

# Factors associated with pregnancy outcomes of adolescents supported by safe motherhood action groups in Zambia

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## Abstract

Mortality related to adolescent pregnancy could be mitigated by lay volunteers in developing country settings. Using logistic regression, this study assessed the factors associated with pregnancy outcomes of adolescents supported by Safe Motherhood Action Groups (SMAGs) in Zambia. SMAG visits initiated in the first 3 months compared to 6-9 months (Adjusted Odds Ratio (AOR) 0.33, 95% CI 0.13-0.82 p 0.017),  $\geq 5$  visits compared to one (AOR 0.09, 0.37-0.22 p<0.001), two (AOR 0.09 (0.04-0.23 p<0.001) ) or three (AOR 0.21 (0.09-0.45 p<0.001), and partner support (AOR 3.35, (1.87 to 6.0) p<0.001) were associated with  $\geq 4$  ANC visits. Partners aged 20-24 (AOR 2.58 95% CI 1.18-5.64 p 0.017) with low birth weight. No factors were associated with place of delivery or caesarean section. The timing of initiation and the number of visits, and partner support were important predictors of adolescents attending antenatal care, and partner's age with low birth weight. (*Afr J Reprod Health* 2022; 26[9]: 133-141).

**Keywords:** Adolescent, community health worker, antenatal care, institutional delivery, low birth weight

## Résumé

La mortalité liée à la grossesse chez les adolescentes pourrait être atténuée par des bénévoles non professionnels dans les pays en développement. À l'aide de la régression logistique, cette étude a évalué les facteurs associés aux issues de grossesse des adolescentes soutenues par les groupes d'action pour une maternité sans risque (SMAG) en Zambie. Visites SMAG initiées au cours des 3 premiers mois par rapport à 6-9 mois (Rapport de cotes ajusté (AOR) 0,33, IC à 95 % 0,13-0,82 p 0,017), >5 visites par rapport à une (AOR 0,09, 0,37-0,22 p<0,001) , deux (AOR 0,09 (0,04-0,23 p<0,001) ou trois (AOR 0,21 (0,09-0,45 p<0,001) et le soutien du partenaire (AOR 3,35, (1,87 à 6,0) p<0,001) étaient associés à > 4 consultations prénatales. Partenaires âgés de 20 à 24 ans (AOR 2,58 IC à 95 % 1,18 à 5,64 p 0,017) ayant un faible poids à la naissance. Aucun facteur n'a été associé au lieu d'accouchement ou à la césarienne. Le moment de l'initiation et le nombre de visites, ainsi que le soutien du partenaire étaient des prédicteurs importants du nombre d'adolescentes fréquentant les soins prénatals et de l'âge du partenaire ayant un faible poids à la naissance. (*Afr J Reprod Health* 2022; 26[9]: 133-141).

**Mots-clés:** Adolescent, agent de santé communautaire, soins prénatals, accouchement institutionnel, faible poids à la naissance

## Introduction

Adolescent pregnancy is a significant public health concern representing 11% of all births worldwide and with poorer pregnancy and child health outcomes<sup>1</sup>. The prevalence of adolescent pregnancy is higher in low- and middle-income countries and in places with high levels of child marriage and poverty, low educational attainment for girls, fewer employment opportunities, and in marginalized communities<sup>2</sup>. Complications from pregnancy and childbirth are the leading cause of death in girls aged 15–19 years<sup>3</sup>, with a disproportionately higher number occurring in developing countries, particularly in sub-Saharan Africa<sup>4</sup>. There is also an increased risk of neonatal deaths in adolescent

mothers, with the risk- being highest among adolescents younger than 16 years<sup>5</sup>.

In Zambia, 29% (19% in urban and 37% in rural areas) of women aged 15-19 years have begun childbearing<sup>6</sup>. Despite the various interventions in developing countries including Zambia, there are still significant challenges with access to antenatal care, delivery in health facilities and low birth weight<sup>7</sup>. Access to quality antenatal care and skilled birth attendance are important for good maternal and childbirth outcomes<sup>8</sup>. In addition, universal access to sexual and reproductive health services is one of the Health Sustainable Development Goals (SDGs) targets<sup>9</sup>. Access to maternal and child health services may be improved using lay volunteers particularly in developing countries

where there is a shortage of skilled health workers. Although it has been shown that lay volunteers can help improve access to maternal and child health services<sup>10,11</sup>. It is not clear how effective they are in supporting pregnant adolescents and their child birth needs, and also the social factors which affect the outcomes of such pregnancies of adolescents supported by lay volunteers are not well known. There is limited literature in Zambia about factors associated with pregnancy outcomes of adolescents, one study shows that receiving HIV test results, Utilization of intermittent preventive treatment for malaria were associated with utilization of antenatal care while having at least one antenatal care visit from skilled health worker was associated with skilled birth attendance and post natal care<sup>12</sup>. Other studies in Zambia not focused on adolescents show that child care burden, wealth, parity, educational status, employment status, distance from health facility and quality of care are associated with utilization of antenatal care<sup>13-15</sup>.

This study evaluated the factors associated with pregnancy outcomes for adolescent mothers under the care of Safe Motherhood Action Groups (SMAGs). SMAGs are lay volunteers that provide counselling to pregnant women and mothers of children under two years in Zambia. The outcomes of interest in this study were antenatal care attendance, place of delivery, type of delivery and low birth weight. The findings helped in identifying social factors that influence adolescent pregnancy and delivery outcomes, which can then be used to improve how lay volunteers work with adolescents.

## Methods

### Design

The study used a cross sectional design using routine data collected by SMAGs on antenatal care, delivery and child birth for program monitoring.

### Study setting

Data was gathered by SMAGs from 20 Area Programs (APs) in Zambia, where World Vision is implementing integrated interventions including

health, nutrition, livelihoods, child protection and education that typically last a period of 15 years. The APs are located in 19 districts of Chipata, Chongwe, Isoka, Kalomo, Kasama, Kasenengwa, Katete, Lumezi, Lundazi, Lupososhi, Mbala, Mumbwa, Mungwi, Mwinilunga, Nyimba, Pemba, Rufunsa, Senga, and Sinazongwe. These districts are from seven of the ten provinces in Zambia.

SMAGs routinely visit pregnant women starting as early as possible after conception to delivery and continue until when the child is 24 months. The SMAGs in this study had been trained in World Visions Timed and Targeted Counselling (TTC) model<sup>16</sup>, which is a behaviour change model that tailors maternal and child health messages in a timely manner so that they are not presented too early and are forgotten or too late to help promote the desired behaviour. TTC is a family-inclusive behaviour change model that targets pregnant women, caregivers, and parents of children up to 2 years of age through appropriately timed household visits. During pregnancy, a mother is expected to receive at least four visits with the first occurring within 2-3 months and covering topics on nutrition, home care, birth planning, malaria, antenatal care and danger signs. The second visit occurs at 4-5 months and covers HIV and Tuberculosis; the third at 6-7 months with topics on birth plan and family planning; and the fourth at 8-9 months with emphasis on labour, delivery and newborn care. However, the frequency of home visits may be increased for high-risk mothers such as those with existing medical conditions such as hypertension, diabetes, HIV and any other circumstances when the need arises. Maternal and child health topics are organized into sets of messages, which are delivered through storytelling to stimulate discussion with the mother with her important family members such as the husband, grandmother, mother in law or other key family decision-makers that influence a woman's health decisions.

### Study population and data collection

The participants included all pregnant adolescents who were receiving support home visits from SMAGs and delivered between January and December 2019. In addition to routine data

collected by SMAGs for all pregnant women, supplementary information was collected by the SMAGS for program improvement purposes through face to face interviews carried out after delivery using a structured questionnaire. The SMAGs were trained on how to collect the information using the questionnaire that was translated into the local languages namely Tonga, Bemba, Lunda and Nyanja.

Information on antenatal care visits and delivery was based on the mother's report while birth weight was based primarily on the Child Health card. If the card was not available then mother's report was used. The data from the questionnaires was cleaned and entered into a database at the district level, which was then forwarded to the Country office for consolidation. Further data cleaning and validation was done and errors remedied in consultation with the APs.

### **Data analysis**

The data collected was entered into a database and was then exported to Stata for analysis. The pregnancy outcomes of interest were antenatal care visits, delivery place (home versus health facility), delivery type (normal, caesarean, or other) and birth weight, while the independent variables were marital status, age, school attendance, gestational age at first TTC Visit, birth order, partner support and adolescent partners age. The partner support was defined by the adolescent reporting that they received any assistance in the form of finances, help with household chores or being accompanied to the health facility by their partner.

Bivariate analysis was done to determine variables that had a significant association ( $p < 0.05$ ) with the pregnancy outcomes of interest. Multivariate analysis was used to further assess associations that were found significant during the bivariate analysis, with significant factors in the bivariate model included so as to develop the final models. In the assessment of the association between delivery place, gestational age at first TTC and adolescent age the actual age or gestation was used rather than categories because when categories were used many sub categories were predicting success perfectly.

## **Results**

A total of 563 (19.3%) pregnant adolescents out of 2,921 under the care of SMAGs in the area program delivered within the period of the study. The age of the adolescents ranged from 12-18 years with a median of 17 years. Nearly three quarters (72%) of the adolescents were in the 17-18 years age group, about a quarter (26%) within 15-16 years and 2% in the 10-14 age group. The partner's age ranged from 15 to 49 with a median of 24, which is 7 years higher than the adolescent median age. However nearly 40% of adolescents did not know the age of their partners.

The study found that 42.6% of the adolescents were single, 54.4% were married and the rest (3%) cohabiting, none of them had been divorced or widowed. Table 1 provides a breakdown of the sociodemographic characteristics of the adolescents.

### **Antenatal care (ANC)**

The study found that the vast majority (80.6%) of the adolescents had four or more ANC visits but only 6.2% had the recommended eight or more ANC visits. There were only 13 (2.3%) of adolescents who did not attend ANC at all, and of these 2 (15.4%) did not attend because the facility was too far away, 1 (7.7%) because the adolescent was busy or at school, and 10 (76.9%) did not respond to the question. These adolescents who did not attend ANC stated that it would be easier for them to attend if they received financial support from their partner 1 (7.7%), had disclosed to their family 1 (7.7%), the clinic was more adolescent friendly 7 (53.8%) and 4 (30.8%) did not respond to the question.

Bivariate analysis found a statistically significant association between  $\geq 4$  ANC visits and marital status, school attendance, gestational age at first TTC visit, partner support and TTC visits (one, two and three visits). However, in the final model (Table 2) only the gestational age at first TTC visit (6-9 months), partner support and TTC Visits (1-3) were statistically significant (LR test  $p < 0.001$ ).

Adolescents who had their first TTC visit at 9 months were 67% less likely to have  $\geq 4$  ANC

**Table 1:** Characteristics of the adolescents

Variable	Frequency n= 563	Proportion (%)
<b>Adolescents Age</b>		
10-14 Age group	10	1.8
15-16 Age group	146	25.9
17-18 Age group	407	72.3
<b>Adolescents partners age</b>		
15-19 Age group	95	16.9
20-24 Age group	196	34.8
25-29 Age Group	34	6.0
30-34 Age Group	13	2.3
Above 34 Age Group	3	0.5
Don't Know	222	39.4
<b>Marital status</b>		
Single	240	42.6
Married	306	54.4
Cohabiting	17	3.0
<b>Birth Order</b>		
No Response	9	1.6
First Pregnancy	495	87.9
Second Pregnancy	58	10.3
Third Pregnancy	1	0.2
<b>Attending School</b>		
Yes	199	35.3
No	364	64.7
<b>Partner support</b>		
Yes	464	82.4%
No	99	17.6%

visits as compared to those who had their first visit in the first 3 months (Adjusted Odds Ratio (AOR) 0.33, 95% Confidence Interval (CI) 0.13 to 0.82 p 0.017). There was no significant difference between those who started their first TTC visit at 4-5 months and those who started in the first 1-3 months (AOR 0.92 95% CI 0.54 to 1.59 p 0.776).

Adolescents who had one TTC visit (AOR 0.09, 0.37 to 0.22 p<0.001) or two TTC visits (AOR 0.09 (0.04 to 0.23 p<0.001) were 91% less likely to have four or more ANC visits than those who had five or more TTC visits. Those who had three TTC visits (AOR 0.21 (0.09 to 0.45 p<0.001) were 79% less likely to have  $\geq 4$  ANC visits than those who had five TTC visits. There was no significant difference between adolescents who received four TTC visits and those who received five or more visits in terms of having  $\geq 4$  ANC visits (AOR 1.47, 0.62 to 3.5 p 0.380). Adolescents who had partner support were 3.35 times as likely as those without to have  $\geq 4$  ANC visits (AOR 3.35, 95% CI 1.87 to

6.00 p<0.001). Table 2 provides the final model for the factors associated with ANC.

### **Delivery place**

The study found that 96% of the adolescents who were visited by SMAGs delivered in a health facility with only 4% delivering at home. In both the bivariate and multivariate analysis, none of the evaluated variables marital status, adolescent age category, school attendance, gestational age at first TTC Visit, birth order, adolescent partner's age, and partner support had a significant association with the delivery place. Table 3 provides the final model for the factors associated with delivery place.

### **Delivery type**

The majority of adolescents delivered normally with only 7.3% delivering by caesarean section. Out of the 563 pregnancies, 559 (99.3%) babies were born alive and 4 (0.7%) were stillbirths; of those babies born alive 2 (0.36%) died within the first 24 hours and 1(0.18%) died after 24 hours. There were no factors found to be significantly associated with type of delivery as shown in Table 4.

### **Low birthweight**

Only 527 (93.6%) adolescents had recorded birth weights and were the only ones included in the analysis of the association between low birth weight and the study variables of interest. The birth weight ranged from 1.2 kg - 4.5 kg with a median birth weight of 2.9kg and the low birth weight prevalence rate was 9.2% (low birth weight was defined as birth weight<2.5kgs). Only school attendance and partner's age were found to be associated with low birth weight in the bivariate model. However, in the final model only partners age had a residual significant effect (LR Test p<0.0127). The LR test for the final model was also significant (LR Test 0.0051). Table 5 shows the final model for Low Birth Weight.

## **Discussion**

The study explored the association between pregnancy outcomes of adolescents under the care

**Table 2:** Final multivariate model for four or more antenatal care visits

Variable	Unadjusted OR		Adjusted OR	
	Antenatal Care Visits	p	Antenatal Care Visits	p
Marital status	1.95 (1.27 to 2.98)	0.002	1.44 (0.87 to 2.46)	0.151
Attending School	0.58 (0.38 to 0.90)	0.014	0.76 (0.46 to 1.29)	0.312
Gestation Age at first TTC Visit 4-5 months	0.59 (0.37 to 0.95)	0.030	0.92 (0.54 to 1.59)	0.776
Gestation Age at first TTC Visit 6-9 months	0.22 (0.10 to 0.50)	<0.001	0.33 (0.13 to 0.82)	0.017
Partner Support	3.00 (1.85 to 4.87)	<0.001	3.35 (1.87 to 6.00)	<0.001
One TTC Visit	0.10 (0.04 to 0.23)	<0.001	0.09 (0.37 to 0.22)	<0.001
Two TTC Visit	0.12 (0.05 to 0.29)	<0.001	0.09 (0.04 to 0.23)	<0.001
Three TTC Visit	0.20 (0.10 to 0.42)	<0.001	0.21 (0.09 to 0.45)	<0.001
Four TTC Visit	1.54 (0.67 to 3.51)	0.301	1.47 (0.62 to 3.50)	0.380

LR Test for model  $p < 0.001$

Reference were Adolescent age 10-15, Gestation age at first TTC visit 1-3months, partner's age 15-19yrs, TTC visits 5 or more

**Table 3:** Final multivariate model for place of delivery

Variable	Unadjusted OR		Adjusted OR	
	Delivery Place	p	Delivery Place	p
Marital status	1.36 (0.58 to 3.20)	0.477	1.31 (0.51 to 3.32)	0.573
Adolescents Age	1.13 (0.78 to 1.65)	0.525	1.16 (0.77 to 1.76)	0.475
Attending School	1.48 (0.57 to 3.84)	0.422	1.41 (0.52 to 3.81)	0.496
Gestation Age at first TTC Visits	0.99 (0.94 to 1.04)	0.683	0.99 (0.93 to 1.04)	0.623
Pregnancy Number	1.2 (0.27 to 5.27)	0.809	1.08 (0.23 to 5.06)	0.925
Partners Age	1.00 (0.99 to 1.02)	0.625	1.00 (0.99 to 1.02)	0.623
Partner Support	1.40 (0.50 to 3.88)	0.520	1.43 (0.49 to 4.15)	0.508
*One TTC Visit				
Two TTC Visit	2.88 (0.35 to 23.71)	0.326	2.87 (0.34 to 24.37)	0.334
Three TTC Visit	2.69 (0.70 to 10.40)	0.151	2.60 (0.65 to 10.38)	0.177
Four TTC Visit	1.58 (0.61 to 4.11)	0.349	1.50 (0.56 to 4.03)	0.423

Reference for dummy variables was Adolescent age 10-15, Gestation age at first TTC visit 1-3months, partner's age 15-19yrs, TTC visit 5 or more.

\* dropped because perfectly predicts outcome

of SMAG members and selected sociodemographic variables of interest to determine if any were significantly associated and hence could inform future program choices. Many studies use educational status as a possible influencer of pregnancy outcomes however in this study, we examined whether adolescent school attendance during the pregnancy influenced pregnancy and delivery outcomes. Partners age was one of the factors assessed in the study however, many of the adolescents didn't know their partner's age which could be due to cultural beliefs which inhibit people from disclosing their age in some parts of Zambia.

### Antenatal care

The study found that adolescents under the care of the SMAGs had much better attendance of antenatal

care visits compared to the national average of 64%.<sup>6</sup> The big difference may be partly due to the TTC counselling received from the SMAGs and the high percentage of partner support both of which factors were found to be significant predictors of having four or more ANC visits. Even though Zambia adopted the relatively new WHO guidelines on ANC which recommend pregnant women should have eight or more ANC visits, in this study four or more ANC visits was used as a bench mark to retain sufficient numbers so as to have sufficient power to detect differences in the studied variables.

The study found that for pregnant women to have four or more ANC visits, SMAG visits of pregnant women need to start early (first 3 months compared with 6-9 months). In addition, to increase

**Table 4:** Final model for delivery type

Variable	Unadjusted		Adjusted	
	Delivery Type	p	Delivery Type	p
Marital status	1.80 (0.95 to 3.41)	0.073	1.35 (0.65 to 2.80)	0.422
Adolescents Age 15-16 years	0.79 (0.09 to 6.61)	0.828	0.58 (0.06 to 5.86)	0.647
Adolescents Age 17-18 years	1.94 (0.24 to 16.04)	0.537	1.25 (0.12 to 12.76)	0.852
Attending School	0.55 (0.29 to 1.04)	0.065	0.58 (0.29 to 1.18)	0.134
Gestation Age at first TTC Visit 4-5 months	0.61 (0.31 to 1.19)	0.146	0.79 (0.38 to 1.65)	0.525
Gestation Age at first TTC Visit 6-9 months	1.81 (0.24 to 13.90)	0.568	3.06 (0.37 to 25.51)	0.301
Pregnancy Number	0.82 (0.31 to 2.19)	0.694	0.60 (0.21 to 1.78)	0.360
Partners Age 20-24years	2.11 (0.99 to 4.47)	0.052	1.70 (0.72 to 4.01)	0.227
Partners Age 25-29years	6.19 (0.79 to 48.76)	0.084	4.93 (0.59 to 40.92)	0.140
Partners Age > 30years	2.81 (0.35 to 22.92)	0.334	2.10 (0.23 to 19.46)	0.514
Don't Know Age	5.02 (2.05 to 12.28)	<0.001	4.52 (1.74 to 11.79)	0.002
Partner Support	1.81 (0.87 to 3.74)	0.111	2.27 (1.01 to 5.09)	0.046
One TTC Visit	3.16 (0.38 to 25.98)	0.285	4.09 (0.48 to 35.23)	0.200
Two TTC Visit	0.42 (0.14 to 1.29)	0.131	0.39 (0.11 to 1.31)	0.127
Three TTC Visit	0.62 (0.24 to 1.58)	0.315	0.72 (0.26 to 1.96)	0.521
Four TTC Visit	1.11 (0.45 to 2.72)	0.823	1.07 (0.42 to 2.75)	0.881

Reference for dummy variables was Adolescent age 10-15, Gestation age at first TTC visit 1-3months, partner's age 15-19yrs, TTC visit 5 or more.

**Table 5:** Final model for Low Birth Weight

Variable	Unadjusted		Adjusted	
	Birth Weight	p	Birth Weight	p
Attending School	0.55 (0.31 to 0.99)	0.044	0.57 (0.32 to 1.02)	0.059
Partners Age 20-24years	2.57 (1.18 to 5.61)	0.017	2.58 (1.18 to 5.64)	0.017
Partners Age 25-29years	6.88 (0.87 to 54.25)	0.067	6.87 (0.87 to 54.34)	0.068
*Partners Age > 30years				
Don't Know Age	1.73 (0.85 to 3.53)	0.129	1.79 (0.88 to 3.66)	0.111

LR Test 0.0051

Reference for dummy variables was Adolescent age 10-15, Gestation age at first TTC visit 1-3months, partner's age 15-19yrs, TTC visit 5 or more.

\*Dropped because perfectly predicted outcome

the use of ANC, it is also essential to have at least four SMAG visits. However, increasing the frequency of TTC visits beyond four did not significantly improve attendance of four or more ANC visits by adolescents. Knowledge and perceived benefits are predictors of late ANC attendance in Zambia<sup>17</sup>. Such gaps in knowledge may be addressed through counselling by SMAGs or similar lay health volunteers. These findings on the factors influencing ANC visits are important for policy and programming considerations, particularly when making recommendations for the optimum number of visits that community health workers should make when visiting pregnant women.

Our findings did not find a significant relationship between first pregnancy and attendance of four or more antenatal care visits. This is in contrast to findings of a systematic review which assessed the factors associated with the utilization of antenatal care in developing countries, and found that older women tended to attend antenatal care less than younger women<sup>18</sup>. This systematic review also identified maternal education, husband's education, marital status, availability, cost, household income, women's employment, media exposure, and history of obstetric complications as the other factors that influence ANC utilization. Other studies in Zambia and elsewhere have also shown that woman's employment status, husband's education, parity,

social class, household childcare burden, and wealth influence ANC attendance<sup>14,19,20</sup>.

### **Delivery place**

The rate of home delivery in this study was much lower than the national average (15.1% and 11.4% for under 20 years)<sup>6</sup>. None of the study factors was found to have a significant association with the place of delivery, this may partly be explained by the very low numbers of adolescents who delivered at home compared to those who delivered in a health facility resulting in insufficient power to detect differences. Other studies have shown that perceived risks of home delivery, access to antenatal care, marital and educational status and obstetric problems during pregnancy are associated with institutional delivery<sup>21,22</sup>. In adolescents, educational status, age, wealth, rural versus urban location and ethnicity were the factors found to be associated with the choice of delivery place<sup>4,12,23,24</sup>.

### **Delivery type**

The caesarean section rate in this study was slightly higher than the national average (5%) and the average for women below 20 years (4.9%)<sup>6</sup>. The difference is probably due to the age differences leading to higher risk of contracted pelvis and hence caesarean section as well as the higher institutional delivery rates for the mothers in the study group compared to the national picture. There were no factors found to be associated with delivery type however, other studies show that adolescents tend to have a lower rate of caesarean section rate compared to older women<sup>25,26</sup>, however in these studies most of the adolescents were in their late teens. Other studies show that the factors associated with caesarean section in adolescents are obstetric risks, higher educational attainment, socio-economic status, and older adolescents 18-19 years<sup>27,28</sup>.

### **Low birth weight**

The low birth weight rate found in the study is the same as the national average (9%) but lower than that for women below 20 years of age (12%)<sup>6</sup>. Adolescents generally have higher rates of low birth

weight compared to non-adolescent mothers<sup>29</sup>. In this study, only partner's age was found to have a significant association with low birth weight in the final model. It is not clear how the partners age affects low birth weight particularly since the younger partners had better outcomes than the older which is contrary to what one would expect given that older men are more likely to be wealthier and thus potentially be able to provide better for their partners. Adolescents of younger age 10-14 tended to have higher odds of getting low birth weight compared to those of 15-16 and 17-18 year olds which is consistent with findings elsewhere<sup>23,30</sup>. Studies show that obstetric complications, cigarette smoking, and mother's educational status are the other factors associated with low birth weight<sup>31,32</sup>. Although cigarette smoking is a known causative for low birth weight, it is not likely to have influenced our findings significantly, as the level of smoking in Zambia particularly in rural areas is very low with less than 1% of females of all ages found to smoke cigarettes<sup>33</sup>.

### **Limitations**

The study used child health card record and mothers report to obtain birth weight, this may have some errors particularly for cases where mothers report was used. The other potential limitation is reporting bias arising from mothers wanting to appear to have good health seeking behaviour on ANC visits and delivery in health institution. This however was alleviated by the use of the SMAGs who already had much of the information collected even before the delivery. SMAGs live close to the mothers and also have an ongoing relationship with the mothers and making it less likely for mothers to report incorrect information to them.

Finally, the study population was that of only rural adolescents receiving visits from SMAGs and not the general population of adolescents which limits the generalizability of the findings.

### **Conclusion**

As compared to the national averages, the adolescents under the care of SMAGs had a higher ANC attendance, institutional delivery and lower

levels of low birth weight children. The factors related to having four or more ANC visits were gestational age at first TTC visit (6-9 months), attending school, partner support, and community volunteer visits while only partner's age was associated with low birth weight. None of the variables studied had a significant association with delivery place or type. The finding that having four community volunteer visits for pregnant women is better than having between 1 to 3 visits, and not inferior to having five or more is an important guide for policy makers in determining the minimum optimal number of visits community health workers should make to support adolescent pregnant women.

### Ethical considerations

Ethical approval for the study was obtained from ERES Converge Zambia reference number 2020-Jul-011 and informed consent was obtained from the respondents.

### Conflict of interest

The authors declare that they have no conflict of interest. The analysis and views expressed in this paper are their own and not those of their organizations.

### Authors contributions

SM provided technical advice to in-country team, contributed to design of study and data collection tools, conducted the data analysis and developed the draft and final version of the manuscript.

MI contributed to development of study design and data collection tools, and reviewed and provided input to the final manuscript.

DM provided technical advice to in-country team, contributed to the development of study design and data collection tools, reviewed and provided input in to the final manuscript.

TC contributed to the development of data collection tools, training of field staff on use of the tools, compiling and cleaning the data, contributed to data analysis and review of the final manuscript. All authors agreed to the final version of the manuscript submitted.

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