How mistimed and unwanted pregnancies affect timing of antenatal care initiation in three districts in Tanzania

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Abstract

Background

Early antenatal care (ANC) initiation is a doorway to early detection and management of potential complications associated with pregnancy. While ANC utilization and its predictors are generally well-known, evidence pertaining to timing of ANC initiation is limited. Whether pregnancy intentions also predict timing of ANC initiation in Tanzania remains unknown.

Methods

Data originate from a cross-sectional household survey on health behaviors and service utilization which was conducted in 2011 in Rufiji, Kilombero and Ulanga districts in Tanzania. Women who had given birth in the past 24 months became a focus of this analysis. ANC initiation was considered to be early only if it occurred in the first trimester of pregnancy. A recently completed pregnancy was defined as mistimed if a woman wanted it later, and if she did not want it at all the pregnancy was termed as unwanted. Chi-square was used to test for associations and multinomial logistic regression model was fitted to examine how mistimed and unwanted pregnancies affect timing of ANC initiation.

Results

Participants were 910 in total and were averagely aged 27.9 years (SD=7.6). Of these, 49.3%, 34.9% and 15.8% reported having had intended, mistimed and unwanted pregnancies respectively. Late ANC initiation (i.e. 1st ANC visit during 2nd and 3rd trimester) amounted to 81.5% of the total participants. Multivariate analysis revealed that ANC

initiation in the 2nd trimester was 1.68 (95% CI 1.10–2.58) and 2.00 (95% CI 1.05–3.82) times more likely for mistimed and unwanted pregnancies respectively compared to intended pregnancies. Similarly, ANC initiation in the 3rd trimester was 2.81 (95% CI 1.41–5.59) and 4.10 (95% CI 1.68–10.00) times more likely for mistimed and unwanted pregnancies respectively compared to intended pregnancies. These effects were controlled for gravidity, age, education, household wealth, marital status, religion, district of residence and travel time to a health facility.

Conclusion

Late ANC initiation is an important maternal and child health consequence of mistimed and unwanted pregnancies in Tanzania. Women should be empowered to delay or avoid pregnancies whenever they need to do so. There is also a need to provide appropriate counseling to the mother to minimize the possibility of delayed ANC initiation especially when she conceives unintentionally.

Key words

Mistimed pregnancies, unwanted pregnancies, timing, ANC initiation, Tanzania

Background

If sought early, antenatal care (ANC) – health care given to women during pregnancy to ensure healthy outcomes of themselves and their newborns [1] – can be most efficient in averting adverse pregnancy outcomes [2;3]. This is a doorway to early detection and management of potential complications associated with pregnancy, and consequently reduces potential maternal and newborn morbidity and mortality [4-7].

Maternal deaths are caused by complications of abortion, obstetric complications such as haemorrhage, dystocia, eclampsia, sepsis and infections such as tuberculosis and HIV-1, to mention a few [8;9]. Records reveal that haemorrhage and hypertensive disorders account for the largest share of the deaths in developing countries [10]. However, most of these deaths are avertable. For example, proper ANC utilization and skilled attendance at birth have been reported to reduced maternal deaths [4;7]. Also access to emergency obstetric care, adequate nutrition and basic health services considerably lessen the risk of maternal death [11]. Extant evidence shows moreover that access to essential obstetric care would results into 52% decline in the current global maternal deaths [12].

Unintended (mistimed and unwanted) pregnancies pose important public health risks and their pernicious consequences have been documented in many studies [13-16]. For example, existing evidence shows presence of a relationship between unintended childbearing and several adverse health outcomes such as maternal depression [17-21], anxiety [20], poor psychological wellbeing [22] and poor utilization of ANC or delivery care [15;16]. Generally, it has been established that women who experience an unintended pregnancy are

less likely than women with intended pregnancies to seek care [15;23]. Most of these studies however were conducted in developed countries while such evidence is limited and sometimes inconsistent in developing countries [24].

The World Health Organization (WHO) recommends that adequate care for a normal pregnancy that has no complications should comprise four ANC visits, with the first occurring within the first trimester [25]. The first visit should occur before 12 weeks of gestation but not later than 16 weeks, and afterwards at 24-28 weeks, 32 weeks and 36 weeks [25;26]. Where any complication is detected, frequent visits and if necessary an admission may be advised [2]. Timely execution of the first ANC visit allows more time for more such visits thus guaranteeing timely identification and mitigation of potential pregnancy complications [2] and enables a woman receive a wide range of health promotion and disease curative and preventive services [27]. This includes but not limited to treatment of anemia, diagnosis and treatment of malaria, tuberculosis (TB), sexually transmitted infections (STIs) and tetanus toxoid (TT) immunization. During ANC visits, women also receive counseling on and promotions of skilled attendance at birth, postpartum care for women and newborns and prevention of mother-to-child transmission (PMTCT) of human immunodeficiency virus (HIV) [27].

The situation of ANC in Tanzania is such that, nationwide, the coverage of ANC utilization at least once on the course of pregnancy is near universal. The recent Tanzania Demographic and Health Survey (TDHS) report [2] shows that 96% of the Tanzania women who gave birth five years preceding the survey sought ANC services at least once

from skilled providers. While this is the case, the first visit (initiation) is often delayed [28] and subsequent visits drop considerably, resulting in incomplete doses of the ANC services such TT immunization, intermittent preventive treatment of malaria during pregnancy (IPTp) and counseling on birth preparedness. The report shows further that 43% of the women made at least 4 ANC visits recommended by WHO and only 15% made the first ANC visit during the first trimester. The median gestational age at first ANC visit among Tanzanian women was estimated at 5.4 months.

Although women are positive about ANC [28], the health system's framework for ANC delivery in Tanzania is challenged by factors such as shortages of trained staff, inadequate supply of drugs and equipments [29] and poor implementation of the guidelines of the focused antenatal care (FANC) [30]. While these may affect ANC utilization on one hand, individual factors such as maternal age, maternal education [31] and parity [31;32] are as well acknowledged on the other. Slim evidence reveal further that mistimed and unwanted pregnancies are also associated with infrequent ANC visits [16]. Many more studies reporting factors affecting ANC utilization are available [33-38].

Overall, factors affecting ANC utilization are well understood and clearly documented in the literature. The literature classifies ANC utilization in three groups as (1) any ANC (2) ANC initiation and (3) adequate number of ANC visits [15]. Of these groups, the first holds prominent recognition among researchers in both developed and developing countries while the second and third are inadequately researched especially in developing countries. A few studies like a recent one from Kenya on utilization of maternal services among young

women (15-24 year-olds) found that place of residence, household wealth, education, ethnicity, parity, marital status and age at birth were associated with both timing of first ANC visit and type of delivery assistance received [3]. One qualitative study which was conducted in Tanzania reports fear of wild animals on a way to a clinic and lack of money as reasons for late ANC initiation [28]. Another one from Tanzania on timing of ANC found that later ANC enrollment was associated with ethnicity, perceived poor quality of care, late recognition of pregnancy and not being supported by husband or partner [39]. However, a comprehensive review of the predictors of timing of ANC initiation is lacking, thus unknown whether other factors such as pregnancy intentions also influence timing of ANC initiation.

Our study is not only one of the rare ones assessing timing of ANC initiation in Tanzania, but also the first to assess whether pregnancy intentions also count. This study therefore intends (1) to determine the proportion of women that initiated ANC in each trimester (2) to assess the association between mistimed pregnancy and timing of ANC initiation and (3) to assess the association between unwanted pregnancy and timing of ANC initiation in three districts in Tanzania.

Methods

Study area

Data for the main survey in which this paper originates were collected in Rufiji, Kilombero and Ulanga districts between April and August 2011. Within these districts, there exists two Health and Demographic Surveillance Systems (HDSS) namely; Rufiji HDSS located in

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Rufiji district and Ifakara HDSS that occupies portions of Kilombero and Ulanga districts. The survey was based on the population under surveillance by these HDSS of which at the time of the survey, they were altogether made up of 101villages (Rufiji, 38; Ifakara, 63) with over 350,000 people. These HDSS are broadly described elsewhere [40-43].

Study design and sampling

The main survey was designed as a cross-sectional household survey. Households were randomly selected from a list of all households in the HDSS and all women aged 15-49 in each household composing the sample were eligible for participation. Since the households were heterogeneously distributed in the 101 villages, Probability Proportional to Size (PPS) sampling technique [44] was used to select the sample to ensure that the sample was representative of each village.

Data collection

Data collection was carried out by the Ifakara Health Institute (IHI), Tanzania in collaboration with the Mailman School of Public Health of the Columbia University (MSPH/CU), United States of America (USA), through *Connect*, a 5-year project which is being implemented in Kilombero, Rufiji and Ulanga districts of Tanzania. The project introduces trained, paid and medically equipped Community Health Agents (CHAs) in order to accelerated achievement of the millennium development goals (MDGs) number 4 and 5. Detailed description of the *Connect* Project is available at http://connectprojecttz.wordpress.com/. The data were collected non-electronically using a questionnaire which was generally closed-ended. Questions pertained to health related

aspects of women and children aged less than five years such as health during pregnancy and ANC, intrapartum care, immediate newborn care and infant and under-five health. Before data collection commenced, a thorough interviewer training was held for two weeks. A pilot survey was conducted in five nearby communities which were similar to those that participated in the main survey, after which the actual data collection followed. The survey served the project's baseline purposes and a portion of these data was analyzed to answer the current research question.

Study population

Women of reproductive age (15-49 years) whose last birth occurred within 24 months preceding the survey and had made at least one ANC visit during that pregnancy were eligible for this analysis, thus extracted from the parent database. Inclusion of women only if they had sought ANC at least once, was dictated by the fact that over 99% of them reported having received ANC at least once. Women who reported having never sought any ANC were exceptionally few (<1%) thus excluded from the analysis.

Study variables

Dependent variable

Our dependent variable was 'Timing of ANC initiation'. As already pointed out [1], ANC initiation in the first trimester is very crucial. This leads to complete doses of various immunizations such as TT and enables timely detection and management of possible pregnancy complications, thus resulting in desirable health outcomes for women and newborns. Therefore, all first ANC visits that occurred within the first trimester were

operationally referred to as 'early ANC initiation' and those that occurred afterwards –
during the 2nd and 3rd trimester – were referred to as 'late ANC initiation'. This definition
has been similarly applied elsewhere [3]. This variable thus had three categories as 1st
trimester, 2nd trimester and 3rd trimester which were statistically represented by codes '1', '2'
and '3' respectively.

Independent variables

Several independent variables were assessed in the prediction of timing of ANC initiation.
The main independent variable was pregnancy intentions for a recently completed
pregnancy and had three categories as (1) intended (pregnancy wanted at the time of
conception), (2) mistimed (pregnancy wanted later) and (3) unwanted (pregnancy not
wanted at all). This assessment accounted for age (<20, 20-34 and >34), marital status
(married, ever married and single), education (none, primary/higher), religion (Christian,
Muslim and other) and ethnicity (Ndengereko, Ngindo, Pogoro, Sukuma and Others).
Household wealth with three categories as poor, middle and rich was created using the
principal component analysis (PCA) [45] based on household asset ownership of a toilet,
type of the toilet and source of drinking water. We also included travel time (in hours) to a
health facility (<0.5, 0.5-1 and >1) which was a self-reported variable requiring a woman to
report how much time it took her to get to a place where she received last ANC during
pregnancy. Other variables included were district of residence (Kilombero, Rufiji, and
Ulanga), type of residence (rural and urban) and gravidity (1, 2-4 and >4). Gravidity was
considered as a proxy for fertility.

Statistical analysis

Simple frequency distribution of the sample was performed. Then timing of ANC initiation was cross-tabulated against pregnancy intentions and each of the independent variables and the degree of association between each pair of variables was tested using Chi-Square.

Finally, a multinomial (polytomous) logistic regression model was fitted to the data to examine how pregnancy intentions affected ANC initiation in the 2nd and 3rd trimester relative to 1st trimester, controlling for the independent variables. The model was chosen because the dependent variable had multiple categories which were assumed to have no natural ordering, and even if they did as Magadi et al [3] shows, the information conveyed by the ordered nature had no meaningful use given the objectives. The baseline or reference category was 1st trimester, and thus elucidating how likely was it that a woman would initiate ANC in the 2nd and 3rd trimester relative to the 1st trimester, holding constant the independent variables. In this process, age, gravidity and travel time were treated as continuous to ensure efficiency of the model [46]. Selection of the variables for the multivariate model was made using log-likelihood ratio test [47], except the main independent variable of interest. This meant that in order to end-up with a parsimonious model, a variable was retained in the multivariate model only if there was adequate statistical justification that its presence improved the overall model. The entire process of data analysis was handled in STATA (version11) statistical software.

Ethical consideration

An ethical approval to conduct the main survey was given by the Medical Research Coordinating Committee (MRCC) of the National Institute for Medical Research (NIMR). The Ifakara Health Institute (IHI)'s Institutional Review Board (IRB) also approved the study. Participation in the survey was perfectly voluntary. All women aged 18 and above signed an informed consent first after which they were interviewed. Similarly, an assent was sought from those that were under 18 years of age. Storage of the completed questionnaires was separate from the consent and assent forms to ensure anonymity of the data. The whole process of data collection and handling was confidential and managed by a few experts.

Results

Sample characteristics

As table 1 shows, the participants were 910 women age 15-49 years (mean = 27.9, SD = 7.6) who had given birth in the past two years and had received ANC at least once on the course of pregnancy. A majority of the women were married or in consensual union (79.9%), 5.5% ever married (widowed or divorced) and 14.6% were single. Around a quarter (24.3%) of the women had no formal education and the rest had primary or higher education. With regard to religion, Islam and Christianity constituted a majority of the participants (51.2% and 42.7% respectively). Concerning ethnic groups, more than 50 tribes were recorded. These were Ndengereko 15.2%, Ngindo14.3%, Pogoro 14.0% and Sukuma 11.0%. Other groups were so small that during analysis were combined into a single category as 'Others' and represented 45.5% of the total participants. In terms of household wealth, women were

distributed in the three household wealth categories as 40.5% poor, 35.1% middle and 24.5% rich. More than a half (58.7%) of all participants resided in Kilombero district.

Timing of ANC initiation

Concerning ANC initiation, only 18.5% of the women made the first visit early (i.e. in the 1st trimester). The rest, 81.5% (71.7% in the 2nd trimester and 9.9% in the 3rd trimester), delayed ANC initiation. Median gestation age at first ANC visit was 5.0 months. Regarding pregnancy intentions for the recent birth, 49.3% of the women reported that they intended to become pregnant at the time of conception, 34.9% mistimed their pregnancies and 15.8% did not want to become pregnant at all.

Figure 1 shows timing of ANC initiation by pregnancy intentions. Of the curves showing the proportion of women initiating ANC, the highest was for intended pregnancies while the lowest was for unwanted pregnancies in the first four months of pregnancy, but the difference was subtle in first two months. The curve representing mistimed pregnancies was the second lowest in the same period. ANC initiation pinnacled in the 5th month of gestation for all levels of pregnancy intentions, but was highest for unwanted pregnancies and lowest for mistimed pregnancies. The situation observed in the first four months was reversed in the last four months, with women who had intended pregnancies being the fewest for ANC initiation while those who had unwanted pregnancies led. Timing of ANC initiation for mistimed pregnancies followed the same pattern as for unwanted pregnancies and the two become the same during the 6-7th month of gestation.

Figure 2 presents bivariate analysis of timing of ANC initiation by maternal characteristics. The results show that timing of ANC initiation was significantly associated with pregnancy intentions (P<0.001), such that ANC initiation in the 1st trimester was highest (23.1%) among women who became pregnant intentionally, but dropped considerably to 15.1% and 11.7% among women whose pregnancies were mistimed and unwanted respectively. The results show further that the higher the gravidity the lower was the proportion of women initiating ANC early (P = 0.001). More than a quarter (28.3%) of gravida one women initiated ANC in the 1st trimester. This proportion was 16.5% and 15.2% among women whose gravidity was 2-4 and >4 pregnancies respectively. Education was also associated with ANC initiation (P = 0.011) with early ANC initiation being 19.3% among women who had primary education or higher and 15.8% among those who had no formal education. ANC initiation by other characteristics is presented in figure 2 with no significant differences (P>0.05) across various categories.

Multinomial logistic regression results

Further analysis was conducted in a multivariable fashion using multinomial logistic regression model to examine how mistimed and unwanted pregnancies relate to ANC initiation, controlling for possible confounders. Relative risk ratios (RRR) and their corresponding 95% confidence intervals were calculated and presented in table 2 in which the effect of pregnancy intentions as a predictor of interest on timing of ANC initiation is adjusted for gravidity, age, education, household wealth, marital status, religion, district of residence and travel time to a health facility.

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The findings reveal that ANC initiation in the second trimester was significantly and independently 1.68 times more likely for mistimed pregnancies compared to intended pregnancies (RRR = 1.68, 95% CI 1.10–2.58). Similarly, ANC initiation in the second trimester was 2.00 times more likely for unwanted pregnancies compared to intended pregnancies (RRR = 2.00, 95% CI 1.05–3.82). On the other hand, ANC initiation in the third trimester resembled the pattern observed in the second trimester, such that women who had mistimed and unwanted pregnancies were 2.81 (95% CI 1.41–5.59) and 4.10 (95% CI 1.68–10.00) respectively times more likely to initiate ANC in the third trimester compared to women whose pregnancies were intended.

There was an age–gravidity interaction in the prediction of ANC initiation in the second and third trimester. At younger ages, the relative risk of ANC initiation in the second trimester was 1.58 times higher for every one pregnancy increase in gravidity (RRR = 1.58, 95% CI 1.04–2.39). This risk was 2.27 times higher in the third trimester (RRR = 2.27, 95% CI 1.21–4.27). At lower values of gravidity, a one-year increase in age was significantly associated with a 6% increase in the relative risk of ANC initiation in the second trimester (RRR = 1.06, 95% CI 1.01–1.12). The risk was 4% in the third trimester but was not statistically significant (RRR = 1.04, 95% CI 0.96–1.13). In contrast, a one pregnancy increase in gravidity was significantly associated with 1% less risk of ANC initiation in the second trimester for older women than it was for younger women (RRR = 0.99, 95% CI 0.98–1.00). Similarly, the risk of ANC initiation in the third trimester was 2% lower for every one pregnancy increase in gravidity at older ages than it was at younger ages (RRR = 0.98, 95% CI 0.97–1.00).

Women from socioeconomically rich households were significantly 2.38 times more likely to initiate ANC in the third trimester compared to women from poor households (RRR = 2.38, 95% CI 1.01–5.64).

Discussion

This study shows that late ANC initiation in Kilombero, Rufiji and Ulanga districts in Tanzania is common. Late ANC initiation of 81.5% observed is unacceptably very high but slightly lower than the national estimate of 85.0% [2]. It is also lower than 89.0% observed in Kenya [3]. The median gestation of 5.0 months at first ANC visit observed was also comparable to the national estimate of 5.4 [2], indicating that a half of the women sought their first ANC after the 5th month of pregnancy gestation. Delaying ANC initiation threatens maternal and newborn health for it deprives a women's full benefits of effective ANC [48]. It forfeits the opportunity for timely diagnosis and identification of possible pregnancy-related problems that enables receipt of early medical care for enhancement of women and newborn health [1]. Deliberate efforts are urgently required to uplift the proportion of women that initiate ANC early. This is important and may be a prerequisite to attaining the adequate number of ANC visits (at least 4) that the WHO recommends for enhanced health outcomes of mothers and newborns [25].

Regarding pregnancy intentions, this study confirms a significant delay in ANC initiation for both mistimed and unwanted pregnancies compared to intended pregnancies. The risk of delaying ANC initiation was even more obvious and much stronger in the third trimester.

Also, the risk of delaying ANC initiation was higher for unwanted than that for mistimed pregnancies in both second and third trimester. Women who experience mistimed or unintended pregnancies may probably have less love to such pregnancies, therefore possible that they may be demoralized to seek appropriate care for healthy development of their pregnancies. Some studies have found that women with unintended pregnancies do not seek ANC as early as do those with planned pregnancies because of late recognition of pregnancy [39] or delay in deciding whether or not to terminate the pregnancy [13]. Although there exists no sufficient evidence of any workable intervention that can increase early ANC initiation [49], alternatives should be devised to rescue the situation. While it is important to adequately counsel women concerning positive mind-sets about ANC for both intended and unintended pregnancies, proper utilization of family planning services should be encouraged in order to reduce the current country's unmet need which is presently one of the highest in the world [2]. If this is successful, a massive reduction in the current level of mistimed or unwanted (both of which were nearly 50%) pregnancies may be expected. Preventing unintended births is very crucial for it enhances the wellbeing of women and their newborns at one hand and beneficially affects the population size on the other[50;51]. These findings imply that mistimed and unwanted pregnancies represent a higher risk of adverse health outcomes as far as maternal and newborn health is concerned. Considering also that induced abortion is illegal in Tanzania, mistimed and unwanted pregnancies may lead to unsafe abortions as women will most likely not obtain proper care. The level of maternal mortality in Tanzania may thus be under estimates since deaths arising from unsafe abortions may be underreported. Women's behavioral and attitudinal outlook of

ANC utilization should be changed especially when they conceive mistimed and unwanted pregnancies.

Although young multi–gravid women and older women with fewer pregnancies delayed ANC initiation as similarly observed elsewhere [16;52], older multi–gravid women were unlikely to do so. The interaction between age and gravidity has also been found to exist in the prediction of other health outcomes apart from timing of ANC initiation [53]. Less risk of delaying ANC initiation observed among older multi–gravid women is possibly due to positively shaped mindsets of ANC from health education sessions that women may have had in previous pregnancies, as well as perceived risk of pregnancy complications at age 35 or older [54]. However, underlying mechanisms of this observation remain less clear. Similar studies did not include an interaction term between age and gravidity or parity, and they report that multi-gravid women delay ANC initiation due to confidence they tend to develop from experience accrued from past pregnancies and they sometimes believe that modern health care makes little or no change [31]. There is also a belief that pregnancy complications and their associated difficulties occur mostly among young women [31].

It was unexpected as we found in this study that women from socioeconomically rich households would delay ANC initiation. This observation differs from findings of one qualitative study conducted in Tanzania that found among other things that lack of money delays ANC initiation [28]. It is however possible that rich women may delay in deciding where to seek ANC (selectivity) due to perceived quality of care thus end-up delaying ANC

initiation. Considering these inconsistencies, a more focused investigation is required to reveal how socioeconomic status actually relates with timing of ANC initiation in Tanzania.

Limitations

We admit absence of some important variables such as family size and pregnancy recognition which would alight more on the question at hand. No causal inferences may be drawn from the findings due to obvious difficulties in ascertaining temporality in cross-sectional surveys. Also there may have been a recall bias effect because the study relied on women's retrospective recall of the timing of their ANC initiation. Since three districts only were studied, findings may not be generalized to the entire population of Tanzania. This suggests that further investigations of assorted designs may be undertaken in different settings of Tanzania. A qualitative study is particularly needed to explore both individual and social perceptions, beliefs, norms and other barriers against early ANC initiation especially with mistimed and unwanted pregnancies in Tanzania.

Conclusion

A significant delay in ANC initiation is confirmed as an adverse maternal and child health consequence of mistimed and unwanted pregnancies in Tanzania. Women should be empowered to be able to delay or avoid pregnancies whenever they need to do so. Uptake of family planning services should be emphasized in order to reduce and eventually eradicate mistimed and unwanted pregnancies. In addition, efforts should be made to change women's health seeking behavior concerning ANC utilization in situations of mistimed and unwanted pregnancies. They should know that even if they may not be happy with a

mistimed or unwanted pregnancy, ignoring proper ANC utilization endangers not only the pregnancy but also their own health as well.

On the part of the *Connect* project, training of the Community Health Agents (CHAs) should emphasize further on establishing from the mother whether the pregnancy was intended, mistimed or unwanted. This would assist in the appropriate counseling to the mother and thus minimize the possibility of delayed ANC initiation particularly with the mistimed and unwanted pregnancy. The CHAs are better positioned to intervene timely as they visit these women early and regularly in their households.

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Authors' contributions

AE conceptualized the problem, designed the study, performed data analysis and wrote the manuscript drafts. AMK participated in designing the study, data analysis and critical

review of the manuscript. AH, GM and SP critically reviewed the manuscript. JFP participated in designing the study and critical review of the manuscript. All authors read and approved the final draft.

Conflict of interest

The authors declare that they have no competing interests.

References

1. World Health Organization (WHO), United Nations Children's Fund (UNICEF). Antenatal Care in Developing Countries: Promises, Achievements and Missed Opportunities - An Analysis of Trends, Levels and Differentials, 1990-2001. WHO, Geneva, 2003.

2. National Bureau of Statistics (NBS) [Tanzania], ICF Macro. Tanzania Demographic and Health Survey 2010. Dar es Salaam, Tanzania, NBS and ICF Macro, 2011.

3. Ochako R, Fotso J, Ikamari L, Khasakhala A: **Utilization of maternal health services among young women in Kenya: Insights from the Kenya Demographic and Health Survey, 2003**. *BMC Pregnancy and Childbirth* 2011, **11:**1.

4. Magadi M, Madise N, Diamond I: **Factors associated with unfavourable birth outcomes in Kenya**. *Journal of Biosocial Science* 2001, **33:**199-225.

5. Mpembeni RMN, Killewo JZ, Leshabari MT, Siriel N, Massawe SN, Jahn A, Mushi D, Mwakipa H: **Use pattern of maternal health services and determinants of skilled care during delivery in Southern Tanzania: implications for achievement of MDG-5 targets**. *BMC Pregnancy and Childbirth* 2007, **7:**29.

6. Reynolds HW, Wong EL, Tucker H: **Adolescents' Use of Maternal and Child Health Services in Developing Countries**. *International Family Planning Perspectives* 2006, **32:**6-16.

7. UNICEF. Eastern and Southern Africa Regional Office: Maternal Mortality Reduction Strategy. 2003.

8. Inter-Agency Group for Safe Motherhood. The safe motherhood action agenda: priorities for the next decade. Report on the safe motherhood technical consultation 18-23 October 1997. Colombo, Sri Lanka, 1997.

9. Khan M, Pillay T, Moodley JM, Connolly CA: **Maternal mortality associated with tuberculosis-HIV-1 co-infection in Durban, South Africa**. *AIDS* 2001, **15:**1863.

10. Khan KS, Wojdyla D, Say L, Gülmezoglu AM, Van Look PF: **WHO analysis of causes of maternal death: a systematic review**. *The Lancet* 2006, **367:**1066-1074.

11. UNICEF. Progress for Children: A report Card on Maternal Mortality. http://www.unicef.org/childsurvival/files/Progress_for_Children-No._7_Lo-Res_082008.pdf . 2008. 7-23-2012.

12. Wagstaff A, Claeson M. The Millennium Development Goals for Health Rising to the Challenges. Washington DC, The World Bank, 2004.

13. Kost K, Landry DJ, Darroch JE: **Predicting maternal behaviors during pregnancy: does intention status matter?** *Fam Plann Perspect* 1998, **30:**79-88.

14. Gage AJ: **Premarital Childbearing, Unwanted Fertility and Maternity Care in Kenya and Namibia**. *Population Studies* 1998, **52:**21-34.

15. Eggleston E: **Unintended pregnancy and women's use of prenatal care in Ecuador**. *Soc Sci Med.* 2000, **51:**1011-1018.

16. Magadi MA, Madise NJ, Rodrigues RN: **Frequency and timing of antenatal care in Kenya: explaining the variations between women of different communities**. *Soc Sci Med* 2000, **51:**551-561.

17. Lau Y, Keung DW: **Correlates of depressive symptomatology during the second trimester of pregnancy among Hong Kong Chinese**. *Soc Sci Med.* 2007, **64:**1802-1811.

18. Nakku JN, Nakasi G, Mirembe F: **Postpartum major depression at six weeks in primary health care: Prevalence and associated factors**. *African Health Sciences* 2006, **6:**207-214.

19. Barber JS, Axinn WG, Thornton A: **Unwanted childbearing, health, and mother-child relationships**. *J Health Soc Behav.* 1999, **40:**231-257.

20. Najman JM, Morrison J, Williams G, Andersen M, Keeping JD: **The mental health of women 6 months after they give birth to an unwanted baby: a longitudinal study**. *Soc Sci Med.* 1991, **32:**241-247.

21. Lara MA, Navarro C, Navarrete L, Cabrera A, Almanza J, Morales F, Juárez F: **Depressive symptoms in pregnancy and associated factors in patients of three health institutions in Mexico City**. *Salud Mental* 2006, **29:**55-62.

22. Hardee K, Eggleston E, Wong EL, Irwanto, Hull TH: **Unintended pregnancy and women's psychological well-being in Indonesia**. *J Biosoc Sci* 2004, **36:**617-626.

23. Marston C, Cleland J: **Do Unintended Pregnancies Carried to Term Lead to Adverse Outcomes for Mother and Child? An Assessment in Five Developing Countries**. *Popul Stud* 2003, **57:**77-93.

24. Gipson JD, Koenig MA, Hindin MJ: **The effects of unintended pregnancy on infant, child, and parental health: a review of the literature**. *Stud Fam Plann.* 2012, **39:**18-38.

25. Villar J, Ba'aqeel H, Piaggio G, Lumbiganon P, Miguel Belizán J, Farnot U, Al-Mazrou Y, Carroli G, Pinol A, Donner A, Langer A, Nigenda G, Mugford M, Fox-Rushby J, Hutton G, Bergsjø P, Bakketeig L, Berendes H, Garcia J, WHO Antenatal Care Trial Research Group: **WHO antenatal care randomised trial for the evaluation of new model of routine antenatal care**. *The Lancet* 2001, **357:**1551-1564.

26. Villar J, Bergsjo P. WHO Antenatal Care Randomized Trial: Manual for the Implementation of the New Model. WHO/RHR/01.30. WHO, Geneva, 2003.

27. Maternal and Child Health Division: Focused Antenatal Care: Providing integrated, individualized care during pregnancy. http://www.accesstohealth.org/toolres/pdfs/ACCESStechbrief_FANC.pdf . 2007. 7-22-2012.

28. Mrisho M, Obrist B, Schellenberg JA, Haws RA, Mushi AK, Mshinda H, Tanner M, Schellenberg D: **The use of antenatal and postnatal care: perspectives and experiences of women and health care providers in rural southern Tanzania**. *BMC Pregnancy and Childbirth* 2009, **9:**10.

29. Nyamtema AS, Jong AB, Urassa DP, Hagen JP, van Roosmalen J: **The quality of antenatal care in rural Tanzania: what is behind the number of visits?** *BMC Pregnancy and Childbirth* 2012, **12:**70.

30. Gross K, Schellenberg JA, Kessy F, Pfeiffer C, Obrist B: **Antenatal care in practice: an exploratory study in antenatal care clinics in the Kilombero Valley,south-eastern Tanzania**. *BMC Pregnancy and Childbirth* 2011, **11:**36.

31. Regassa N: **Antenatal and postnatal care service utilization in southern Ethiopia: a population-based study**. *African Health Sciences* 2011, **11:**390-397.

32. Agus Y, Horiuchi S: **Factors influencing the use of antenatal care in rural West Sumatra, Indonesia**. *BMC Pregnancy and Childbirth* 2012, **12:**9.

33. Iyaniwura CA, Yussuf Q: **Utilization of antenatal care and delivery services in Sagamu, south western Nigeria**. *African journal of reproductive health* 2009, **13:**111-122.

34. Tura G: **Antenatal care service utilization and associated factors in Metekel zone, northwest Ethiopia**. *Ethiop J Health Sci* 2009, **19:**2.

35. Ye Y, Yoshida Y, Harun-Or-Rashid MD, Sakamoto J, Sakamoto J: **Factors affecting the utilization of antenatal care services among women in Kham District, Xiengkhouang province, Lao PDR**. *Nagoya journal of medical science* 2010, **72:**33.

36. Simkhada B, Teijlingen ERv, Porter M, Simkhada P: **Factors affecting the utilization of antenatal care in developing countries: systematic review of the literature**. *Journal of Advanced Nursing* 2008, **61:**244-260.

37. Tewodros B, Mariam AG, Dibaba Y: **Factors Affecting Antenatal Care Utilization in Yem Special Woreda, Southwestern Ethiopia**. *Ethiop J Health Sci.* 2009, **19:**1.

38. Dairo MD, Owoyokun KE: **Factors affecting the utilization of antenatal care services in Ibadan, Nigeria**. *Benin Journal of Postgraduate Medicine* 2010, **12:**1.

39. Gross K, Alba S, Glass TR, Schellenberg JA, Obrist B: **Timing of antenatal care for adolescent and adult pregnant women in south-eastern Tanzania**. *BMC Pregnancy and Childbirth* 2012, **12:**16.

40. Shabani J, Lutambi AM, Mwakalinga V, Masanja H: **Clustering of under-five mortality in Rufiji Health and Demographic Surveillance System in rural Tanzania**. *Global Health Action Supplement 1* 2010.

41. Schellenberg JR, Abdulla S, Minja H, Nathan R, Mukasa O, Marchant T, Mponda H, Kikumbih N, Lyimo E, Manchester T, Tanner M, Lengeler C: **KINET: a social marketing programme of treated nets and net treatment for malaria control in Tanzania, with evaluation of child health and longterm survival**. *Trans R Soc Trop Med Hyg* 1999, **93:**225-231.

42. Hetzel MW, Iteba N, Makemba A, Mshana C, Lengeler C, Obrist B, Schulze A, Nathan R, Dillip A, Alba S, Mayumana I, Khatib RA, Njau JD, Mshinda H: **Understanding and improving access to prompt and effective malaria treatment and care in rural Tanzania: the ACCESS Programme**. *Malar J* 2007, **6:**83.

43. Gross K, Alba S, Schellenberg J, Kessy F, Mayumana I, Obrist B: **The combined effect of determinants on coverage of intermittent preventive treatment of malaria during pregnancy in the Kilombero Valley, Tanzania**. *Malar J* 2011, **10:**140.

44. Steps in applying Probability Proportional to Size (PPS) and calculating Basic Probability Weights.
http://www.who.int/tb/advisory_bodies/impact_measurement_taskforce/meetings/prevalence_survey/psws_probability_prop_size_bierrenbach.pdf. 2012. 7-1-2012.

45. Vyas S, Kumaranayake L: **Constructing socio-economic status indices: how to use principal components analysis 2006; 21 (6): 459-468**. *Health Policy and Planning* 2006, **21:**459-468.

46. de Leon AR, Soo A, Williamson T: **Classification with discrete and continuous variables via general mixed-data models**. *Journal of Applied Statistics* 2011, **38:**1021-1032.

47. Vittinghoff E, Shiboski SC, Glidden DV, McCulloch CE: **Predictor Selection**. In *Regression Methods in Biostatistics: Linear, Logistic, Survival, and Repeated Measures Models*. Edited by Dietz K, Gail M, Krickeberg K, Samet J, Tsiatis A. New York, USA: Springer Science+Business Media, Inc.; 2005:133-156.

48. Oluwatosin OA, Aluko JO, Onibokun A: **Factors influencing initiation of antenatal care in Ibadan, Nigeria**. *African Journal of Midwifery and Women's Health* 2011, **5:**163-168.

49. Oakley L, Gray R, Kurinczuk JJ, Brocklehurst P, Hollowell J: **P14 Interventions to increase the early initiation of antenatal care in socially disadvantaged and vulnerable women: a systematic review**. *J Epidemiol Community Health* 2010, **64:**A39.

50. Yohannes S, Wondafrash M, Abera M, Girma E: **Duration and determinants of birth interval among women of child bearing age in Southern Ethiopia**. *BMC Pregnancy & Childbirth* 2011, **11:**38.

51. Bongaarts J. The proximate determinants of unwanted childbearing in the developing world. Paper presented at the Annual Meeting of Population Association of America. 1997.

52. Fotso JC, Ezeh A, Oronje R: **Provision and Use of Maternal Health Services among Urban Poor Women in Kenya: What Do We Know and What Can We Do?** *Journal of Urban Health* 2008, **85**.

53. Schempf AH, Branum AM, Lukacs SL, Schoendorf KC: **Maternal age and parity-associated risks of preterm birth: differences by race/ethnicity**. *Paediatr Perinat Epidemiol* 2007, **21:**34-43.

54. http://www.beststart.org/resources/rep_health/pdf/bs_pregnancy_age35.pdf . 2012. 10-16-2012.
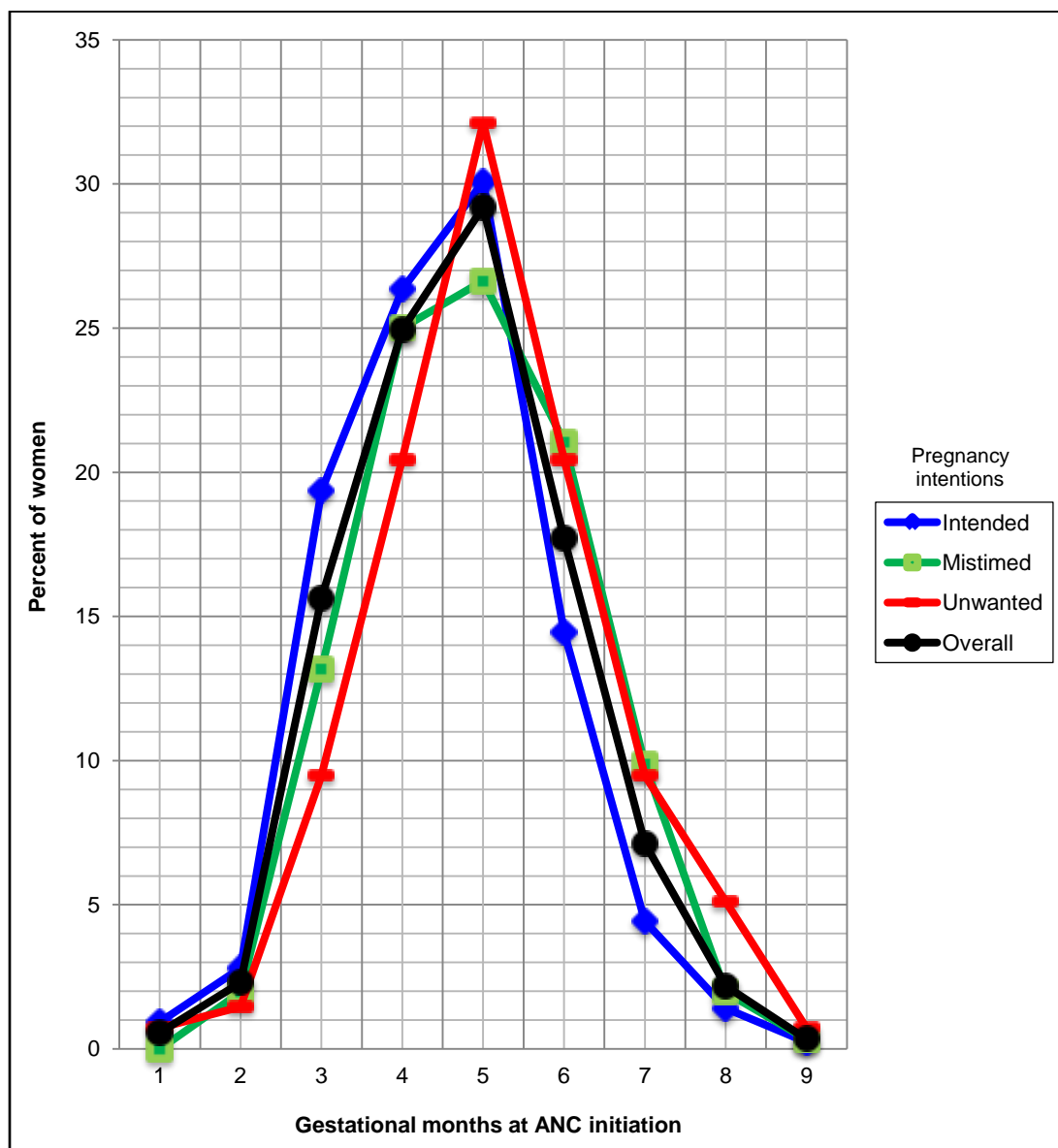
Figures

FIGURE 1. Timing of ANC initiation by pregnancy intentions among 15-49 year-old women who gave birth in the past two years in three districts in Tanzania, 2011 (n = 870)
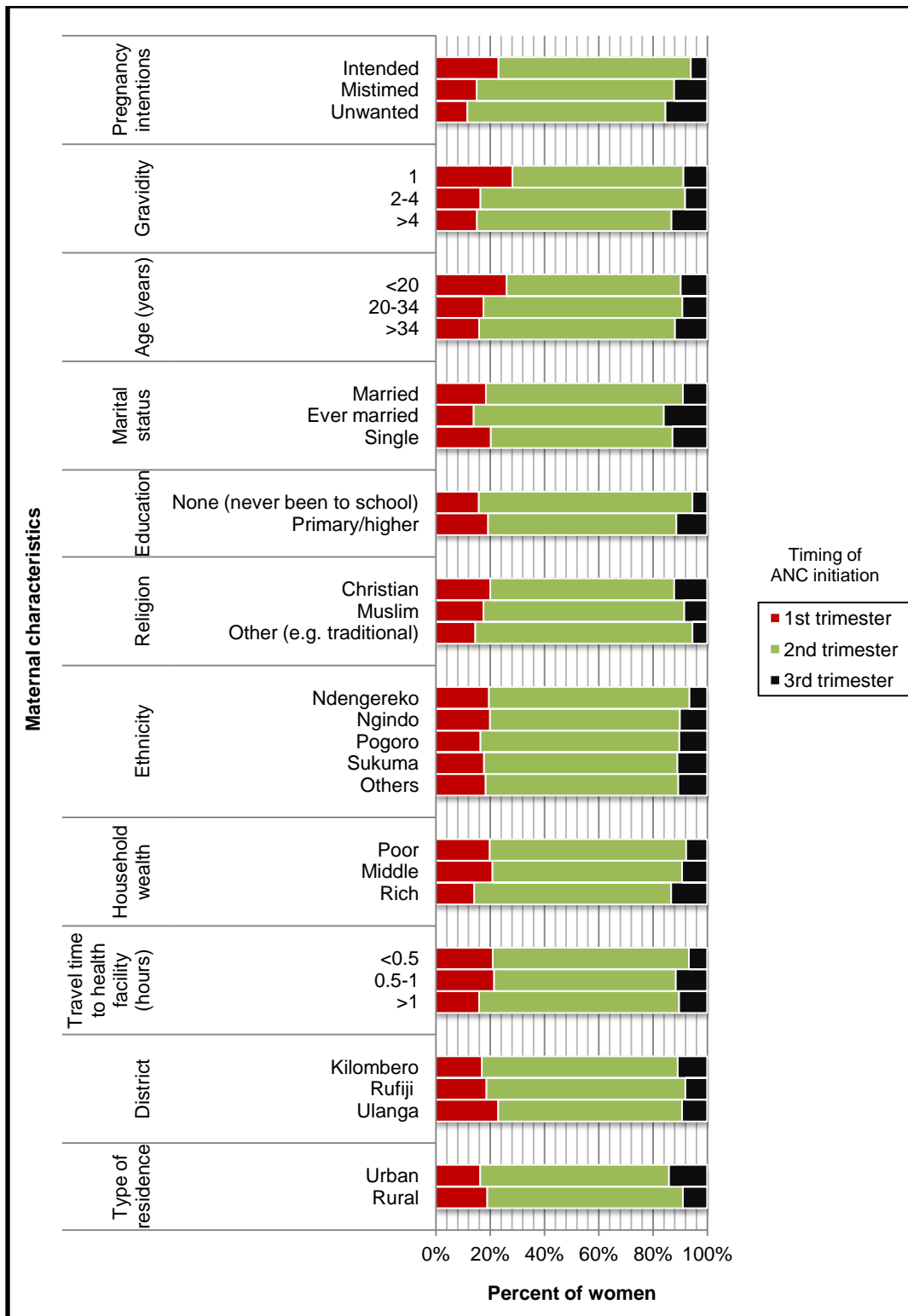
FIGURE 2. Timing of ANC initiation by maternal characteristics among 15-49 year-old women who gave birth in the past two years in three districts in Tanzania, 2011 (n = 910)

Tables

TABLE 1. Sample characteristics (N = 910)

Variable	n	%
ANC initiation		
1st trimester (early)	168	18.5
2nd trimester (late)	652	71.7
3rd trimester (very late)	90	9.9
Median = 5.0 months	—	—
Pregnancy intentions[m]		
Intended	429	49.3
Mistimed	304	34.9
Unwanted	137	15.8
Gravidity		
1	184	20.2
2-4	430	47.3
>4	296	32.5
Median = 3, IQR = 3	—	—
Age (years)		
<20	134	14.7
20-34	557	61.2
>34	219	24.1
Mean = 27.9, SD = 7.6	—	—
Marital status[m]		
Married	726	79.9
Ever married	50	5.5
Single	133	14.6
Education		
None (never been to school)	221	24.3
Primary/higher	689	75.7
Religion[m]		
Christian	388	42.7
Muslim	465	51.2
Other (e.g. traditional)	55	6.1
Ethnicity		
Ndengereko	138	15.2
Ngindo	130	14.3
Pogoro	127	14.0
Sukuma	101	11.0
Others	414	45.5
Household wealth[m]		
Poor	337	40.5
Middle	292	35.1
Rich	204	24.5
Travel time to health facility (hours)[m]		
<0.5	195	21.9
0.5-1	260	29.2
>1	436	48.9
Mean = 1.05, SD = 0.92	—	—
District of residence		
Kilombero	534	58.7
Rufiji	224	24.6
Ulanga	152	16.7
Type of residence[m]		
Rural	737	81.2
Urban	171	18.8
TOTAL	**910**	**100.0**

[m]Variable categories do not add-up to 910 due to missing

TABLE 2. Multivariate polytomous logistic regression model of factors associated with ANC initiation in 2nd and 3rd trimester relative to 1st trimester in three rural districts in Tanzania, 2011 (n = 777)

Variable	ANC initiation in the 2nd trimester relative to 1st trimester		ANC initiation in the 3rd trimester relative to 1st trimester	
	Relative risk ratio (RRR)	95% confidence interval (CI)	Relative risk ratio (RRR)	95% confidence interval (CI)
Pregnancy intentions				
Intended[a]	1.00	—	1.00	—
Mistimed	1.68**	1.10-2.58	2.81***	1.41-5.59
Unwanted	2.00*	1.05-3.82	4.10***	1.68-10.00
Gravidity-Age interaction				
Gravidity	1.58*	1.04-2.39	2.27**	1.21-4.27
Age	1.06*	1.01-1.12	1.04	0.96-1.13
Gravidity*Age	0.99*	0.98-1.00	0.98*	0.97-1.00
Education				
None (never been to school)a	1.00	—	1.00	—
Primary/higher	0.83	0.50-1.38	2.12	0.81-5.57
Household wealth				
Poor[a]	1.00	—	1.00	—
Middle	1.11	0.71-1.75	1.31	0.62-2.77
Rich	1.73	0.98-3.06	2.38*	1.01-5.64
Marital status				
Married[a]	1.00	—	1.00	—
Ever married	1.45	0.53-3.95	3.09	0.86-11.08
Single	1.21	0.69-2.11	2.11	0.91-4.88
Religion				
Christian[a]	1.00	—	1.00	—
Muslim	1.31	0.85-2.02	0.9	0.46-1.79
Other (e.g. traditional)	2.41	0.71-8.21	1.61	0.15-17.79
District				
Kilombero[a]	1.00	—	1.00	—
Rufiji	0.97	0.55-1.69	0.90	0.36-2.26
Ulanga	0.66	0.38-1.12	0.45	0.17-1.16
Travel time to health facility (hours)	1.23	0.95-1.59	1.26	0.86-1.84

***P<0.01, **P<0.02, *P<0.05; [a]Reference/baseline category