

# Factors Associated With Changes in Adequate Antenatal Care Visits Among Pregnant Women Aged 15-49 Years in Tanzania From 2004 to 2016

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## Research article

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# Abstract

## Background:

Antenatal care (ANC) is crucial for the health of the mother and the unborn child as it delivers highly-effective health interventions that can prevent maternal and newborn deaths and morbidity. In 2002, the World Health Organization (WHO) recommended a minimum of four ANC visits for a pregnant woman with a positive pregnancy during the entire gestational period. Tanzania has sub-optimal adequate (four or more) ANC visits and the trend has been fluctuating over time. An understanding of the factors associated with changes in adequate ANC visits over years is crucial in improving the proportions of pregnant women attaining adequate ANC visits in Tanzania.

## Methods

The study used secondary data from Tanzania Demographic Health Survey (TDHS) from 2004 to 2016. The study included 17976 women aged 15–49 years. Data were analyzed using stata version 13. Categorical and continuous variables were summarized using descriptive statistics and using the weighted proportions. A Poisson regression analysis was done to determine factors associated with adequate antenatal. A multivariable Poisson decomposition analysis was done to determine factors associated with changes in adequate ANC visits among pregnant women in Tanzania from 2004 to 2016.

## Results

The overall proportion of women who had adequate ANC visits in 2004/05, 2010 and 2015/16 was 62%, 43% and 51% respectively. The identified determinants of adequate ANC visits were: early ANC initiation, zones, having more than one child, being aged 20 years and above, wanting pregnancy later, belonging to a richer and richest wealth quintile, having secondary and higher education, reporting distance to health facility not a big problem and watching TV at least once per week. Comparing 2004/05 and 2010 surveys, changes in the population structure contributed 4.2% of changes in adequate antenatal care visits while changes in coefficients contributed 95.8% of the changes. Also, comparing 2015/16 to 2010 surveys, changes in population structure and coefficients contributed 66.2% and 33.8% respectively.

## Conclusion

Early ANC initiation has greatly contributed to increased proportion of pregnant women who attain four or more ANC visits overtime. More effort should focus on pregnant women to initiate ANC in the first trimester in order to increase proportion of women with adequate ANC visit.

## Background

Adequate and quality antenatal care (ANC) is effective at promoting better health outcomes for both the mother and child during pregnancy(1, 2). Strong evidence exists to support the link between ANC during pregnancy, skilled birth attendant during delivery and quality postnatal and reduced maternal and infant morbidity and mortality(3–8). Globally, almost 60% of stillbirths are due to poor fetal growth, untreated and unattended maternal infection and conditions, which could have been prevented or treated by expert attention available during ANC visits(7). A wide range of services can be offered during ANC including screening, detection, prevention to treatment of any pregnancy related complication, infection or morbidity(9).

WHO 2002 Focus Antenatal care (FANC) model recommends a minimum of four ANC visits for a woman with uncomplicated pregnancy with the first visit during the first trimester, although currently there is a 8 contacts model in place (9, 10). In 2002 Tanzania adopted FANC with the exception that the first ANC was initiated within 16th gestational weeks(11). Globally, ANC coverage (one ANC visit) is 86%, however only 62% meet the recommended four ANC visits. In Africa ANC coverage is 69% with only 54% attending the minimum of four ANC visits, in Tanzania ANC coverage is higher (98%) but only 51% of pregnant women attend the minimum of four ANC visits(12). Despite a high ANC coverage, adequate ANC visits (defined as 4 or more visits) is still suboptimal and could in part explain the unacceptably high neonatal mortality and still birth rates in Tanzania, 25 deaths/1000 live births and 39 deaths/1000 pregnancies respectively(13).

The Tanzania demographic and Health survey (TDHS) reported a fluctuating trend in adequate ANC visits; a fall from 62–43% and a rise to 51% for the 2004/05, 2010 and 2015/16 survey respectively(13). This underutilization of ANC has been associated with a number of factors as documented in various studies. The factors include: Long distance to health facility, geographical zone, 1st ANC initiation, woman's desire to avoid pregnancy, marital status, wealth quintiles, parity, living in urban, and higher education level(14–19). With the current trend, it is still unclear what had contributed to the changes in adequate ANC visits among pregnant women over time. Therefore, this rises a need to determine factors associated with changes in adequate ANC visits among pregnant women aged 15–49 years in Tanzania from 2004 to 2016.

## Methods

### Study design and study settings

The study was conducted in Tanzania, which includes mainland and island. This was a Crosssectional study. The study used data from the Tanzania Demographic Health Survey (TDHS), Further details of the survey are available elsewhere(13), but in brief this is a national representative survey done after a period of five years and the main objective is to obtain the current and reliable information on demographic and health indicators with regard to family planning, fertility levels and preferences, maternal mortality, infant and child mortality, nutritional status of mothers and children, ANC, delivery care, and childhood immunizations and diseases. Data were obtained from [www.dhsprogram.com](http://www.dhsprogram.com), DHS measure website

whereby the permission to access the data was first obtained before being authorized to download data from DHS measure website. Data from 2004/04, 2010 and 2015/16 surveys were used.

## Study Population

The population was all women of reproductive age (15–49 years) who had given birth to at least one child within the five years prior the survey and had information on ANC visits. For a woman with more than one child birth during the five-year period, the most recent birth was considered for this analysis. A total of 33,734 women age 15–49 years in Tanzania participated in the three TDHS surveys. Within 2004/5 there were 10,329, 10,139 in 2010, and 13,266 in 2015/16. Of these, 15,668 (46.4%) did not give birth within the preceding five years period and they were excluded from the analysis leaving 18,066 (53.6%) who reported a birth in the previous 5 years. Women who reported a birth in the past 5 years was 5658 in 2004/05, 5358 in 2010 and 7050 in 2015/16. Of the remaining a total of 90(0.5%) were also excluded due to missing information on the outcome and finally a total of 17,976(53.3%) were included for the final analysis. Of the 17,976 women enrolled in the study; 4541(77.9%), 4201(76.9%) and 5193(70.1%) for 2004/05, 2010 and 2015/16 surveys respectively (Fig. 1).

## Study Variables

The dependent variable was adequate ANC visits, which was categorized as four or more ANC visits and coded 1. Less than four ANC visits as inadequate and coded 0. The independent variables included respondent's age at last birth (15–19 years, 20–24 years, 25–29 years, 30–34 years, 35 + years), education level (no formal education, primary education, secondary and higher education), employment status (unemployed, employed), marital status (married/cohabiting, single, divorced/widowed/separated), residence (urban, rural), wealth index (poorest, poorer, middle, richer, richest), zones (western zone, northern zone, central zone, southern highlands, southern zone, south west highlands zone, lake zone, eastern zone, Zanzibar), first ANC initiated (later than 1st trimester, within 1st trimester), decision maker of respondent's health care (respondent alone, respondent and partner, partner alone, someone else), parity (1 child, 2–3 children, 4–5 children, 6 or more children), frequency of listening to radio (not at all, Less than once a week, at least once a week), frequency of watching TV (not at all, less than once a week, at least once a week), desire of last pregnancy (wanted then, wanted later, wanted no more), history of terminated pregnancy (never had, ever had) and distance from health facility (big problem, not a big problem).

## Statistical analysis

Data were analyzed using STATA Corporation, College Station, TX, USA version 13. The trend in adequate ANC visits across the three surveys, zones and initiation of first ANC visit was calculated by dividing the number of women with adequate ANC in the particular survey year divided by total number of pregnant women in that particular survey year multiply by 100, then done for all the three surveys.

Poisson regression was used to identify the factors associated with adequate ANC visits. Poisson regression was used as an alternative to classical logistic regression as the outcome was prevalent. Crude and adjusted prevalence ratios were obtained and presented with their respective 95% confidence intervals (CI). All associations were considered statistically significant at a P-value of less than 0.05. Variables included in the final multivariable model were considered if they were priori confounders or had a p-value less than 5% in the crude analysis.

A multivariable Poisson decomposition analysis was conducted to determine factors associated with changes in adequate ANC visits. The decomposition analysis was conducted to understand whether observed changes in adequate ANC visits could be explained by changes in factors or in the population structure. The decomposition analysis was conducted between two time points, firstly to unpack the changes between the 2004/05 to 2010 surveys and secondly to look at the changes between the 2015/16 to 2010 surveys. Contributions were considered statistically significant at a P-value of less than 0.05.

## Results

### Characteristics of the study participants

A total of 17,976 women across all the three surveys were enrolled in the study. Most of the participants were from the rural areas, the mean age ( $\pm$  SD) of the study population was 27.06( $\pm$  7.00). More than a half of the respondents in each survey had at least primary education level. The majority of the participants were married or cohabiting: 85.4%, 84.2% and 81.6% for the 2004/05, 2010 and 2015/16 survey respectively. The proportions of women aged 35 to 45 years increased across the survey years, from 15.6%, in 2004/05 to 17.8% in 2015/16. The percentage of women who achieved secondary education and above also increased from 9.2% in 2004/05 to 19.9% in 2015/16 and the percentage of women without formal education decreased from 26.8% in 2004/05 to 19.5% in 2015/16. Substantial regional variation in survey participation was observed; throughout the three surveys the Lake Zone had the highest percentage of women participating in the survey (18.7%, 19.2% and 25.7% for 2004/05, 2010 and 2015/16 surveys respectively) while the Southern zone had lowest (6.5%, 6.4% and 4.9% for 2004/05, 2010 and 2015/16 surveys respectively) (Table 1).

Table 1  
 Characteristics of the study participants (N = 17976)

Variables	2004-05 TDHS	2010 TDHS	2015-16 TDHS
	Frequency (%) (n = 5632)	Frequency (%) (n = 5325)	Frequency (%) (n = 7019)
Age at delivery (in years)			
15–19	961(17.1)	775(14.5)	1253(17.8)
20–24	1532(27.2)	1376(25.8)	1733(24.7)
25–29	1326(23.5)	1249(23.5)	1593(22.7)
30–34	933(16.6)	940(17.7)	1194(17.0)
35+	880(15.6)	985(18.5)	1246(17.8)
Mean age ( $\pm$ SD)	27.1( $\pm$ 7.07)	27.80( $\pm$ 7.10)	27.41( $\pm$ 7.23)
Zones			
Western zone	522(9.3)	502(9.4)	619(8.8)
Northern zone	546(9.7)	489(9.2)	562(8.0)
Central zone	676(12.0)	625(11.7)	690(9.8)
Southern Highlands	399(7.1)	366(6.9)	561(8.0)
Southern zone	368(6.5)	342(6.4)	347(4.9)
South West Highlands zone	499(8.9)	410(7.7)	778(11.1)
Lake Zone	1051(18.7)	1020(19.2)	1803(25.7)
Eastern zone	522(9.3)	534(10.0)	713(10.2)
Zanzibar	1049(18.5)	1037(19.5)	946(13.5)
Place of residence			
Rural	4541(80.6)	4201(78.9)	5193(74.0)
Urban	1091(19.4)	1124(21.1)	1826(26.0)
Highest level of education			
No formal education	1509(26.8)	1262(23.7)	1368(19.5)
Primary education	3603(64.0)	3393(63.7)	4255(60.6)
Secondary and above	520(9.2)	670(12.6)	1396(19.9)
Current marital status			

Variables	2004-05 TDHS	2010 TDHS	2015-16 TDHS
	Frequency (%) (n = 5632)	Frequency (%) (n = 5325)	Frequency (%) (n = 7019)
Single	285(5.0)	296(5.6)	451(6.4)
Married/Cohabiting	4809(85.4)	4486(84.2)	5724(81.6)
Widowed/Divorced/Separated	538(9.6)	543(10.2)	844(12.0)
Employment status*			
Unemployed	1029(18.3)	929(17.5)	1515(21.6)
Employed	4602(81.7)	4388(82.5)	5504(78.4)
Wealth index			
Poorest	1167(20.7)	1006(18.9)	1441(20.5)
Poorer	1131(20.1)	1150(21.6)	1356(19.3)
Middle	1082(19.2)	1078(20.2)	1376(19.6)
Richer	1247(22.1)	1161(21.8)	1544(22.0)
Richest	1005(17.9)	930(17.5)	1302(18.6)
*Employment status 2004/5 (n=5631) *Employment status 2010 (n=5317)			

Table 2  
Factors associated with adequate antenatal care visits in Tanzania

Characteristics	2004-05 TDHS	2010 TDHS	2015-16 TDHS
	APR (95% CI)	APR (95% CI)	APR (95% CI)
Age at delivery (in years)			
15-19	1	1	1
20-24	0.92(0.85-0.99)	1.21(1.05-1.40)	1.06(0.96-1.18)
25-29	0.95(0.87-1.04)	1.21(1.03-1.42)	1.04(0.93-1.17)
30-34	0.95(0.85-1.06)	1.45(1.20-1.74)	1.15(1.01-1.30)
35+	0.96(0.85-1.09)	1.28(1.03-1.58)	1.19(1.02-1.38)
Zones			
Western zone	1	1	1
Northern zone	1.47(1.31-1.66)	1.45(1.19-1.77)	1.52(1.31-1.76)
Central zone	1.50(1.34-1.69)	1.37(1.13-1.66)	1.71(1.48-1.98)
Southern Highlands	1.37(1.21-1.56)	1.11(0.89-1.38)	1.25(1.07-1.46)
Southern zone	1.49(1.32-1.69)	1.16(0.93-1.45)	1.30(1.10-1.54)
South West Highlands	1.40(1.23-1.58)	0.74(0.58-0.96)	1.25(1.05-1.49)
Lake Zone	1.29(1.15-1.44)	1.27(1.06-1.53)	1.47(1.28-1.68)
Eastern zone	1.62(1.44-1.81)	1.53(1.26-1.85)	1.71(1.49-1.97)
Zanzibar	1.46(1.31-1.63)	1.27(1.05-1.53)	1.48(1.28-1.72)
Place of residence			
Rural	1.00(0.94-1.08)	0.98(0.87-1.11)	0.93(0.85-1.01)
Urban	1	1	1
Highest level of education			
No formal education	1	1	1
Primary education	1.04(0.98-1.10)	1.13(1.01-1.26)	1.05(0.96-1.14)
Secondary and above	1.09(0.99-1.20)	1.25(1.06-1.48)	1.12(1.01-1.25)
Parity			
1	1	1	1
2-3	0.98(0.92-1.05)	0.89(0.78-1.02)	0.88(0.81-0.96)



Characteristics	2004-05 TDHS	2010 TDHS	2015-16 TDHS
	APR (95% CI)	APR (95% CI)	APR (95% CI)
4-5	0.99(0.92-1.06)	0.76(0.64-0.91)	0.83(0.74-0.94)
6+	0.95(0.87-1.03)	0.74(0.60-0.92)	0.78(0.67-0.91)
Decision maker on respondent's health			
Respondent alone	1	1	1
Respondent and partner	0.94(0.88-1.00)	0.93(0.83-1.03)	1.05(0.97-1.13)
Partner alone	0.96(0.91-1.01)	0.87(0.78-0.98)	0.93(0.87-1.03)
Someone else	0.89(0.80-0.99)	0.89(0.58-1.37)	1.02(0.62-1.68)
Desire of last pregnancy			
Wanted then	1	1	1
Wanted later	0.96(0.90-1.02)	0.82(0.74-0.92)	0.92(0.86-0.98)
Wanted no more	0.95(0.86-1.06)	1.06(0.85-1.31)	0.93(0.78-1.11)
Wealth index			
Poorest	1	1	1
Poorer	1.08(1.00-1.17)	0.95(0.83-1.09)	1.03(0.93-1.14)
Middle	1.07(0.99-1.16)	1.03(0.90-1.17)	1.05(0.95-1.16)
Richer	1.12(1.03-1.21)	1.18(1.03-1.35)	1.22(1.11-1.35)
Richest	1.16(1.05-1.27)	1.10(0.93-1.31)	1.16(1.02-1.31)
First ANC initiated			
Later than 1st trimester	1	1	1
Within 1st trimester	1.47(1.41-1.52)	1.96(1.82-2.11)	1.89(1.79-2.00)
Distance to Health facility			
Not a big problem	1.06(1.01-1.12)	1.03(0.93-1.14)	1.05(0.99-1.11)
Big problem	1	1	1
Frequency of watching TV			
Not at all	1	1	1
Less than once a week	1.04(0.97-1.12)	1.03(0.91-1.17)	0.99(0.92-1.08)
At least once a week	1.01(0.93-1.08)	1.24(1.09-1.42)	1.05(0.96-1.16)

Table 3  
Decomposition of changes in adequate antenatal care visits 2004 to 2010

Characteristics	Differences in Population structure (E)			Differences in coefficients(C)		
	Coefficient	%	p-value	Coefficient	%	p-value
Age at delivery (in years)						
15–19	1.0			1.0		
20–24	0.0015	-0.7	0.352	0.0345	-16.3	0.001
25–29	-0.0007	-0.3	0.709	0.0232	-11.1	0.013
30–34	-0.0026	1.2	0.707	0.0284	-13.4	< 0.001
35+	-0.0038	1.8	0.707	0.0148	-7	0.065
Zones						
Western zone	1.0			1.0		
Northern zone	-0.0035	1.7	0.711	-0.0008	0.4	0.865
Central zone	-0.0012	0.6	0.711	-0.0045	2.1	0.431
Southern Highlands	-0.0001	0.1	0.73	-0.0074	3.5	0.083
Southern zone	0.0002	-0.1	0.729	-0.0071	3.3	0.037
SouthWest Highlands	-0.0008	0.4	0.71	-0.0301	14.2	< 0.001
Lake Zone	0.0033	-1.6	0.713	-0.0014	0.7	0.941
Eastern zone	0.0029	-1.4	0.711	-0.0042	2	0.551
Zanzibar	-0.0005	0.2	0.713	-0.0014	0.7	0.291
Highest level of education						
No formal education	1.0			1.0		
Primary education	0.0014	-0.7	0.713	0.0197	-9.3	0.34
Secondary and above	-0.0014	0.7	0.709	0.002	-0.9	0.448
Parity						
1 child	1.0			1.0		
2–3 children	-0.0004	0.2	0.745	-0.0136	6.5	0.121
4–5 children	0.0039	-1.9	0.721	-0.0195	9.2	0.04

<b>Characteristics</b>	<b>Differences in Population structure (E)</b>			<b>Differences in coefficients(C)</b>		
6 + children	0.001	-0.5	0.717	-0.0175	8.2	0.096
Wealth index						
Poorest	1.0			1.0		
Poorer	0.0041	-1	0.745	-0.0121	5.7	0.111
Middle	-0.0001	0.05	0.792	-0.004	1.9	0.588
Richer	-0.0002	0.1	0.714	0.0035	-1.6	0.644
Richest	-0.0001	0.03	0.919	-0.0127	6	0.865
Decision on respondent's health						
Respondent alone	1.0			1.0		
Respondent & partner	0.0136	-6.4	0.759	-0.0006	0.3	0.898
Partner alone	0.0042	-2	0.738	-0.0126	5.9	0.21
Someone else	-0.0028	1.3	0.743	0.0002	-0.1	0.96

Table 4  
Decomposition of changes in adequate antenatal care visits 2010 to 2016

Characteristics	Differences in population structure (E)			Differences in coefficients (C)		
	Coefficient	%	p-value	Coefficient	%	p-value
Age at delivery (in years)						
15–19	1.0			1.0		
20–24	-0.0014	-1.7	0.138	-0.010	-12.2	0.209
25–29	-0.0002	-0.2	0.252	-0.009	-11.4	0.255
30–34	0.0002	0.2	0.009	-0.011	-13.1	0.116
35+	0.001	1.2	0.006	-0.001	-1.6	0.875
Zones						
Western zone	1.0			1.0		
Northern zone	-0.0005	-6.2	< 0.001	0.0013	1.6	0.785
Central zone	-0.0006	-0.8	< 0.001	0.0080	9.9	0.113
Southern Highlands	-0.0028	-3.5	0.006	0.0030	3.7	0.385
Southern zone	-0.0017	-2.2	0.004	0.0024	2.9	0.374
South West Highlands	-0.0016	-0.2	0.013	0.0173	21.4	0.001
Lake Zone	0.0026	3.2	< 0.001	0.0126	15.6	0.239
Eastern zone	0.0108	13.4	< 0.001	0.0053	6.6	0.303
Zanzibar	-0.0003	-0.4	< 0.001	0.0011	1.4	0.333
Highest level of education						
No formal education	1.0			1.0		
Primary education	-0.0011	-1.3	0.324	-0.014	-17.6	0.356
Secondary and above	0.0063	7.1	0.073	-0.002	-2.4	0.367
Parity						
1 child	1.0			1.0		
2–3 children	0.0003	0.4	0.009	-0.078	-9.6	0.378

Characteristics	Differences in population structure (E)			Differences in coefficients (C)		
4–5 children	0.0025	3.1	0.001	-0.008	-0.2	0.488
6 + children	0.0023	2.8	< 0.001	-0.004	-4.8	0.866
Wealth index						
Poorest	1.0			1.0		
Poorer	-0.0003	-0.4	0.645	0.0051	6.3	0.419
Middle	-0.0008	-0.9	0.3	0.0017	2.1	0.761
Richer	-0.0022	-2.7	< 0.001	0.0044	5.5	0.428
Richest	0.0028	3.4	0.018	0.0087	10.7	0.122
Decision on respondent's health						
Respondent alone	1.0			1.0		
Respondent & partner	0.0042	5.2	0.255	0.0177	21.9	0.079
Partner alone	0.0057	7.1	0.125	0.0066	8.2	0.508
Someone else	-0.0008	-0.1	0.951	0.0005	0.6	0.728

## Trends of adequate antenatal care visits

The trend in adequate ANC attendance fluctuated over time. Adequate ANC attendance decreased from 61% in 2004/05 to 43% in 2010 survey, and then increased again to 51% in the 2015/16 survey (Fig. 2). Similar pattern was also found when stratified by zones. The eastern zone had the highest percentage of women with adequate ANC attendance for all the three surveys (Fig. 3). Percentage of women with four ANC visit who initiated the first ANC visit in the first trimester increased over time (Fig. 4).

## Factors associated with adequate antenatal care visits

Various factors were associated with adequate ANC visits for each survey. First ANC in first trimester, multiparous, wanting pregnancy later, watching TV at least once a week, older age, zones, secondary education and above, reporting distance to health facility not a problem, richer and richest household wealth index had influence on adequate ANC visits.

In the multivariable Poisson regression analysis, for all the three surveys ANC initiation within the first trimester had a positive effect on adequate ANC visits. The proportion of women with adequate ANC attendance was 1.47(95% CI: 1.41–1.52) times greater among women who initiated ANC within first trimester compared to those who initiated later in 2004/05, and 1.96(95% CI: 1.82–2.11) times higher in

2010, and 1.89 (95% CI: 1.79-2.00) times higher in 2015/16. Whereby, wanting pregnancy later had a negative influence on adequate ANC visits. In 2004/05 adequate ANC attendance was 0.96 (95% CI: 0.90–1.02) times lower among women who wanted pregnancy later compared to a woman who wanted pregnancy then, 0.82 (95% CI: 0.74–0.92) times lower in 2010, and 0.92 (95% CI: 0.86–0.98) times lower in 2015/16.

## **Factors associated with changes in adequate antenatal care visits across the three surveys**

The multivariable decomposition regression models found that 95.8% of the decline in adequate ANC visits from 2004/05 (62%) to 2010 (43%) were due to changes in the coefficients (prevalence ratios of factors obtained from the surveys) and only 4.2% of the changes was due to the change in the population characteristics (population dynamics). There were no significant changes in the population structures during this period suggesting that the population remained relatively static between the 2004/05 and 2010 survey. The individual contributions to the observed change between the 2004/05 and 2010 surveys included changes in the uptake of ANC in the southwest highland zone which contributed 14.2% to the observed decline and was statistically significant. Meaning that, the zone where a pregnant woman lived affected her ability to attain adequate ANC. Changes in the uptake of first ANC within the first trimester slowed down the decline by 8.7%, this was also statistically significant (p-value < 0.001).

The proportion of women attending adequate ANC increased from 43% in 2010 to 51% in 2015/16. The decomposition analysis showed that 33.8% of the changes observed were due to the changes in the coefficients and 66.2% of the changes was due to the changes in the population characteristics. These changes were statistically significant with a p-value < 0.001. The increase in proportion of women who had initiated ANC during the first trimester contributed 50.5% to the increase observed in 2010 to 2015/16 survey. This was statistically significant at a p-value < 0.001. In the contributions due to differences in coefficients, South West highlands had contributed 21.4% in the overall increase.

## **Discussion**

This study has shown that the prevalence of adequate ANC visits has fluctuated in 10-year period between 2004/05 and 2015/16; starting at 62% in 2004/05, dropping to 43% in 2010 and then rising again to 51% in 2015/16. The fluctuating trend of adequate ANC visit could be partially explained by changes in the timing of ANC initiation. This findings were similar to TDHS but contrast to Bangladesh and Ethiopia the proportion of women achieving an adequate ANC visits (13, 20, 21). Between 2004 and 2016 both the proportion of women achieving adequate ANC visits and those who initiated within the first trimester increased. Suggesting that women who initiate first ANC visit within the first trimester are more likely to attain four recommended ANC visits. The initial timing of the first ANC visit may, in some way, explain the decline in the proportion of women achieving adequate ANC visits that was observed between 2004 and 2010. At this time the national guidance in Tanzania stated that women should attend by her

16th gestational week and not, within 12 weeks, like in other countries(11). This of course, delays the first visit and could then subsequently lead to a lower adequate attendance. Also, Tanzania Service Provision Assessment Survey reports although 82% of all facilities offer ANC there have been differentials on services offered across region (22). Efforts to ensure Tanzania reached the MDG 4 and 5 and “Wazazi nipendeni” campaign in 2012 could explain the increase in adequate attendance between 2010 and 2016 (15, 16). Whilst it is not possible to directly attribute impact to these campaigns it is likely that these played a part in increases early attendance, which is a contributing factor to adequate attendance. Strengthened and focused efforts are needed where early ANC attendance and subsequent adequate attendance remains sub-optimal.

The study findings for 2004/05 TDHS suggest that women who initiate first ANC within first trimester were more likely to accomplish adequate ANC visits. These findings are consistent with another study done in Tanzania, Peru, Cambodia, Cameroon, Senegal, Uganda and Nepal (23, 24). This similarity can be explained by NGOs support and various campaigns that have been conducted in the mentioned countries on ANC utilization as well as early initiation of ANC visits among pregnant women. This positive association between early ANC initiation and adequate ANC visits has also been reported in many other literatures as well. These findings were also observed in 2010 and 2015/16 surveys as well.

Also, for the same survey year, the study found that pregnant women belonging to richer or richest wealth status had higher prevalence of having adequate ANC visits. This findings are similar to a study done in Indonesia, Nepal, Senegal, Uganda and Ethiopia as well as Colombia (18, 19, 23, 25, 26). The findings complements the 2018 USAID Health Policy Plus report which also showed wealth status as a significant determinant of maternal healthcare utilization in Tanzania (17). This would reflect inequities across wealth quintiles which is a barrier in accessing ANC thus leads to not attaining adequate ANC attendance. This can also be explained by the indirect costs such as transportation, unexpected fees or costs for medication, tests or procedures which are not covered in waivers or exemptions policies for ANC services. Also, women from richer and richest household had most of women who had secondary and higher education 28.8% and 57.7% respectively. Education to a woman implies empowerment whereby she becomes more aware has autonomy in utilization health services which influences attaining adequate ANC visits during pregnancy. This highlights the need to address financial barriers and to accessing ANC service and advocating on educating girls and women which will help women from low income families to achieve adequate ANC visits.

The decomposition analysis in this study suggest that changes in both the population and the effects contributed to the changes seen in adequate ANC visits. The changes in adequate ANC in the South West Highlands contributed to 14.2% of this decline from 2004 to 2010, which was due to the decrease in effects of zone between the two time points. However, initiating ANC within first trimester contributed negatively (-8.9%) to a decline in adequate ANC visits. This means that initiating ANC within first trimester leads to the increase in adequate ANC visits, and if there had not been an increase in women initiating ANC within first trimester the decline in adequate ANC visits would have been 8.9% larger. This was

influenced by an increase in proportion of women who had first ANC visit within first trimester from 14% (2004) to 16% (2010), so mainly due to the population dynamics. Also,

For 2010 and 2015-16 survey, first ANC within the first trimester had contributed 50.5% of the increase in proportion of women with adequate ANC visits on differences due to population structure. This might be explained by efforts of government and other stakeholders through safe motherhood campaign (Wazazi nipendeni campaign) which emphasized on initiating ANC within first trimester and sharpened one plan, Big Results which have been improving maternal, neonatal, and child health services (15, 16). Not only that, but also South West Highlands contributed 21.4% of the increase in proportion of pregnant women with adequate ANC visits. This is explained by the increase in proportion of pregnant women with adequate ANC visits compared to other zones of which it might be attributed by Wazazi na mwana campaign which was in Rukwa one of the regions included in the zone (27). So, a need to focus on other regions in Tanzania so as to promote early ANC initiation and subsequently lead to increase in number of women attaining adequate ANC.

## 5.2 Conclusion

The results of this study indicate that adequate ANC attendance has been declining from 2004 to 2010 but a gradual increase has been observed in 2016. This study has found association between early ANC initiation, zones, having more than one child, someone else decides on a woman's health, being aged 20 years and above, wanting pregnancy later, belonging to a richer and richest wealth quintile, having secondary or tertiary education, reporting distance to health facility not a big problem and watching TV at least once per week as factors associated with adequate ANC attendance. Early ANC initiation has greatly contributed to increased proportion of pregnant women who attain four or more ANC visits overtime.

## 5.3 Study Limitation And Strength

The study has utilized national representative data which makes the findings generalizable. The study has enough sample size which gives it power to make a conclusion about factors associated with changes in adequate ANC visits. Also, to the best of our knowledge this is the first study in Tanzania to look at factors associated with the observed changes in adequate ANC visits across three time points. This study has been able to analyze the data using Poisson regression analysis, as an alternative to the classical logistic regression when the outcome is common. This study has used the decomposition analysis which made it possible to obtain the contribution for each factor that influenced the changes in adequate ANC visits.

The study has used secondary data of which some variables have been missing in some of the survey, variable such as covered by health insurance which is known to be positively associated with adequate ANC visits was only captured in 2015-16 TDHS. Also, the data was self-reported by a woman, this makes the data more prone to failure to recall which might have led to an over estimation or under estimation of the effect. Also, the study is prone to social desirability bias as the women are aware of the recommended



minimum ANC visits, which could have overestimated the effects. This study is a Crosssectional study, thus no temporal relationship can be established.

## 5.4 Recommendation

Basing on the findings obtained, we would recommend the following:

- The government and policy makers to put more effort on promoting first ANC visit to be initiated within the first trimester.
- The government to add more effort on various zones in Tanzania that have been shown to have lowest proportions in adequate ANC visits such as in the western zone which includes regions Tabora and Kigoma.
- Interventions emphasizing on pregnant women to attain adequate ANC visits should focus women who are more vulnerable, this includes women at younger age less than 30 years old, from poorer, poorest and middle wealth quintiles, women with more than one child, women with unwanted pregnancy and also among women without secondary or tertiary education.
- Further studies to asses why women are not able to attain adequate ANC despite a high ANC coverage (98%).

## List Of Abbreviations

ANC Ante-natal care

APR Adjusted Prevalence Ratios

FANC Focused Antenatal Care

LBW Low Birth Weight

MDG Millennium Development Goals

MMR Maternal Mortality Ratio

SDG Sustainable Development Goals

TDHS Tanzania Demographic and Health Survey

WHO World Health Organization

## Declarations

## Ethics approval and consent to participate

Ethical approval to conduct the study was obtained from the Kilimanjaro Christian Medical University college research ethical committee. The ethical approval number granted was 2389. Demographic and Health Survey Program authorized data access and the data were used solely for the purpose of the current study.

## **Consent for publication**

Not applicable.

## **Availability of data and materials**

Data and material will be available upon request from the corresponding author with authorization from demographic and health survey program, measure DHS.

## **Competing Interests**

The authors declare that they have no competing interests.

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## **Authors' contributions**

Concept development and study design: EK, JT, JR; Data acquisition: EK; Supervision of the study: JT, JR; Data analysis and statistical support: JT, JR; critically revised the manuscript: EK, JT, JR; All authors read and finally approved the manuscript draft for publication.

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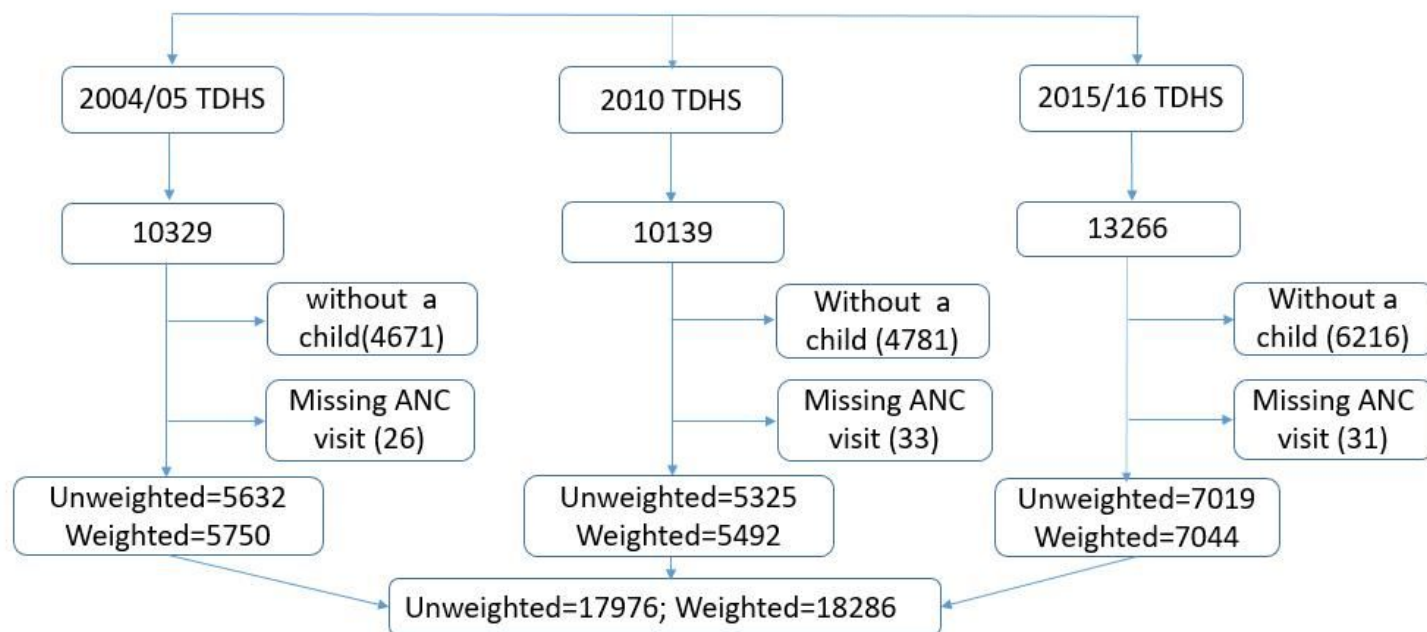
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28. Titles for the figures:.

## Figures



**Figure 1**

Flow chart showing participants enrolled in the study per respective survey years

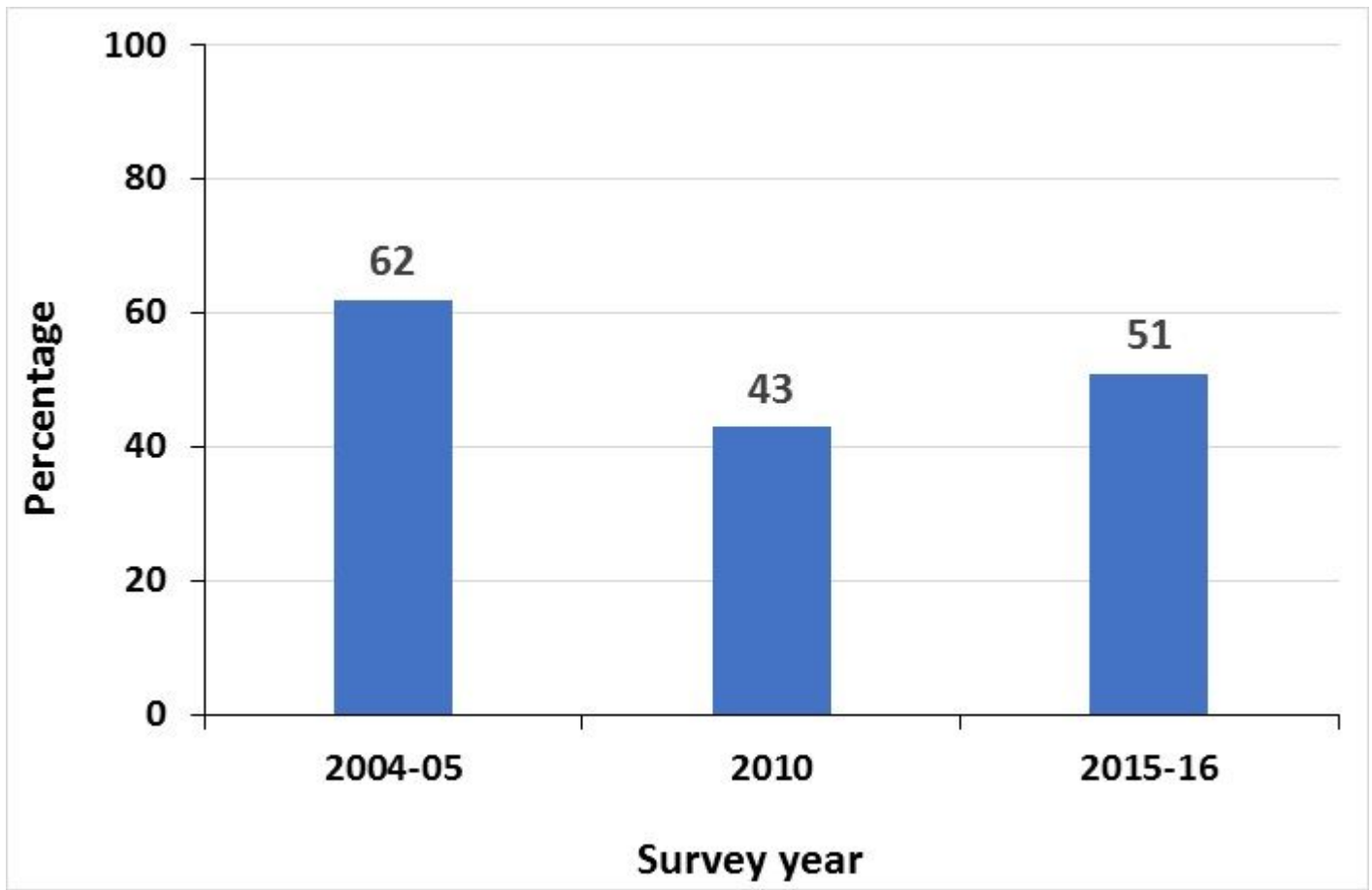


Figure 2

Percentage of pregnant women with adequate ANC visits from 2004 to 2016

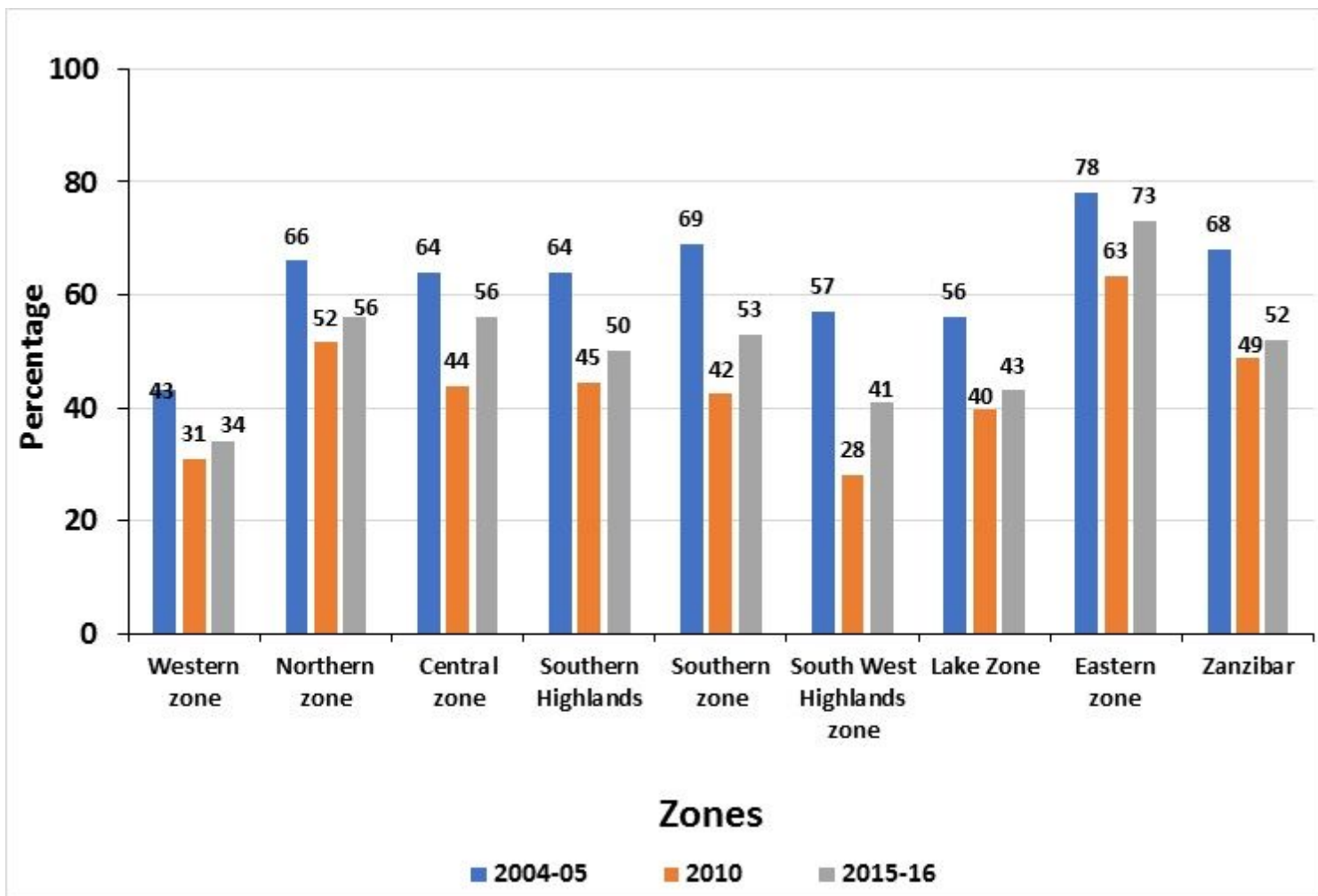


Figure 3

Percentage of pregnant women with adequate ANC visits by zones in Tanzania from 2004 to 2016

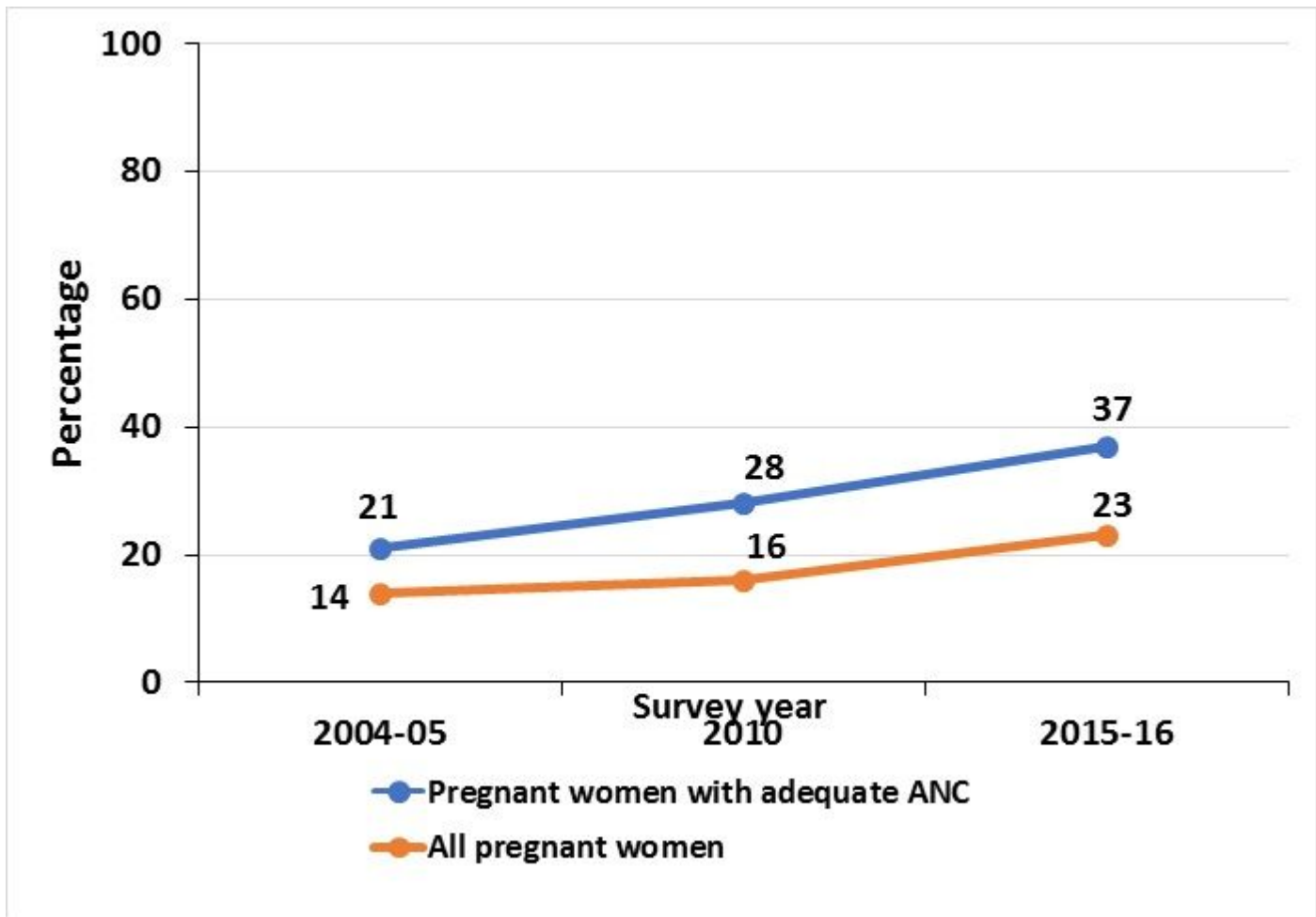


Figure 4

Percentage of pregnant women with first ANC visit in first trimester from 2004 to 2016