:' affordability, accessibility and adequacy of transport options. Women reported that all of these factors had influenced their decision not to deliver in a health facility. The two countries had markedly different patterns of transportation for obstetric care, and modes of transport and travel times varied dramatically by wealth quintile, which policymakers need to take into account when designing obstetric transport interventions.

Key words: Maternal health, neonatal health, obstetric emergencies, sub-Saharan Africa, transport

Background

Every year, ~280 000 women die during and immediately following childbirth (Kassebaum *et al*. 2014; Say *et al*. 2014), 2.6 million infants are stillborn (Bhutta *et al*. 2014), and 1 million newborns die within the first week of life (Wright *et al*. 2014). The vast majority of these deaths occur in developing countries, and many of them are preventable with skilled attendance and proper equipment at the

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Key Messages

- Average travel time to reach a clinic for obstetric care was reported to be between 62 and 68 min in select districts in Uganda and Zambia
- Travel patterns were markedly different in the two countries, with more motorized transport use (including motorcycles) in Uganda
- Intra-country disparities are great: in Zambia, women in the poorest wealth quintile took 94 min to reach a facility vs 34 min for the wealthiest quintile
- Deficiencies were reported by all focus groups in the affordability, accessibility and adequacy of transport options

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time of delivery. Many obstetric complications are unpredictable and require not only skilled attendance, but also technologies and surgical or transfusion capacities. Thus women's ability to reach an equipped health facility in a timely manner in case of emergency is critical, for both their health and that of their newborns. Increased coverage and quality of known interventions for comprehensive emergency obstetric care, including Caesarean sections, magnesium sulfate, blood transfusions, antenatal corticosteroids, antibiotics and resuscitation equipment, along with skilled providers, could avert a large number of these deaths (Bhutta et al. 2014).

Among women who wish to deliver in a health facility, a number of obstacles have been identified, including cost, distance and geographic barriers to reach a facility (Moyer and Mustafa 2013; Bohren et al. 2014). Yet some specific aspects of transport, such as a lack of available vehicles and drivers, have been less explored. In addition, women and their families may decide the effort is not worthwhile if a facility delivery is not deemed necessary, or if the actual or perceived quality of care at the facility is poor (Bohren et al. 2014). There is an increased interest in including transportation-related interventions, such as the distribution of heavily subsidized transport vouchers, as part of efforts to reduce maternal mortality (Bellows et al. 2013). However, the effectiveness of these approaches will depend on current patterns and context-specific barriers to care in various settings, which are not often considered. Twenty years ago, the pivotal article 'Too far to walk' highlighted the challenges faced by parturient women in reaching adequate obstetric and newborn care in resource-limited settings (Thaddeus and Maine 1994). Many studies continue to identify transport challenges as a critical barrier to reaching obstetric care globally (Murray and Pearson 2006; Islam and Yoshida 2009; Hussein et al. 2012; Keya et al. 2014), highlighting a lack of transport options, financial barriers, difficult geography, time needed to travel and poor ergonomics as domains within transport that still need to be addressed (Wilson et al. 2013). Although barriers to transport during an emergency represent a clear delay to receipt of care (Barnes-Josiah et al. 1998), there is insufficient research on the specifics of transport—including the mode of transport, average time of travel, factors associated with various means of transport and concerns about referrals—for patients in countries with high rates of maternal and newborn mortality.

A recent systematic analysis of qualitative studies on emergency obstetric transportation in low- and middle-income countries identified 29 studies, most of which were based on small samples in a single country or location; none used mixed methods (Wilson et al. 2013). A few modelled studies have estimated that travel time to facilities has a significant impact on women's likelihood to deliver in

a facility (Gabrysch et al. 2011; Masters et al., 2013; Hirose et al. 2015). Although it is expected that easier access to a facility would positively impact maternal mortality, there is limited evidence. Nonetheless, given the importance of rapidly identifying and treating obstetric complications, which frequently emerge without warning, minimizing travel time to obstetric care is an important component of maternal mortality strategies (Global Health Initiative 2011). Further, while there is growing evidence around the use of transport vouchers, a strategy designed to encourage facility deliveries (Rob et al. 2009; Van de Poel et al. 2014), there is limited information on their affect on the choice of mode of transportation.

This study addresses several of the gaps in the literature on transport in maternal care in low-resource settings. Using quantitative and qualitative data, we describe modes of transport in four districts in Uganda and four districts in Zambia and analyse differences by country, wealth quintile, receipt of travel vouchers and facility level. We also investigate the different modes of transportation utilized by women who were referred from a lower-level health facility to a higher-level health facility during the intra-partum period, a topic that has received nearly no attention in the literature. We further explore what factors influence women's choice of particular modes of transport using focus group discussion data. We believe the findings of this study can help inform future policies designed to improve access to health facilities in resource-constrained settings.

Materials and methods

During 2012–13, we conducted a strategic implementation evaluation of the 'Saving Mothers, Giving Life' (SMGL) initiative in Zambia and Uganda, a $200 million public–private initiative to reduce maternal and neonatal mortality through both supply- and demand-side interventions, including community mobilization, provision of a new ambulance in each district, and the availability of subsidized obstetric transport vouchers (Kruk et al. 2014). As part of this evaluation, we collected cross-sectional quantitative and qualitative data on transportation issues in the eight SMGL intervention districts. All intervention districts were rural, with a primarily agricultural workforce. The four Ugandan intervention districts (Kabarole, Kamwenge, Kibaale and Kyenjojo) are located in the country's Western region, and are contiguous. The Zambian intervention districts (Mansa, Lundazi, Nyimba and Kalomo) are dispersed throughout the country, with Mansa located in Luapula province, bordering the Democratic Republic of the Congo and Lundazi and Nyimba located in the Eastern province, sharing a border with Malawi and Mozambique. Kalomo is located in the

Southern province, bordering Zimbabwe. Districts in Uganda had between 23 and 41 primary health facilities (health posts and health centres), and those in Zambia had between 17 and 42 primary health facilities. All districts had at least one secondary referral facility.

According to the most recent Demographic and Health Surveys (DHS), 57% of deliveries in Uganda were attended by a skilled birth attendant and only 5% of births were by Caesarean section; in the same survey, 65% of respondents reported difficulties accessing care when needed (UBOS 2011). In Zambia, it was reported that 47% of deliveries were attended by a skilled birth attendant and only 3% of women received Caesarean sections; over 77% of DHS respondents in Zambia reported difficulties accessing care when needed (ZDHS 2007). Zambia is a considerably larger country, with a generally sparser, more heterogeneous population, which often makes transport and coordination more difficult (Kruk *et al.* 2014). Yet, Zambia is a wealthier country overall, with a gross national income of $1160 USD per capita (Atlas method) and government spending on health at $44 per person, compared with Uganda's gross national income of $510 USD per capita (Atlas method) and government spending of $10 per person on health in current US dollars (WHO 2013). Uganda also has a significantly larger Muslim population than Zambia, which could influence cultural preferences around birth.

Data collection took place between November 2012 and July 2013. Before data collection began in each country, all instruments were piloted in non-study districts. We conducted exit interviews with postpartum women directly following their discharge from facilities. We sampled at both Basic (BEmONC) and Comprehensive Emergency Obstetric and Neonatal Care (CEmONC) facilities. BEmONCs were defined as those that could handle routine care and common complications with antibiotics, anticonvulsants, uterotonics and neonatal resuscitation. CEmONC facilities were those that could additionally provide Caesarean sections and blood transfusions. We held 48 focus groups in each country: half with women who delivered at home, and half with women who had delivered in facilities, all within the preceding year.

Women aged 15–49 were eligible for facility exit interviews if they had delivered in the previous week and had been discharged from the health facility. Exit interviews included questions about respondents' demographics, health history, past experiences with the health system, mode of travel to the health facility, utilization of various incentives and satisfaction with care. Exit interviews were conducted in local languages (Runyoro/Rutooro and Runyankole/Rukiga in Uganda, and Nyanja, Chitonga, and Bemba in Zambia). Multilingual research assistants collected data on Galaxy Nexus tablets using SurveyCTO software. Data collectors stationed at study facilities invited women to participate in exit interviews immediately after their discharge. If women were eligible and consented to participate, they were interviewed in a private, shaded area separated from the main facility buildings, health workers, and other patients. All respondents completed an informed consent process prior to participation. Women were given a 'chitenge' (local fabric) or large bar of soap as a token of appreciation. A total of 1633 women completed the surveys.

Data were collected and transformed into CSV files using SurveyCTO and then imported into STATA (version 12.0, StataCorp LP, College Station, TX, USA) for cleaning and analysis. Univariate statistics were calculated for all variables. Women were asked to rate their health on a five-part Likert scale, which was then transformed into a binary outcome grouping the top two categories ('very good' and 'good') and the bottom three categories together ('moderate,' 'bad' and 'very bad'). Women's literacy was assessed by asking them to rate their facility with reading and writing on a three-part Likert scale. Two binary outcomes were constructed to assess literacy: 'fully literate' vs not for women who declared themselves able to both read and write 'easily', and 'fully illiterate' vs not for women who said they could read and write 'not at all'. We used principal components analysis of 52 questions pertaining to women's household assets to construct a relative wealth index within each country. Women were grouped into wealth quintiles based on their index scores, and the wealthiest 20% was compared with the poorest 20%. Women were asked to identify all modes of transport they had used to reach their health facility. Their responses were used to create a variable identifying the most 'advanced' mode of transport used during their journey; i.e. a woman who had walked part of the way and then taken a motorcycle taxi for the rest of the trip was considered a motorcycle user, rather than a walker. A binary variable was constructed that counted all women who used a motorcycle taxi, ambulance, car, truck, public transport or taxi during their journey to a facility as having used motorized transport. For comparisons of categorical variables (such as mode of transport) across countries, wealth quintiles, facility level, and delivery status, *P*-values were calculated using logistic bivariate regression, clustering on facility, treating each category as a binary outcome. For continuous variables, *P*-values were calculated using OLS (ordinary least squares) regression, clustering on facility.

Women were eligible to participate in focus groups if they had delivered in the previous year and lived in the project catchment areas. Recently delivered women were recruited by local village health workers and community leaders. Participants were stratified by those living within town boundaries and those living outside of town boundaries (who were generally considered to be further away from the town centre in less accessible areas). Focus groups were held in private locations and lasted between 45 min and 1.5 h. The focus groups were semi-structured, were conducted in local languages by trained facilitators, using a field guide, and individual women completed an informed consent process prior to participation in focus groups. Participants were asked about their decision-making processes, utilization of vouchers and delivery experiences. If all participants individually consented, the focus group discussion was audio recorded. Participants were provided lunch and compensated for transport to the venue. Data from focus group discussions were coded in NVivo (QSR, Australia) and analysed using thematic content analysis (Creswell 2012). Emergent themes were the affordability of transport, accessibility of transport and adequacy of transport.

In three districts in Uganda, non-governmental organizations provided transport vouchers to pregnant women in their second and third trimesters at a highly subsidized cost. The vouchers could be used to hire a motorcycle taxi for travel to antenatal care visits, a facility for delivery and a clinic for a postnatal care visit. Vouchers were not available in Zambia, but other efforts were untaken to improve ambulance networks. In both countries, ambulances were used to transport women from lower-level clinics to higher-level care, at no cost to the patient, but were not available to transport women from home to the clinics.

This study was reviewed and approved by the Columbia University Institutional Review Board, the Higher Degrees Research and Ethics Committee at the Makerere University School of Public Health, College of Health Sciences in Uganda the Uganda National Council of Science and Technology, and the ERES Converge Research Ethics Committee in Zambia and the Ministry of Health in Zambia.

Table 1. Descriptive statistics for facility exit interview respondents

Women's characteristics	Uganda ($n = 790$) n (%)	Zambia ($n = 843$) n (%)	P-value
Demographics			
Age, mean (SD)	24.6 (6.0)	25.1 (6.7)	0.34
Married or cohabiting	635 (80.7)	739 (87.7)	0.02
Farmer/homemaker	618 (79.7)	565 (68.0)	0.05
Woman is head of household	36 (4.6)	16 (1.9)	0.01
Self-rated health (Rate 'very good' or 'good')	428 (54.2)	654 (77.7)	<0.01
Literacy			
Reads and writes easily	326 (41.3)	353 (41.9)	0.89
Does not read or write at all	150 (19.0)	248 (29.4)	<0.01
Religion			
Christian	748 (94.9)	837 (99.3)	<0.01
Muslim	39 (5.0)	3 (0.4)	<0.01
Traditional/Other	1 (0.1)	3 (0.4)	0.36
Delivery experiences for facility exit interview respondents			
Parity			
1 birth	239 (30.3)	274 (32.6)	0.52
2–3 births	258 (32.7)	282 (33.5)	0.77
4+ births	293 (37.1)	285 (33.9)	0.31
Days spent in facility after delivery			
<1 day	259 (32.8)	434 (51.7)	<0.01
1–2 days	309 (39.2)	190 (22.6)	<0.01
3–5 days	114 (14.5)	95 (11.3)	0.29
>5 days	107 (13.6)	121 (14.4)	0.85
Referred from another facility	170 (21.9)	171 (20.5)	0.81
Used voucher to reach facility	113 (14.4)	n/a	n/a
Experienced complications	781 (66.5)	835 (51.5)	<0.01
Travel time (min), mean (SD)	62.46 (62.7)	68.39 (79.3)	0.49

Results

Quantitative findings

As shown in Table 1, women who completed the exit survey in Uganda and Zambia were largely comparable; however, there were some important differences between the two samples. Of note, more Zambian women rated their overall health more highly (77.7 vs 54.2%) and fewer reported experiencing an obstetric complication (51.5 vs 66.5%). Most Zambian women reported staying in the facility for <1 day after childbirth (51.7%), while the plurality of Ugandan women reported staying for 1–2 days (39.2%); similar numbers of women stayed in the facility beyond 3 days in both countries. Mean reported travel time was 63 min in Uganda and 68 min in Zambia. In Uganda, where vouchers were made available in three of the four districts, 14.4% of all respondents reported having used a voucher.

Mode and travel time to health facilities

As shown in Table 2, motorcycle taxis were the most commonly used mode of transportation in Uganda (63.4% of survey respondents) for both the poorest and wealthiest women in the sample. In Zambia, there was more variation in the modes of transportation used, with 16.3% of women using a taxi, 16.9% of women travelling by car or truck and 30.4% of women walking or using a stretcher. Overall use of motorized forms of transportation was very high in Uganda (91.1%), but substantially lower in Zambia (57.5%). Interestingly, only 5.7% of women in Zambia travelled to the clinic via motorcycle taxi, the most common mode of transportation in Uganda, suggesting distinctly different patterns of use of motorcycle taxis between the two countries.

There were also differences between women in low- and high-wealth quintiles. In Uganda, women in the wealthiest quintile were significantly more likely to travel by car or truck than their poorer counterparts (18.4 vs 4.0%, respectively), who were more likely to travel by ambulance (22.5 vs 7.9%). The difference between modes of transport between wealth quintiles in Zambia was more pronounced than in Uganda: 62.7% of women in the poorest quintile in Zambia reported travelling via non-motorized transport, compared with only 23.8% of women in the wealthiest quintile. In Uganda, there was no significant difference in the use of motorized transport across wealth quintiles. Different patterns of modes of transportation between the poor and the wealthy translated into markedly different mean travel times between the wealth quintiles. In Uganda, poorer women took more than 50 additional minutes to reach the health facility than wealthier women. In Zambia, this difference translated into nearly an additional hour of travel time for poorer women.

In Zambia, but not in Uganda, the difference in use of motorized vs non-motorized vehicles was statistically significant between women who delivered at basic (BEmONC) vs comprehensive (CEmONC) emergency obstetric and neonatal care facilities. In Uganda, differences were significant between women who delivered in BEmONC vs CEmONC facilities across all modes of transport except for ambulances, bicycles and walking. Women who delivered at BEmONC facilities in Uganda were more likely to travel by motorcycle taxi (76.7 vs 56.0%, respectively); women who delivered at CEmONC facilities were more likely to travel by car/truck (10.0 vs 1.8%) or taxi (7.7 vs 0.7%). In Zambia, women who delivered at BEmONC facilities were far more likely to travel by foot (47.6 vs 16.2%). Overall, women who delivered at CEmONC facilities were significantly more likely to use motorized transport.

Table 2. Mode of travel to health facility and travel times, by wealth and facility level

	Uganda (*n* = 789)							
	Mode of travel	Minutes to facility	Wealth quintile			Facility level		
			Poorest quintile (*n* = 151)	Wealthiest quintile (*n* = 152)		BEmONC (*n* = 279)	CEmONC (*n* = 509)	
	n (%)	mean (SD)	*n* (%)	*n* (%)	*P*-value	*n* (%)	*n* (%)	*P*-value
Motorcycle taxi	500 (63.4)	52.62 (47.3)	86 (57.0)	85 (55.9)	0.90	214 (76.7)	285 (56.0)	0.02
Walked or stretcher	65 (8.2)	60.68 (53.7)	16 (10.6)	15 (9.9)	0.90	33 (11.8)	32 (6.3)	0.22
Ambulance	103 (13.1)	98.56 (100.9)	34 (22.5)	12 (7.9)	<0.01	22 (7.9)	81 (15.9)	0.34
Car/truck	56 (7.1)	62.27 (58.6)	6 (4.0)	28 (18.4)	<0.01	5 (1.8)	51 (10.0)	<0.01
Public transport	19 (2.4)	123.42 (89.9)	6 (4.0)	1 (0.7)	0.15	1 (0.4)	18 (3.5)	0.02
Taxi	41 (5.2)	71.49 (67.5)	3 (2.0)	11 (7.2)	0.11	2 (0.7)	39 (7.7)	<0.01
Bicycle	5 (0.6)	37.00 (21.7)	0 (0.0)	0 (0.0)		2 (0.7)	3 (0.6)	0.83
Total motorized	719 (91.1)	62.80 (63.7)	135 (89.4)	137 (90.1)	0.90	244 (87.5)	474 (93.1)	0.25
Total non-motorized	70 (8.9)	58.99 (52.4)	16 (10.6)	15 (9.9)		35 (12.5)	35 (6.9)	
Time to facility (min), mean (SD)		62.46 (62.7)	86.70 (81.3)	36.26 (34.4)	<0.01	59.17 (52.2)	64.27 (67.8)	0.55

	Zambia (*n* = 840)							
	Mode of travel	Minutes to facility	Wealth quintile			Facility level		
			Poorest quintile (*n* = 166)	Wealthiest quintile (*n* = 164)		BEmONC (*n* = 374)	CEmONC (*n* = 462)	
	n (%)	mean (SD)	*n* (%)	*n* (%)	*P*-value	*n* (%)	*n* (%)	*P*-value
Motorcycle taxi	48 (5.7)	49.40 (39.8)	9 (5.4)	10 (6.1)	0.76	7 (1.8)	41 (8.9)	0.07
Walked or stretcher	255 (30.4)	73.20 (88.7)	71 (42.8)	31 (18.9)	<0.01	178 (47.6)	75 (16.2)	<0.01
Ambulance	92 (11.0)	63.21 (45.9)	19 (11.5)	8 (4.9)	0.07	5 (1.3)	87 (18.8)	<0.01
Car/truck	142 (16.9)	74.24 (86.4)	19 (11.5)	42 (25.6)	0.03	55 (14.7)	87 (18.8)	0.57
Public transport	64 (7.6)	107.83 (103.4)	8 (4.8)	8 (4.9)	0.98	30 (8.0)	34 (7.4)	0.88
Taxi	137 (16.3)	43.27 (65.6)	7 (4.2)	57 (34.8)	<0.01	44 (11.8)	93 (20.1)	0.19
Bicycle	102 (12.1)	70.75 (66.9)	33 (19.9)	8 (4.9)	0.01	55 (14.7)	45 (9.7)	0.37
Total motorized	483 (57.5)	65.45 (76.4)	62 (37.4)	125 (76.2)	<0.01	141 (37.7)	342 (74.0)	0.02
Total non-motorized	357 (42.5)	72.51 (83.0)	104 (62.7)	39 (23.8)		233 (62.3)	120 (26.0)	
Time to facility (min), mean (SD)		68.39 (79.3)	94.42 (92.3)	34.44 (37.5)	<0.01	66.79 (78.3)	69.81 (80.4)	0.83

Travel times varied considerably across the various modes of transportation. In Uganda, women reported taking between 37 min (bicycles) and 123 min (public transportation) to arrive at the facility, and in Zambia the travel times ranged from 43 min (taxis) to 108 min (public transportation). Not including the small number of women that rode bicycles to their health facility in Uganda, in both countries the mode of transportation with the shortest reported travel time appears to be the most commonly used.

Mode of travel for inter-facility referral

We also investigated the different modes of transportation utilized by women who were referred from a lower-level health facility to a higher-level facility during the intra-partum period. As shown in Table 3, in both countries, nearly all women who were referred from a clinic to a higher-level facility traveled by motorized transport (99.4% in Uganda and 88.3% in Zambia); ambulances were the most commonly used mode of transportation for referrals in both countries. In Uganda, the primary modes of transportation for referrals were ambulances (51.8%) and motorcycle taxis (27.0%). In Zambia referrals were transported mainly in ambulances (50.9%), cars/trucks (16.4%) and taxis (9.9%).

Qualitative findings

Focus group data largely confirmed that transport posed a critical challenge to women in both countries. We categorized responses into 'three A's': the affordability, accessibility and adequacy of transport.

Affordability of transport

In Zambia, women in all focus groups reported that a lack of affordability of transport was a major barrier to facility delivery. This challenge held true for women in all focus groups, regardless of their distance from the health facility. Many women discussed their desire to deliver at a facility, but identified the lack of resources to arrange a taxi, combined with the far distances to clinics, as prohibitive barriers. Although women in many of the home delivery focus groups expressed a desire to deliver in facilities, they faced financial challenges with regard to transport, which resulted in home deliveries.

> I did not deliver at home deliberately . . . and also they [community health workers] talk too much, they think we deliver at home willingly but it's because of lack of money for transport. Like me, where I live is about two hours' walk (FGD Zambia, Nyimba, home delivery).

Table 3. Mode of travel to health facility, by referral status

Mode of transport	Uganda (n = 775)			Zambia (n = 834)		
	Direct (n = 605) n (%)	Referred (n = 170) n (%)	P-value	Direct (n = 662) n (%)	Referred (n = 171) n (%)	P-value
Walked or stretcher	63 (10.4)	1 (0.6)	<0.01	242 (36.6)	10 (5.9)	<0.01
Bicycle	5 (0.8)	0 (0.0)		92 (13.9)	10 (5.9)	0.02
Car/truck	43 (7.1)	13 (7.7)	0.87	112 (16.9)	28 (16.4)	0.94
Public transport	11 (1.8)	7 (4.1)	0.13	55 (8.3)	8 (4.7)	0.06
Motorcycle taxi	444 (73.4)	46 (27.1)	<0.01	36 (5.4)	11 (6.4)	0.49
Taxi	25 (4.1)	15 (8.8)	0.06	120 (18.1)	17 (9.9)	0.01
Ambulance	14 (2.3)	88 (51.8)	<0.01	5 (0.8)	87 (50.9)	<0.01
Total motorized	537 (88.8)	169 (99.4)	<0.01	328 (49.6)	151 (88.3)	<0.01
Total on-motorized	68 (11.2)	1 (0.6)		334 (50.5)	20 (11.7)	

Women's autonomy and reliance on others played a role in barriers to adequate transportation in Zambia. Financial reliance on one's husband or partner created challenges in accessing care, as the responsibility of saving transport money was considered the role of the husband or partner.

> The problem is that most husbands do not prepare transport money for their wives to go to the clinic when they are in labor (FGD Zambia, Kalomo, facility delivery).

In Uganda, women's enthusiasm for vouchers came mainly as a result of the financial relief from the cost required to send a woman to a facility, as well as their sense that the intervention was providing for them.

> People see that the program is helping them because those days you used to go to [the private hospital] and pay a lot of money but now you do not pay a single coin so pregnant mothers are enjoying it (FGD Uganda, Kabarole, facility delivery).

For women further from a facility, the cost was greater and often prohibitive. Focus groups of women living closer to facilities reported fewer challenges with transport, although there was still a cost associated with using motorized transport for short distances. Although the vouchers did not address all of the challenges, women in some focus groups reported that they were able to deliver in a facility once the transport cost was eliminated.

Accessibility of transport

Overall, women in all focus groups reported a lack of availability of various modes of transport, as well as a lack of ability to access certain types of transport quickly. Even with the cost of transport reduced, these women expressed frustration at the ease of use, especially at night and in the rainy season.

> When we talk about lack of transport to the clinic . . . we do not find transport at the clinic or it is not always there, so that is the challenge; bicycles are also few (FGD Zambia, Lundazi, home delivery).

In one district in Uganda, women spoke of problems with terrain, especially during the rainy season, and the unsuitability of motorcycles for pregnant women. In this group, women faced challenges in convincing motorcycle drivers to pick them up at their homes when the weather was poor and road conditions were not ideal.

> For me, the motorcycle man delayed to reach in time and he was the one responsible for transporting me to the health facility and this made me deliver from home but I wanted to deliver from the health facility (FGD Uganda, Kamwenge, home delivery).

> For me on my day of delivery, I had my elder daughter. I gave a phone call to the motorcycle rider but he found me when I had already delivered. He however emphasized that we go to the health facility and drove me there (FGD Uganda, Kyenjojo, home delivery).

Adequacy of transport

In Zambia, where bicycle ambulances were being promoted via the SMGL program, women in focus groups expressed the fear that their slow speed would be insufficient to bring them to a facility in time for the delivery. Many women with no access to motorized transport chose to deliver at home for fear of delivering on the road. Ugandan women also expressed worry about delivering on the road. Although this was a greater fear for women living further from clinics, women living closer to facilities also expressed this worry.

> Sometimes we fear to deliver our babies on the way due to the long distance to the clinics so we end up just delivering at home especially if your husband did not save money for booking a taxi. During labor we suffer a lot (FGD Zambia, Mansa, facility delivery).

Long distances, poor road infrastructure and logistical challenges related to calling motorcycle taxis and ambulances continue to be paramount challenges with transport to facilities. In almost all of the focus groups, women asserted that if they were not able to secure transport quickly, they would not go to a facility.

> The reason I delivered at home is that I went to the farm and whilst there delivery pains started. You know for me . . . by the time I was making a call, time had gone already. That was the reason why I gave birth at home (FGD Zambia, Mansa, home delivery).

> The reason I delivered at home is that my delivering time just came sudden at night around 20 hours [8 pm] when it was already dark and around 23.30 hours [11:30 pm] I gave birth. So it was very dark and so I couldn't manage to reach the place because it's also very far (FGD Uganda Kibaale, home delivery).

In every focus group, there were women who reported that the unexpected start of labor and fast progression was an impediment to a facility delivery. Transport methods that took a long time to reach the facility or were unsafe at night, such as bicycles, were not seen as appropriate and thus not utilized much.

Discussion

On average, women spent 62–68 min travelling to a clinic for delivery. Different patterns in modes of transport were observed in the

two countries: 91% of Ugandan women employed motorized forms of transportation, while only 57% of women in Zambia did. Motorcycle taxis were the most commonly used in Uganda, while cars, trucks and taxis were the most commonly used mode of transportation in Zambia. Women in the lowest income quintile were less likely to use motorized modes of transportation in both countries. Women in the poorest quintile in Zambia took an hour more than those in the wealthiest quintile to travel to a health facility; this difference between quintiles was ~50 min in Uganda. Focus group discussions confirmed that transport is a continuing challenge due to a number of factors in each of the 'three A's:' affordability, accessibility, and adequacy of transport. Women reported that all of these factors had influenced their decision not to deliver in a health facility.

In both countries, the average travel time to a health clinic was slightly more than an hour: 62 min in Uganda and 68 min in Zambia. This finding is consistent with a range of other studies from Nepal, Honduras, Tanzania and the Gambia, which also showed an average of an hour travel time for a half to two-thirds of women to reach a facility (Rosales *et al*. 2003; Bhusal *et al*. 2011; Samson 2012; Lerberg *et al*. 2014). A more striking finding is that we also observe very large differences in mean travel times between the poorest and wealthiest income groups, with poorer women taking an additional 50–60 min to travel to the clinic than wealthier women in both countries. Because our survey did not ask women about the distances they travelled between their homes and the clinics, these differences might be because poorer women simply live further away from a health clinic. However, we also find that women in the poorest quintile were less likely to use motorized modes of transport than their wealthier counterparts, suggesting that it is not simply an issue of distance. Because our focus group discussions found that women fear giving birth en route to facilities, longer travel times might further discourage women from seeking transport to a clinic. Longer transportation times, due to any of the 'three A's'—affordability, accessibility or adequacy— of transportation methods available to poorer women likely influences their propensity to deliver in a health facility.

The modes of travel most commonly used by women varied markedly across countries. Overall use of motorized modes of transportation was quite high in Uganda, but notably much lower in Zambia. In Uganda, motorcycle taxis were the mode of transportation of choice for the majority of women, whereas only a small percentage of women used motorcycle taxis in Zambia. This is in keeping with the relative prevalence of household motorcycle ownership reported by the DHS in each country: 8% of Ugandan households own a motorcycle or scooter, while only 0.5% of Zambian households do (ZDHS 2007; UBOS 2011). This finding suggests that existing transportation patterns should be considered in the design of policy efforts to address transportation challenges. Had Zambia implemented a voucher program similar to that in Uganda, which made it easier for women to use motorcycle taxis for transportation, it is likely that they would not have been as useful, given the relative rarity of motorcycle ownership in Zambia compared with Uganda.

Our study did not ask women how much they spent on transportation, but other studies suggest that there is also great variation in this measure within countries (Keya *et al*. 2014). It is notable that >20% of women in the poorest quintile in Uganda travelled via ambulance. As was intended by the design of the voucher program, the distribution of the transport vouchers disproportionately affected poorer women, allowing access to motorized transport that may not have been utilized otherwise. Using ambulances to transport patients

from their homes to the clinic was relatively rare in both countries, since they are generally reserved for transporting patients between clinics.

In both countries, women who delivered at higher-level (CEmONC) facilities were more likely to use motorized transport, possibly indicating the urgency of those cases. This difference was more pronounced in Zambia. It is also possible that once the decision is made to use motorized transport, the marginal cost of travelling to a higher-level facility rather than a basic care facility or clinic (BEmONC) makes it worthwhile to go to a higher-level facility. In both countries, women with complications were more likely to travel by ambulance, as were women who were referred from one facility to another, rather than self-referred from home.

Because this study was not set up to investigate the impact of the transportation vouchers on the number of facility deliveries, we cannot comment on the extent to which vouchers influence modes of transportation or women's delivery times with great confidence. However, since the percentage of women in Uganda that used a voucher to arrive at a health facility was relatively low (14.4% of the Ugandan sample), it is unlikely that this explains the large differences in the patterns of modes of transportation observed in Uganda vs Zambia, or the large difference in the rates of motorized vs non-motorized transportation observed between these countries.

Focus group data reveal that women faced challenges across many types of transportation, even among those who live closer to facilities. Women reported challenges with distance, cost, difficult terrain and a lack of available vehicles and drivers. Women were generally willing to utilize vouchers or call for provided modes of transport, yet they reported a number of delays with these services. Even with vouchers, they noted challenges with roads and the difficulties of travelling at night and during the rainy season. Importantly, women worried that slow transport options would lead to deliveries on the road. It is critical for policymakers to note that transport systems that are too slow could lead to more deliveries en route to health facilities, which was a concern of many women in our sample, as these deliveries are potentially more dangerous than home deliveries.

Our study was limited by the fact that travel time was self-reported; thus, there may be recall bias and some individuals may have included waiting time. Our study did not include information on bypassing, i.e. women circumventing primary care facilities in favour of higher-level clinics or hospitals (Parkhurst and Ssengooba 2009), and did not measure the travel time to a woman's nearest facility or ask them about the distances they travelled to reach a health facility. In addition, we only asked women 'how' they travelled to a facility, rather than their 'preferred mode' of transportation to reach a clinic. Our study did not include longitudinal data, and thus cannot identify change over time as new initiatives are implemented. Additionally, we did not collect data on birth plan intention, so we were unable to separate women who planned home deliveries from those who planned facility deliveries, or those who had chosen specific facilities. More research is needed on women's travel costs, as well as their intentions, compared with their actual use of various transport modes.

This study has implications for policies designed to improve maternal and newborn health in isolated and resource-poor areas. It reveals the continuing challenges of transport for obstetric care. Women rely on difficult modes of transport, such as motorcycle taxis, in order to minimize the time spent travelling. Not including the small number of women that rode bicycles to their health facility in Uganda, in both countries the mode of transportation with the

shortest reported travel times was the most commonly used. This suggests that women are prioritizing modes of transportation with shorter travel times. In one focus group a woman indicated feeling 'shaken up' after using a motorcycle taxi for transport. Given the physical discomfort of riding on the back of a motorcycle while in labour, this finding might also suggest that women are willing to sacrifice comfort in order to save on travel time.

The fear of delivering on the road leads some women to have home deliveries, especially when arranging transport is logistically difficult, slow to arrive, at night or in bad weather. Thus, bicycle ambulances and other non-motorized transport methods may not prove to be as popular as expected. In addition, more interventions may be needed to help women better predict delivery due dates, or waiting homes closer to facilities could be provided where women can stay prior to the start of labor.

Uganda and Zambia demonstrated markedly different patterns of transportation, and inequality in modes of transport between groups within countries, which policymakers need to take into account when designing obstetric transport interventions. The heterogeneity in geography, wealth and existing transport use—which typifies the range of challenges throughout rural sub-Saharan Africa—is essential for informing the practicality, utility and suitability of programs in various regions. In the context of current policy debates, our findings suggest that targeted programs that provide subsidized vouchers, or other methods of accessing motorized transport, to those most vulnerable or in the poorest quintiles could be beneficial. Yet there are challenges in addressing all 'three A's'. affordability, accessibility and adequacy. Policymakers must take into account country context and geographically specific patterns of transport, seasonal variations and the affects on affordability, accessibility and adequacy when identifying the best ways to improve maternal and newborn outcomes.

Ethical approval

This study was reviewed and approved by the Columbia University Institutional Review Board, the Higher Degrees Research and Ethics Committee at the Makerere University College of Health Sciences in Uganda the Uganda National Council of Science and Technology, and the ERES Converge Research Ethics Committee in Zambia and the Ministry of Health in Zambia.

References

Barnes-Josiah D, Myntti C, Augustin A *et al.* 1998. The "three delays" as a framework for examining maternal mortality in Haiti. *Social Science and Medicine* **46**: 981–93.

Bellows BW, Conlon CM, Higgs ES *et al.* 2013. A taxonomy and results from a comprehensive review of 28 maternal health voucher programmes. *Journal of Health, Population and Nutrition* **31**: 106–28.

Bhusal CL, Singh SP, Bc RK *et al.* 2011. Effectiveness and efficiency of Aama Surakshya Karyakram in terms of barriers in accessing maternal health services in Nepal. *Journal of Nepal Health Research Council* **9**: 129–37.

Bhutta ZA, Das JK, Bahl R *et al.* 2014. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost?. *Lancet* **384**: 347–70.

Bohren MA, Hunter EC, Munthe-Kaas HM *et al.* 2014. Facilitators and barriers to facility-based delivery in low- and middle-income countries: a qualitative evidence synthesis. *Reproductive Health* **11**: 71.

Creswell J. 2012. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. London: Sage Publications.

Gabrysch S, Cousens S, Cox J *et al.* 2011. The influence of distance and level of care on delivery place in rural Zambia: a study of linked national data in a geographic information system. *PLoS Medicine* **8**: e1000394.

Global Health Initiative. 2011. *Saving Mothers' Lives Zambia: Operational Plan. October 2011–December 2012*. Washington DC: U.S.: Global Health Initiative.

Hirose A, Borchert M, Cox J *et al.* 2015. Determinants of delays in travelling to an emergency obstetric care facility in Herat, Afghanistan: an analysis of cross-sectional survey data and spatial modelling. *BMC Pregnancy Childbirth* **15**: 14.

Hussein J, Kanguru L, Astin M *et al.* 2012. The effectiveness of emergency obstetric referral interventions in developing country settings: a systematic review. *PLoS Medicine* **9**: e1001264.

Islam M, Yoshida S. 2009. Women are still deprived of access to lifesaving essential and emergency obstetric care. *International Journal of Gynaecology and Obstetrics* **106**: 120–4.

Kassebaum NJ, Bertozzi-Villa A, Coggeshall MS *et al.* 2014. Global, regional, and national levels and causes of maternal mortality during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* **384**: 980–1004.

Keya KT, Rob U, Rahman M *et al.* 2014. Distance, transportation cost, and mode of transport in the utilization of facility-based maternity services: evidence from rural Bangladesh. *International Quality of Community Health Education* **35**: 37–51.

Kruk ME, Rabkin M, Grepkin KA *et al.* 2014. 'Big push' to reduce maternal mortality in Uganda and zambia enhanced health systems but lacked a sustainability plan. *Health Affairs (Millwood)* **33**: 1058–66.

Lerberg PM, Sundby J, Jammeh A *et al.* 2014. Barriers to skilled birth attendance: a survey among mothers in rural Gambia. *African Journal of Reproductive Health* **18**: 35–43.

Masters SH, Burstein R, Amofah G *et al.* 2013. Travel time to maternity care and its effect on utilization in rural Ghana: a multilevel analysis. *Social Science and Medicine* **93**: 147–54.

Moyer CA, Mustafa A. 2013. Drivers and deterrents of facility delivery in sub-Saharan Africa: a systematic review. *Reproductive Health* **10**: 40.

Murray SF, Pearson SC. 2006. Maternity referral systems in developing countries: current knowledge and future research needs. *Social Science and Medicine* **62**: 2205–15.

Parkhurst JO, Ssengooba F. 2009. Assessing access barriers to maternal health care: measuring bypassing to identify health centre needs in rural Uganda. *Health Policy and Planning* **24**: 377–84.

Rob U, Rahman M, Bellows B. 2009. Using vouchers to increase access to maternal healthcare in Bangladesh. *International Quality of Community Health Education* **30**: 293–309.

Rosales A, Galindo J, Flores A. 2003. *A Community Based Surveillance System for Maternal and Early Neonatal Complications: The Intibuca Case Study*. Baltimore, MD: Catholic Relief Services.

Samson G. 2012. *Utilization and factors affecting delivery in health facility among recent delivered women in Nkasi District*. Master of Public Health, Muhimbili University of Health and Allied Sciences.

Say L, Chou D, Gemmill A *et al*. 2014. Global causes of maternal death: a WHO systematic analysis. *The Lancet Global Health* **2**: e323–33.

Thaddeus S, Maine D. 1994. Too far to walk: maternal mortality in context. *Social Science and Medicine* **38**: 1091–110.

UBOS. 2011. *Uganda Demographic and Health Survey*. Kampala, Uganda: Uganda Bureau of Statistics and ICF Macro.

Van De Poel E, Flores G, Ir P *et al*. 2014. Can vouchers deliver? An evaluation of subsidies for maternal health care in Cambodia. *Bulletin of the World Health Organization* **92**: 331–9.

WHO. 2013. *World Health Organization Global Health Observatory Data Repository*. Available online: http://apps.who.int/gho/data/node.country, accessed May 2013.

Wilson A, Hillman S, Rosato M *et al*. 2013. A systematic review and thematic synthesis of qualitative studies on maternal emergency transport in low- and middle-income countries. *International Journal of Gynaecology and Obstetrics* **122**: 192–201.

Wright S *et al*. 2014. *Ending Newborn Deaths: Ensuring every baby survives*. London, UK: Save the Children.

ZDHS. 2007. *Zambia Demographic and Health Survey*. Lusaka, Zambia: Central Statistical Office (CSO) Zambia and Macro International.