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A Multilevel Analysis of Grand Multiparity: Trend and its determinants in the Sidama National Region State of Ethiopia: Evidence from 2016 Ethiopia Demographic and Health Survey.

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Abstract

Objective: The study was aimed at examining the magnitude, trends, and determinants of grand multiparity in the Sidama regional state of Ethiopia.

Design: We retrieved cross-sectional data from the Ethiopian demographic health survey 2016.

Setting: Community-based demographic health survey was conducted in Ethiopia.

Participants: The study population was women (aged 15 to 49 years) who had delivered children with available DHS data set.

Outcomes: Multilevel multivariate logistic regression analyses assessed the relationship between grand multiparity and its determinants.

Results: The magnitude of grand multiparity was 70.8% (95% CI: 68.5-72.9). The multilevel multivariable logistic regression model showed illiteracy [AOR=2; 95%CI:1.25-3.75], non-use of any contraceptive [AOR=3.8; 95% CI:1.2-12.2], early marriage [AOR=4.5; 95% CI: 2.6-7.9], polygamous marriage [AOR=4.2; 95% CI:2.0-9.3], short interbirth intervals [AOR=2.3; 95% CI:1.4-3.5] and husband low education status [AOR=5.8; 95%CI:2.1-16.1] were significantly associated with grand multiparity.

Conclusions: This study revealed that seven of ten women were grand multipara, and the magnitude did not show significant change over the last sixteen years. Early marriage and early age of first birth, low literacy level, low family planning utilization, polygamy, short inter-birth interval, and unmet need of family planning were determinants of grand multiparity. We recommended to the stakeholders to design new strategies to address the root cause of high fertility factors in communities.

Keywords: High parity, High fertility, Grand multiparity, Multilevel analysis, Sidama, Ethiopia.

Strengths and Limitations of this study

- The strength of this study was that we used the recent Ethiopia demographic and health survey for Sidama national regional state.
- Also, we applied multilevel modeling to handle the hierarchical nature of the EDHS data. Despite the above strengths, the study might have recall bias since the participants were asked about the events that took place 5 years or more preceding the survey.
- Meanwhile, the data were cross-sectional studies, it could not display causal inferences concerning individual- and community-level factors with grand multiparity.
- Another limitation is that the management of missing data was also overlooked.

Background

Grand multiparty, a situation when a woman has at least five deliveries at gestational age greater than or equal to 20 weeks, is a major public health concern in developing countries particularly in sub-Saharan Africa [1-3]. Its obstetric performance is considered as high risk which is defined as the one in which the woman, fetus, and/or newborn are at increased risk of morbidity or mortality prenatal, intra-partum or postpartum [4]. In this regard, there is a high disparity in the fertility rates between the developed and developing countries [5]. The factors responsible for the huge disparity are usually neglected in existing family planning and reproductive health programs which causes the grand multi-parity to be a serious public health problem worldwide, particularly for developing countries including Ethiopia [6, 7].

While the global fertility rate declined from 3.2 live births per woman in 1990 to 2.5 in 2019, the magnitude increased to 4.6 in 2019 in sub-Saharan Africa including Ethiopia which indicates a high fertility rate [8-10].

Various factors have been identified to be associated with the grand multi-parity and these include early age at first marriage, low socio-economic status, polygamous marriage [11], husband's preference, culture, religion, and residence in a rural area. Others are low literacy level, poor mass media exposure, low level of awareness on health, and lack of access to modern contraceptives especially in most sub–Saharan Africa [1, 12, 13].

Even to date, the gap between previous studies is missing some variables, limited data on the factors, and a lack of adequate literature special from the study area. Furthermore, numerous numbers of previous studies were conducted at a health facility level which is less generalizable to the larger community. Also, there were inadequate studies carried out on the trend, magnitude, and associated factors of grand multiparity by using national representative demographic health survey data (DHS). Therefore, we addressed the above-mentioned gaps by using largely nationally representative data which were conducted at the community level and used large sample sizes.

Methods and materials

Study area and period

Sidama national regional state is one of the 10 national regional states in Ethiopia. The region is divided into 36 Districts (6 urban districts and 30 rural districts). Hawassa city is the capital of the region and it is situated in the Southern part, about 273 Kilometers away from Addis Ababa, Ethiopia's capital. The Sidama people number 8.8 million (4.01% of the national population) and are the fifth most populous ethnic group in Ethiopia. Sidama national region state has 123 health

centers and 17 hospitals[10, 14-17]. For this study, we used secondary data from the 2016 Ethiopia demographic health and survey (DHS). The DHS data had been collected from January 18, 2016, to June 27, 2016, by the Ethiopian Central Statistical Agency (ECSA)[10].

Study design, data source, and sampling techniques

A cross-sectional survey data was obtained from 2016 (EDHS). The data were retrieved from the (DHS) program official database website (***http://dhsprogram.com***). It is a nationally representative household survey that collects information about population, health, and other important indicators. The sample of the EDHS study was designed to collect up-to-date information from each of the ten regions and the two administrative cities. Each region was stratified into urban and rural areas 21 sampling strata were obtained. Samples of enumeration areas (EAs) were selected independently in each stratum in two stages. In the first stage, a total EAs was selected with proportional sampling technique and with independent selection in each sampling stratum. The selection of households was the second stage. A fixed number of households per cluster were selected with an equal probability proportional allocation to sample size was done [10].

This study used the birth record dataset and the study population was women (aged 15 to 49 years) who had delivered children with available DHS data set. From the birth record dataset, the total number of multiparous (para 2 to 4) and grand multiparous (para 5 to 9) women was extracted for Sidama national region state from 2016 EDHS. The total sample was extracted for women who gave birth (parity 2 to 9) from the birth record dataset. The total number of women whose parity (2 to 9) in the study region of Ethiopia was included in 1,654 weighted samples. For trend analysis, grand multipara in all the four DHS data from 2000 to 2016 were extracted by using the quantitative method [10, 18-20].

Study variables

Dependent variable: The outcome variable of this study was grand multiparity which was categorized into "Yes = 1/ No = 0" form. These include all women who have five to nine deliveries as grand multi-parity categories [1, 2, 21].

$$Yi = \begin{cases} 0; \text{ Multiparity, for the women had given birth 2 to 4 times.} \\ 1; \text{ Grand multiparity, for the women who had given birth 5 to 9 times.} \end{cases}$$

Yi = represent the parity of the i^{th} ever born children.

Independent variables: The independent variables for this study were identified based on previous studies conducted on the factors affecting grand multiparity at the different places that were reviewed from the literature as associated factors of grand multiparity [11, 22-33]. The independent variables selected for analysis from the available dataset were the place of residence, maternal age, educational status of women, wealth index, current marital status, polygamy marriage, women currently working, religion, husband education level husband occupation status, women supported by husband, community media exposure, age of women at first birth, age at first sex, number of living children, preceding birth interval (months), the contraceptive method used, unmet need of contraceptive, the desire for more children, the child being alive, place of delivery, and husband's desire for more children. In this analysis, independent variables were categorized into individual-level variables and community-level variables. Individual-level variables were the age of women, women education status, wealth index, women age of first birth, number of living children, current marital status, polygamy marriage, women age at first sex, desire for more children, contraceptive method, unmet need of contraceptive, women currently working, the child is alive, preceding birth interval (months), place of delivery, women supported by husband, husband education status, husband occupation status, husband desire for more

children. Community-level variables were religion, place of residence, and community media exposure.

Data Analysis

For analysis, the weighted samples data were used to ensure the survey results were representative of the regions. Based on each weighted variable, the descriptive statistics were reported with summary indices, frequency, and proportion. The trend analysis of grand multiparity was assessed using the Extended Mantel-Haenszel Chi-square test for linear trend using the OpenEpi (version 3.01)- Response program[34]. A P-value of less than 0.05 was used to declare a 95% significant probability of the existence of a trend. The degree of crude association for individual and community variables was checked by employing a χ^2 test.

For the nested structure of the EDHS data, multilevel multivariable logistic regression analysis was used. Also, the mixed effect (fixed effect for both the individual and community level factors and a random effect for the between cluster-variation), a two-level mixed-effect logistic regression analysis was used. The final findings were measured using an adjusted odds ratio (AOR). Within the multilevel multivariable logistical regression analysis, four models were fitted for the result variable. The primary model (null or empty model) was fitted without explanatory variables. The second model (individual model), third model (community model), and fourth model (final model) variables were fitted for individual level, community-level, and each individual- and community-level variable respectively. The final model was used to check for the independent effect of the individual and community level variables on grand multiparity.

The model fitness was assessed using Akaike Information Criterion (AIC), the Bayesian information criterion (BIC), and the Likelihood Ratio (LR) test. The values for each model of AIC and BIC were compared, the lowest one assumed to be a better explanatory model[35].

Multicollinearity between the individual- and community-level variables was checked using the Variance Inflation Factor (VIF). The mean value of VIF < 10 was the cut-off point[36]. In the present study, the mean VIF value was estimated to be 2.44 showing the absence of multicollinearity in the models. The data were analyzed using the STATA statistical software system package version 14.0 (StataCorp., College Station, TX, USA). It was considered statistically significant if the P-values were less than 0.05 with the 95% confidence intervals.

Patient and Public Involvement

No patient was involved in this study.

Results

Socio-demographic characteristics of study participants

In this study, a total weighted sample of 1,654 women was included in the analysis from the latest EDHS data (2016). The mean age (±SD) of the women was 35±6.7 years with the majority of women aged between 40-49 years. Almost all (99%) of women lived in a rural setting, and close to two-thirds (67%) of women were illiterate. Slightly more than half (55%) of the women were under a low level of socio-economic status. Almost all of them were married (93%) and follow the protestant religion (92%). More than three-fourths (77%) of the women were not supported by their husbands to do day-to-day chores. In addition, the majority of husbands had attended formal education and had different types of occupations. The summarized information of socio-demographic background is displayed below (table 1).

Table 1: Sociodemographic characteristics of study participants in the Sidama national region state, data from 2016 Ethiopia demographic health and survey.

Individual and community Variables	Categories	Weighted (No_)	Weight (%)
Place of residence	Urban	13	0.75
	Rural	1641	99.25
Age in years	20-29	329	19.87
	30-34	441	26.66
	35-39	413	25.00
	40-49	471	28.47
	Mean ±SD	35±6.7	
Educational status	Have formal education	532	32.16
	No formal education	1122	67.84
Wealth index	Low	912	55.14
	Middle	357	21.58
	Higher	385	23.28
Current marital status	Other marital statues	110	6.66
	Married	1544	93.34
Polygamy	No	1205	77.09
	Yes	357	22.91
Women currently working	No	942	56.94
	Yes	712	43.04
Religion	Orthodox	16	0.97
	Catholic	27	1.63
	Protestant	1535	92.80
	Muslim	76	4.59
Husband education level	Lack of formal education	504	32.28
	Primary education	944	60.41
	Secondary education and above	114	7.31
Husband occupation status	Professionals	187	11.96
	Merchant	262	16.74
	Agriculture/Farmer	1,114	71.30
Women supported by husband	No	1216	77.82
	Yes	347	22.18
Community media exposure	No	1122	67.82
	Yes	532	32.18

Sexual and reproductive health characteristics of study participants

The mean age (±standard deviation) of women at first delivery was 17.69 ± 2.75 years and at first coital exposure was 16±2.6 years. The women's mean number of living children was 4.9 with a

±1.8 standard deviation. About two-thirds (64.8%) of women had short birth intervals within or less than 36 months. Among participants, a considerable proportion of women (45.81%) did not utilize modern contraceptives. Nearly, one-out of ten women (10.9%) had experienced child death in the survey. Slightly more than three-fourths (80%) of women gave birth at home (table 2).

Table 2: Fertility, sexual and reproductive health characteristics of study participants in Sidama regional state, data from 2016 Ethiopia Demographic and Health Survey.

Individual-level variables	Categories	Frequency	Percent (%)
Age of women at first birth	Less than18 years Greater than or equal 18 years Mean ±SD	1,077 577 17.69±2.75	65.11 34.89
Age at first sex	Less than or equal to 18 years Greater than 18 years Mean ±SD	1356 298 16± 2.6	81.98 18.02
Number of living children	Mean ±SD	4.9 ±1.8	
Preceding birth interval (months)	Less than or equal to 36 months Greater than 36 months Mean ±SD	844 459 34.47 ± 18.6	64.8 35.2
Contraceptive method used	Not using any methods Short-acting family planning Long-acting family planning	758 680 216	45.81 41.13 13.06
Unmet need of contraceptive	Unmet of contraceptive Met of contraceptive Infecund/Menopausal	219 1,313 302	13.25 68.51 18.24
The desire for more children	Wants no more children Wants more children	1,106 548	66.84 33.16
Husband desire more child	Husband wants fewer Husband wants more Both want more	357 583 611	23.02 37.56 39.42
Child is alive	No Yes	181 1473	10.95 89.05
Place of delivery	Home Health facilities	251 62	80.0 20.0

The magnitude of grand multi-parous women

The prevalence of grand multiparity with the weighted sample was 70.8 % (95 % CI, 68.5 - 72.9), in the 5 years preceding the survey in the Sidama region. Evidence from 2016 EHDS (Figure 1).

The trend of grand multiparous women

The magnitudes of the grand multi-parity were 70.93 % in 2000 EDHS, 68.58 % in 2005 EDHS, 74.23 % in 2011 EDHS, and 70.82 % in 2016 DHS in the Sidama national region state. Over 16 years, the trend of grand multiparous women from four surveys showed no significant change (Extended Mantel-Haenszel chi-square for leaner trend= 1.13 and P-values= 0.29). Likewise, no percentage change was observed between 2000 and 2016 EDHS in the Sidama region (Figure 2).

Bivariate variables association with grand multi-para women

With regards to education status, the lack of formal education (75.8%) was significantly higher in grand multiparous women than in multipara (48.6%), (P<0.001). An enormous number of women in both groups were of poorest and poorer statuses on the wealth index. The unmet need for contraceptives and underutilization of long-acting family planning utilization was significantly higher in grand multipara than multipara (p<0.001). Among grand multipara, women in polygamous marriage were significantly higher compared with multipara women, (p<0.001). Likewise, the age of women at first birth, short birth intervals, husband education level, number of living children, and place of residence showed significant associations in both study groups, (p<0.001).

However, no significant differences were observed between grand multipara and multiparous regarding women currently working, place of delivery, the child is alive, current marital status, husband occupation status, and community media exposure, (P> 0.05), (table 3).

Table 3: Bivariate variables association of individual and community level variable with grand multipara and multiparous women in Sidama national region state, Ethiopia, data from EDHS 2016.

Individual and community Variables	Categories	Multiparous No_ (%)	Grand Multipara No_ (%)	P-value
Age in year	Mean ± SD	29.4 ± 0.3	37.7 ± 0.2	p<0.001
Educational level	Lack of formal education Have formal education	234(20.9) 248(46.7)	888(79.1) 283 (53.3)	p<0.001
Wealth Index	Poorest Poorer Middle Richer Richest	134(28.9) 146(32.5) 89(24.8) 54(25.2) 61(35.2)	329(71.1) 303(67.5) 269(75.2) 159(74.8) 112(64.8)	p=0.049
Age of women at first birth	Mean ± SD	18.8±2.9	17.5± 2.6	p<0.001
Number of living children	Mean ± SD	2.8± 0.8	5.8 ±1.4	p<0.001
Current marital status	Other marital statues Married	30(26.8) 453(93.9)	80(73.2) 1,091(93.1)	P=0.74
Polygamy marriage	No Yes	426(35.3) 34(9.6)	780(64.7) 322(90.4)	p<0.001
Age at first sex	Mean ± SD	16.56±2.77	16.13±2.52	P=0.022
The desire for more children	Not want more children Want more children	178(16.1) 305(55.5)	927(83.9) 244(44.5)	p<0.001
Unmet need of contraceptive	Unmet Met Infecund/Menopausal	36(16.6) 414(36.5) 33(10.7)	183(83.4) 719(63.5) 269(89.3)	p<0.001
Women currently working	No Yes	270(28.6) 213(29.9)	672(71.4) 499(70.1)	P= 0.594
Child is alive	No Yes	34(19.0) 448 (30.4)	147(81.0) 1,025(69.6)	P=0.098
Preceding birth interval (months)	Mean ± SD	40±21.9	32.6±16.9	p<0.001
Place of delivery	Home Health facilities	138(54.8) 34(61.5)	114(45.2) 22(38.5)	p=0.262
Religion	Orthodox Protestant Muslim	21(47.3) 428(28.0) 33(43.8)	23(52.7) 1,106(72.0) 43(56.2)	P=0.025
Women supported by husband	No Yes	326(26.8) 132(38.6)	890(73.2) 213(61.4)	P=0.007
Husband education level	Lack of formal education Primary education Secondary education and above	115(22.7) 281(29.8) 65(56.7)	390(77.3) 663(70.2) 50(43.3)	p<0.001
Husband occupation status	Professionals Merchant	39(21.0) 90(34.5)	148(79.0) 171(65.5)	P = 0.064

	Agriculture/Farmer	331(29.7)	783(70.3)	
Husband desire more child	Husband wants fewer Husband wants more Both want more	112(31.2) 123(21.1) 226(37.0)	246(68.8) 460(78.9) 385(63.0)	P =0.012
Contraceptive method used	Not using any methods Short acting family planning Long-acting family planning	196(25.8) 212 (31.1) 75(34.9)	562(74.2) 469(68.9) 141(65.1)	P = 0.167
Place of residence	Urban Rural	11(83.6) 472(28.8)	2(16.4) 1,169(71.2)	P<0.001
Community media exposure	No Yes	337(30.0) 146(27.5)	786(70.0) 386(72.5)	P=0.905

Determinants of grand multiparity

We applied a two-level mixed effect multivariable logistic regression using the extracted data from 2016 DHS for the Sidama national regional state that is aimed at identifying individual and community-level determinants of grand multiparity or women having high parity. Those four models were developed to analyze factors accordingly. The result was reported based on Model IV (combined individual and community level factors were fitted simultaneously) (Table 4).

The odds of grand multiparity compared to multiparity was 2 times [AOR=2; 95 % CI:1.25-3.75] higher among women who were uneducated compared with women who were educated. The odds of grand multiparity compared to those multiparous women not using any contraceptive method was 3.85 times higher compared to those women using long-acting family planning [AOR=3.8; 95% CI:1.2-12.2].

The odd of grand multiparity was 4.5 times higher among women who had their first births before 18 years old compared to those after 18 years old [AOR=4.5; 95% CI: 2.6–7.9]. The odd of grand multiparity was 4.2 times higher for those who were in polygamous marriage compared to those in monogamy [AOR=4.2; 95% CI: 2.0–9.3]. In addition, the likelihood of grand multiparity was 80% less likely to have met of contraceptive compared to those women who have met

contraceptive) [AOR=0.2; 95% CI: 0.09 -0.83]. The odd of grand multiparity was 2.3 times higher among women who had short birth intervals compared to those women with normal birth intervals [AOR=2.3; 95% CI: 1.4-3.5]. The odd of grand multiparity was 5.8 times higher among women whose husbands had primary education compared to those who attended secondary schools and above [AOR=5.8; 95%CI: 2.1–16.1]. Also, the odd of grand multiparity was 3.4 times higher among women whose husbands lack formal education compared to those women husbands had secondary level of education and above [AOR=3.4; 95%CI: 1.2-9.9].

According to random-effect analysis; Model-I had no individual- and community-level variables and it observed only the random and intercept variables. About model I, the ICC value was 20%. This indicates that the variation on the grand multiparity occurred at the community level (between-cluster variability) and is contributable to the community-level factors. The ICC in the null model greater than zero indicates that it guided the researcher to use multilevel modeling than the standard single-level regression model. Also, results in subsequent models, between cluster variability found to be 14.4% in Model II (individual-level factors), 18.6% in Model III (communities level factors), and 14.5% in Model IV (combined individual and community level factors). In another way, the proportional change in variance (PCV) results indicated that the predictor variables to the null model better explained the factors associated with grand multiparity. The PCV finding for Model-II was (33.7%), in Model-III was (9.6%) and for Model-IV was (33.7%). The final Model (combined individual and community level factors) indicated 33.7% of the community-level variation on grand multiparity was explained by the combined factors at both the individual and community levels (table 4).

Table 4: Multilevel logistic regression model of individual and community-level factors associated with grand multiparous women in Sidama national region state, Ethiopia using data from the 2016 EDHS.

Individual- and community-level variables	Model 1	Model 2	Model 3	Model 4
	Empty (Null)model	Individual-level variables AOR (95% CI)	Community-level variables AOR (95% CI)	Individual- and community-variables AOR (95% CI)
Educational level				
Have formal education		Ref.		Ref.
Lack of formal education		2 (1.24-3.74) **		2.2(1.3 -3.4) **
Sex of household head				
Female		Ref.		Ref.
Male		0.3(0.1 - 0.8) **		0.3(0.1-0.8) *
Wealth index combined				
Low		0.5(0.24 – 0.99) *		0.5(0.2-1)
Middle		1.4 (0.66 – 2.96)		1.4 (0.7-3.0)
High		Ref.		Ref.
Age of women at first birth				
Greater than or equal 18 years		Ref.		Ref.
Less than18 years		4.5 (2.6 – 7.9) ***		4.5(2.6 –7.9) ***
Contraceptive methods used				
Not using any methods		3.8(1.2 -12.2) *		3.8 (1.2- 12.2) *
Short-acting family planning		2.2(1.1– 4.5) *		2.2(1.1 -4.4) *
Long-acting family planning		Ref.		Ref.
Husband occupation status				
Professionals		2.2(1.0 -4.7)		2.2(1.03 -4.8) *
Merchant		0.5(0.3 – 0.9) *		0.5(0.3-0.9) *
Agriculture/Farmer		Ref.		Ref.
Husband desire more child				
Husband wants fewer		Ref.		Ref.
Husband wants more		1.4(0.7- 2.6)		1.3(0.7-2.6)
Both want more		1.3(0.7- 2.4)		1.3(0.7-2.4)

Polygamy/ number of other wives No Yes		Ref. 4.2 (1.9 -9.3) ***			Ref. 4.2 (2.0 – 9.3) *
Age at first sex Less than or equal to 18 years Greater than 18 years		Ref. 3.8(1.9 - 7.9) ***			Ref. 3.9(1.9- 8.1) ***
Unmet need of contraceptive Unmet Met Infecund/Menopausal		Ref. 0.2 (0.07- 0.5) *** 1.1 (0.3 -3.3)			Ref. 0.2(0.1 -0.5) *** 1.1(0.34-3.26)
Preceding birth interval (months) Greater than 36 months Less than or equal to 36 months		Ref. 2.3(1.4- 3.5) ***			Ref. 2.3(1.4 -3.5) ***
Husband education level Lack of formal education Primary education Secondary education and above		3.4 (1.2- 10.0) * 5.9(2.2 – 16.2) *** Ref.			3.4(1.2-9.9) * 5.8(2.1 – 16.1) *** Ref.
Religion Orthodox Protestant Muslim			Ref. 4.9(1.8 -13.4) ** 2.6 (0.8 - 8.4)		
Type of place of residence Urban Rural			Ref. 6.6(1.29 -33.8) *		Ref. 1.2(0.2- 10.7)
Random effect Community-level variance (SE) ICC (%) MOR PCV	0.83*** (0.4) 20% 2.4 Reference	0.55***(0.3) 14.4% 2.0 33.7%	0.75*** (0.4) 18.6% 2.3 9.6%		0.56 *** (0.3) 14.5% 2.0 33.7%

Model fit statistics				
Log-likelihood	-523	-281	-513	-281
AIC	1050	602	1036	604
BIC	1059	692	1059	698

Note: *significant at *P < 0.05; ** P < 0.01; *** P < 0.001; AOR =Adjusted Odds Ratio, CI =Confidence Interval, AIC =Akaike information criterion, BIC =Bayesian information. criterion, Model 1-Empty (null) model; Model 2- Only individual-level explanatory variables included in the model; Model 3-Only community-level explanatory variables included in the model; Model 4-Combined model; PCV= Proportional Change in Variance, MOR= Median Odds Ratio and Ref.=reference.

Discussion

Seven out of ten reproductive-age women had experienced grand multi-parity. Age at marriage, literacy status of women, age of women at first birth, modern contraceptive method utilization, polygamy, husband education level, preceding birth interval and unmet need of contraceptive were significantly associated with women having high parity.

During the analysis, the ICC value was found to be 14.5% in the combined Model. This indicates that 14.5% of the chances of grand multiparous women were explained through cluster differences. The ICC in the null model greater than zero indicates that it guided the researcher to use multilevel modeling than the standard single-level regression model [35, 37, 38]. Similarly, the study indicates that the proportion change in variance of the final model was accountable for about 33.7% in the log odds of high parity in the communities. In addition to that, the results of median odds ratio, a measure of unexplained cluster heterogeneity, is 2.48, 3.51, 2.43, and 3.34 in models 1, 2, 3, and 4, respectively. Hence, the results of the median odds ratio showed that there is unexplained variation between the clusters of the community.

In the present study, the magnitude of grand multiparity was 70.8 %. This is similar to a study conducted community-based in Gedeo Zone 69.1 % and Tigray region, Ethiopia 51 % [22, 26]. This figure was quite higher than the prevalence reported by other investigators ranging from 9.4 % to 27% in Gambian, Cameroon, Nigeria, Tanzania, and India [2, 30, 31, 39, 40]. The fact that later studies were all carried out in health facilities and urban catchment areas could explain these low prevalence rates. The educational backgrounds, socioeconomic, sociodemographic, and cultural settings of these studies are different from the current findings[28]. Similarly, there are many contributing factors for high fertility, among which are early marriage, the perceived ideal number of children, and mass media exposure by women [22, 33]. While the prevalence of grand

multiparity in developed countries has significantly declined ranging from 3 to 4 % [41], it has increased in the current study and this could be explained by lack of formal education (75.8%) and a high number of early marriages. As individual health implications, the women are given more subsequent births while they get more maternal and child health risks and many socioeconomic challenges in their lifetime in low resource setting areas [21, 32, 42, 43].

The trends of grand multiparity over study periods showed no significant change. This finding was consistent with a previous study done in rural Cameroon[28]. However; in Tanzania, the previous study's findings showed a significant change of trend on grand multiparity [23]. This decline could have been explained by the availability of higher education to women and increased community awareness on the health risks of giving birth at an advanced maternal age and benefits of family planning and empowerment of women on reproductive health decision making[23].

This study revealed that grand multiparity was higher among women who had their first births before 18 years old compared to those women who started after 18 years. We realized that in the study community where women start birth before 18 years, the period of fertility is longer, and they have many ever-born children. As a result of these, the women have high parity. Similarly, the women not using modern family planning appropriately and timely for spacing and limiting the number of births have high fertility. This is similar to the previous study done in Gedeo Zone, Ethiopia [22], Nigeria[44], Nepal [33], and Pakistan [25]. Nevertheless, the problem of early age at first delivery is significantly alarming in the present study area than the previous findings.

The odds of grand multiparity compared to that of multiparity were higher among women who were illiterate compared with literate women. This finding is in line with previous studies conducted in Nigeria[44], Kenya[24], Nepal[33], and the Tigray region in Ethiopia[26]. In this study, almost all of the women were rural dwellers (99%). Women who are rural inhabitants are

less likely to spend much time in school and would rather get married early. A possible explanation is that women residing in the urban area stay longer in school, thereby postponing the time for marital engagement[22]. On the other hand, researchers found that education is an important factor for high parity with several causal relationships from a theoretical perspective[45]. To sum up, education generally results in an improvement in the status of individuals in society in the form of a better understanding of health issues, and employment status [46]. The low social class found among the grand multiparous women are usually associated with illiteracy and low socioeconomic status which may be an encouraging factor to produce more children[11]

The grand multiparity was higher among women with short birth intervals (less than or equal to 36 months). This finding is also consistent with a study conducted in Wonago District, Gedeo Zone, Ethiopia [22]. The possible explanation might be due to women utilizing modern contraceptives that lead the women to get more children in a short period of time.

In our study, it was found that grand multiparity is significantly associated with polygamous marriage compared with monogamous marriage. This finding is similar to other studies conducted in Nigeria[1]. The variation could be due to competition amongst wives to have many children and to build large family sizes.

The grand multiparity among women not using any contraceptive and using short-acting contraceptive methods was higher compared to those women using long-acting contraceptives. Similar findings were reported in Nigeria [44], Cambodia[47], Pakistani [25], and Wonago District, Gedeo Zone[22]. Most factors in this study are directly or indirectly associated with the low utilization of contraceptives which indicated that it is the root cause for high fertility in the study setting. In addition, in one study, the women were not using contraceptives because their husbands did not allow them to make contraceptive decisions[47].

Conclusions

This study revealed that seven of ten women had experienced grand multiparity and the magnitude did not show significant change over the last sixteen years. Early marriage and early age of first birth, low literacy level, low family planning utilization, polygamy marital status, short birth interval, and unmet need of family planning were determinants of grand multiparity. We recommended to the stakeholders to design new strategies to address the root cause of high fertility factors in communities. Health ministry should focus on health education and create awareness about maternal health risks related to grand multiparity in the community. Furthermore, special attention should be given to improving the utilization of contraceptives in the community to reduce the prevalence of grand multiparity.

Author Contributions.

All authors made a significant contribution to the work reported, whether at the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Abbreviations

AIC, Akaike's Information Criterion; AOR, Adjusted Odd Ratio; BIC, Bayesian Information Criterion; CI, Confidence Interval; DHS, Demographic and Health Survey; EDHS, Ethiopia Demographic Health Survey; LR, Likelihood Ratio; MOR, Median Odds Ratio; PCV, Proportional Change Variance; SD, Standard Deviation; VIF, Variance Inflation Factors and WHO, World Health Organization.

Data Sharing Statement

The data retrieved for this research are available upon request from the (DHS) program official database website (***http://dhsprogram.com***). All relevant data are in the paper and its Supporting Information files.

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Ethical aprroval

This study does not involve human participants. The data were retrieved from the DHS website (http://www.measuredhs.com) after permission was obtained (AuthLetter_145712). The accessed data were used for this registered research only. The data were preserved as confidential, and no effort was made to detect any household or individual respondent.

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Not applicable

Disclosure

The authors report no conflicts of interest in this work.

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Fig 1: *The magnitude of grand multiparity in Sidama region, data from EDHS 2016.*

Fig 2: Trend of grand multiparous women in Sidama national regional state, Ethiopia, DHS data from years 2,000 to 2016.

Fig 1:

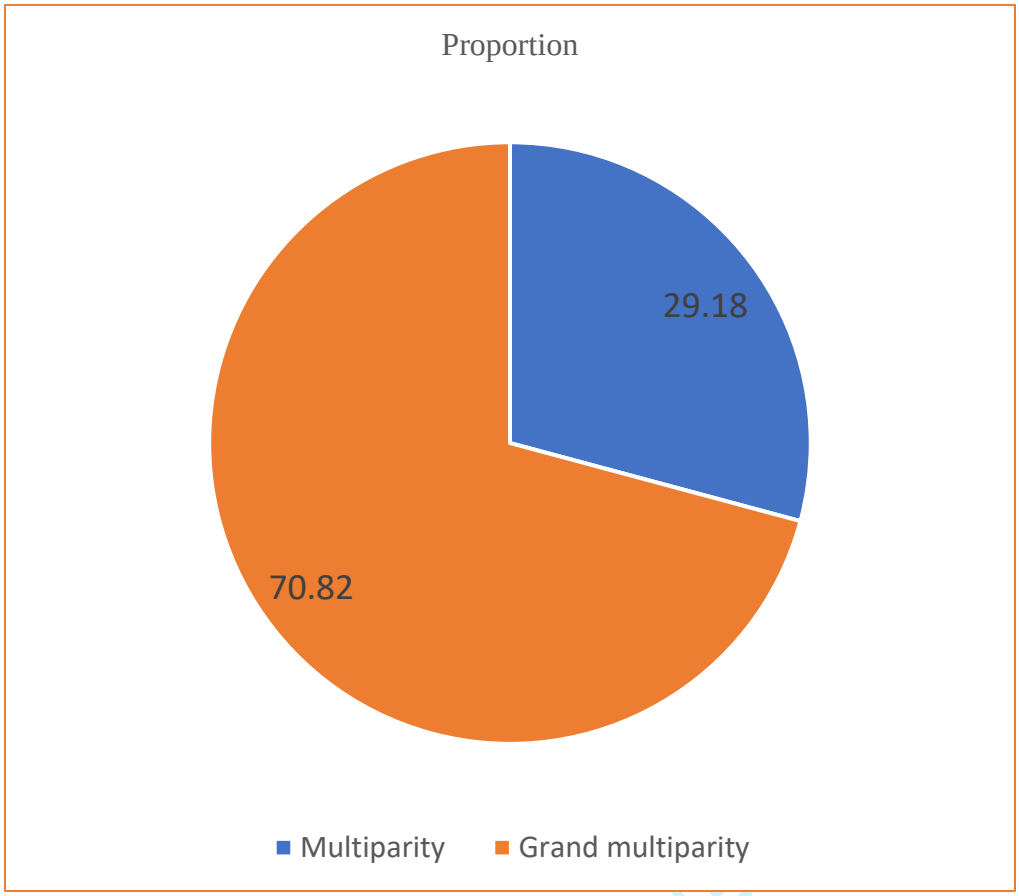
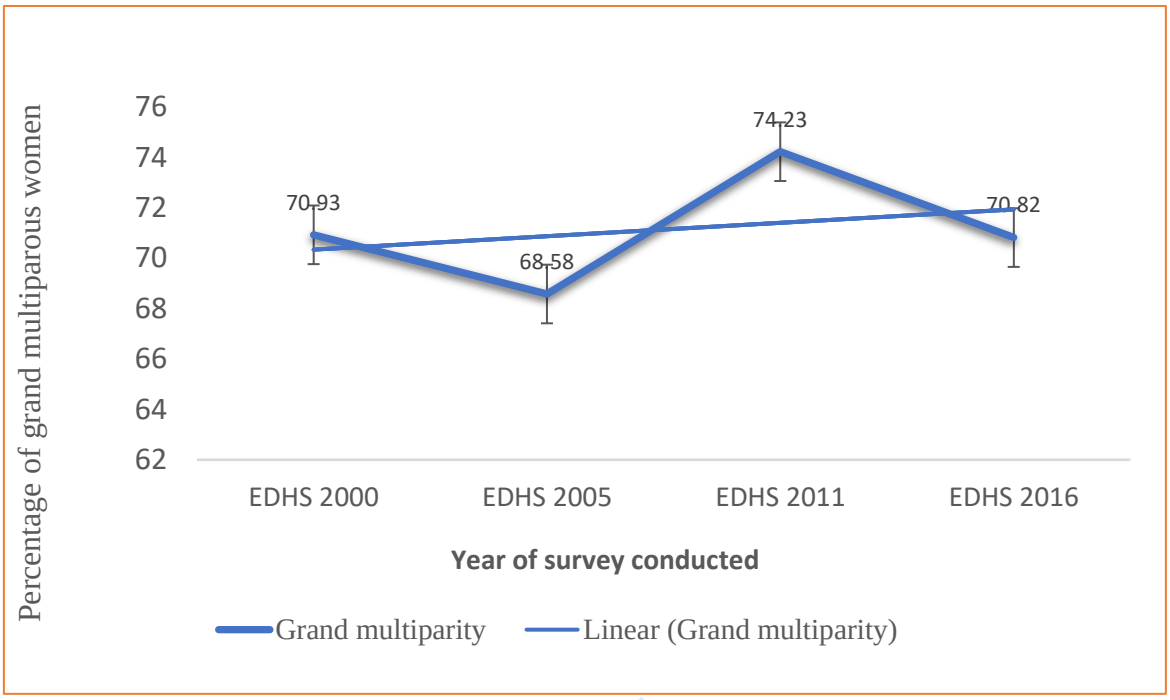


Fig 2:



Reporting checklist for cross sectional study.

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	5
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4&5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5&6
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	5

Bias	#9	Describe any efforts to address potential sources of bias	NA
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	6
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7
Statistical methods	#12c	Explain how missing data were addressed	NA
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	7
Statistical methods	#12e	Describe any sensitivity analyses	NA
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	8
Participants	#13b	Give reasons for non-participation at each stage	NA

Participants	#13c	Consider use of a flow diagram	NA
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	9
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	11
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15
Main results	#16b	Report category boundaries when continuous variables were categorized	12
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	#18	Summarise key results with reference to study objectives	18

Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	2
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	18,19 & 20
Generalisability	#21	Discuss the generalisability (external validity) of the study results	21
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

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A Multilevel Analysis of Grand Multiparity: Trend and its determinants in the Sidama National Region State of Ethiopia: A Cross Sectional Study Design from Demographic and Health Survey 2000 to 2016.

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A Multilevel Analysis of Grand Multiparity: Trend and its determinants in the Sidama National Region State of Ethiopia: A Cross Sectional Study Design from Demographic and Health Survey 2000 to 2016.

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Word count= 3621

Abstract

Objective: The study was aimed at examining the magnitude, trends, and determinants of grand multiparity in the Sidama regional state of Ethiopia.

Design: We retrieved cross-sectional data from the Ethiopian demographic health survey from 2000 to 2016.

Setting: Community-based demographic health survey was conducted in Ethiopia.

Participants: The study population was women (aged 15 to 49 years) who had delivered children with the available DHS data set.

Outcomes: Multilevel multivariate logistic regression analyses assessed the relationship between grand multiparity and its determinants.

Results: The magnitude of grand multiparity was 70.8% (95% CI: 68.5-72.9). The multilevel multivariable logistic regression model showed illiteracy [AOR=2; 95%CI:1.25-3.75], non-use of any contraceptive [AOR=3.8; 95% CI:1.2-12.2], early marriage [AOR=4.5; 95% CI: 2.6-7.9], polygamous marriage [AOR=4.2; 95% CI:2.0-9.3], short interbirth intervals [AOR=2.3; 95% CI:1.4-3.5] and husband low education status [AOR=5.8; 95%CI:2.1-16.1] were significantly associated with grand multiparity.

Conclusions: This study revealed that seven of ten women were grand multipara, and the magnitude did not show significant change over the last sixteen years. Early marriage and early age of first birth, low literacy level, low family planning utilization, polygamy, short inter-birth interval, and unmet need for family planning were determinants of grand multiparity. We

recommended to the stakeholders design new strategies to address the root cause of high fertility factors in communities.

Keywords: High parity, High fertility, Grand multiparity, Multilevel analysis, Sidama, Ethiopia.

Strengths and Limitations of this study

- The strength of this study included analyzing the most recent nationally representative data sets aided in providing a broad comparative picture of grand multiparity in the study setting, as well as significant predictors of children ever born among ever-married women.
- To avoid misleading inferences and thus valid interpretation of the results, clustering effects were considered using a mixed modeling approach.
- Despite the above strengths, the study may have had recall bias because participants were asked about events that occurred 5 years or more before the survey.
- Also, we used secondary datasets, we were limited in our ability to select exposure variables for statistical analysis.

Background

Grand multiparty, a situation when a woman has at least five deliveries at gestational age greater than or equal to 20 weeks, is a major public health concern in developing countries particularly in sub-Saharan Africa [1-3]. Its obstetric performance is considered as high risk which is defined as the one in which the woman, fetus, and/or newborn are at increased risk of morbidity or mortality prenatal, intra-partum or postpartum [4]. In this regard, there is a high disparity in the fertility rates between the developed and developing countries [5]. The factors responsible for the huge disparity are usually neglected in existing family planning and reproductive health programs which causes

the grand multi-parity to be a serious public health problem worldwide, particularly in developing countries including Ethiopia [6, 7].

While the global fertility rate declined from 3.2 live births per woman in 1990 to 2.5 in 2019, the magnitude increased to 4.6 in 2019 in sub-Saharan Africa including Ethiopia which indicates a high fertility rate [8-10].

Various factors have been identified to be associated with the grand multi-parity and these include early age at first marriage, low socio-economic status, polygamous marriage [11], husband's preference, culture, religion, and residence in a rural area. Others are low literacy level, poor mass media exposure, low level of awareness of health, and lack of access to modern contraceptives especially in most sub–Saharan Africa [1, 12, 13].

According to studies conducted in some developing countries, grand multipara women have a higher number of children than women in developed countries. Indeed, many factors contribute to grand multiparity, but some published literature identified the factors for grand multiparity in low and lower-middle-income countries [1, 14-16]. Still, grand multiparity has not been well-addressed as there is a dearth of evidence on a larger scale. Also, there were inadequate studies carried out on the trend, magnitude, and associated factors of grand multiparity by using national representative demographic health survey data (DHS). Therefore, this study was carried out to assess the trend and associated factors of grand multiparity using demographic and health survey data for the Sidama region from 2000 to 2016. The findings will assist program managers and policymakers in developing appropriate intervention strategies to effectively address the challenges and problems of grand multipara women in order to prevent high parity in the community in terms of reproductive health services at all levels.

Methods and materials

Study area and period

Sidama national regional state is one of the 10 national regional states in Ethiopia. The region is divided into 36 Districts (6 urban districts and 30 rural districts). Hawassa city is the capital of the region, and it is situated in the Southern part, about 273 Kilometers away from Addis Ababa, Ethiopia's capital. The Sidama people number 8.8 million (4.01% of the national population) and are the fifth most populous ethnic group in Ethiopia. Sidama national region state has 123 health centers and 17 hospitals[10, 17-20]. For this study, we used secondary data from the 2000 to 2016 Ethiopia demographic health and survey (DHS). The DHS data had been collected from January 18, 2016, to June 27, 2016, by the Ethiopian Central Statistical Agency (ECSA)[10].

Study design, data source, and sampling techniques

A cross-sectional survey data was obtained from 2000 to 2016 (EDHS). The data were retrieved from the (DHS) program's official database website (***http://dhsprogram.com***). It is a nationally representative household survey that collects information about population, health, and other important indicators. The sample of the EDHS study was designed to collect up-to-date information from each of the ten regions and the two administrative cities. Each region was stratified into urban and rural areas 21 sampling strata were obtained. Samples of enumeration areas (EAs) were selected independently in each stratum in two stages. In the first stage, a total of EAs was selected with a proportional sampling technique and with independent selection in each sampling stratum. The selection of households was the second stage. A fixed number of households per cluster were selected with an equal probability proportional allocation to sample size was done [10].

This study used the birth record dataset, and the study population was women (aged 15 to 49 years) who had delivered children with the available DHS data set. From the birth record dataset, the total number of multiparous (para 2 to 4) and grand multiparous (para 5 to 9) women was extracted for Sidama national region state from 2016 EDHS. The total sample was extracted for women who gave birth (parity 2 to 9) from the birth record dataset. The total number of women whose parity (2 to 9) in the study region of Ethiopia was included in 1,654 weighted samples. For trend analysis, grand multipara in all the four DHS data from 2000 to 2016 were extracted by using the quantitative method [10, 21-23].

Study variables

Dependent variable: The outcome variable of this study was grand multiparity which was categorized into "Yes = 1/ No = 0" form. These include all women who have five to nine deliveries as grand multi-parity categories [1, 2, 24].

$$Yi = \begin{cases} 0; \text{ Multiparity, for the women had given birth 2 to 4 times.} \\ 1; \text{ Grand multiparity, for the women who had given birth 5 to 9 times.} \end{cases}$$

Yi = represent the parity of the i^{th} ever born children.

Independent variables: The independent variables for this study were identified based on previous studies conducted on the factors affecting grand multiparity at the different places that were reviewed from the literature as associated factors of grand multiparity [11, 14, 25-35]. The independent variables selected for analysis from the available dataset were the place of residence, maternal age, educational status of women, wealth index, current marital status, polygamy marriage, women currently working, religion, husband education level husband occupation status, women supported by husband, community media exposure, age of women at first birth, age at first sex, number of living children, preceding birth interval (months), the contraceptive method

used, unmet need of contraceptive, the desire for more children, the child being alive, place of delivery, and husband's desire for more children. In this analysis, independent variables were categorized into individual-level variables and community-level variables. Individual-level variables were the age of women, women's education status, wealth index, women's age of first birth, number of living children, current marital status, polygamy marriage, women's age at first sex, desire for more children, contraceptive method, unmet need of contraceptive, women currently working, the child is alive, preceding birth interval (months), place of delivery, women supported by husband, husband education status, husband occupation status, husband desire for more children. Community-level variables were religion, place of residence (rural or urban), and community media exposure.

Data Analysis

For analysis, the weighted sample data were used to ensure the survey results were representative of the regions. Based on each weighted variable, the descriptive statistics were reported with summary indices, frequency, and proportion. The trend analysis of grand multiparity was assessed using the Extended Mantel-Haenszel Chi-square test for linear trend using the OpenEpi (version 3.01)- Response program[36]. A P-value of less than 0.05 was used to declare a 95% significant probability of the existence of a trend. The degree of crude association for individual and community variables was checked by employing a χ^2 test.

For the nested structure of the EDHS data, multilevel multivariable logistic regression analysis was used. Also, for the mixed effect (fixed effect for both the individual and community level factors and a random effect for the between cluster-variation), a two-level mixed-effect logistic regression analysis was used. The final findings were measured using an adjusted odds ratio (AOR). Within the multilevel multivariable logistical regression analysis, four models were fitted

for the result variable. The primary model (null or empty model) was fitted without explanatory variables. The second model (individual model), third model (community model), and fourth model (final model) variables were fitted for individual level, community-level, and each individual- and community-level variable respectively. The final model was used to check for the independent effect of the individual and community level variables on grand multiparity. To show cluster correlation within a model, the Intra-Cluster Correlation (ICC) was calculated. The Proportional Change in Variance (PCV) was also calculated to determine the predictive power of the variables included in each model. To identify the factors associated with grand multiparity, the model with the highest PCV value was used.

The model fitness was assessed using Akaike Information Criterion (AIC), the Bayesian information criterion (BIC), and the Likelihood Ratio (LR) test. The values for each model of AIC and BIC were compared, the lowest one assumed to be a better explanatory model[37]. Multicollinearity between the individual- and community-level variables was checked using the Variance Inflation Factor (VIF). The mean value of VIF < 10 was the cut-off point[38]. In the present study, the mean VIF value was estimated to be 2.44 showing the absence of multicollinearity in the models. The data were analyzed using the STATA statistical software system package version 14.0 (StataCorp., College Station, TX, USA). It was considered statistically significant if the P-values were less than 0.05 with the 95% confidence intervals.

Patient and Public Involvement

No patient was involved in this study.

Results

Socio-demographic characteristics of study participants

In this study, a total weighted sample of 1,654 women was included in the analysis from the latest EDHS data (2016). The mean age (±SD) of the women was 35±6.7 years with the majority of women aged between 40-49 years. Almost all (99%) of women lived in a rural setting, and close to two-thirds (67%) of women were illiterate. Slightly more than half (55%) of the women were under a low level of socio-economic status. Almost all of them were married (93%) and follow the protestant religion (92%). More than three-fourths (77%) of the women were not supported by their husbands to do day-to-day chores. In addition, the majority of husbands had attended formal education and had different types of occupations. The summarized information on socio-demographic background is displayed below (table 1).

Table 1: Sociodemographic characteristics of study participants in the Sidama national region state, data from 2016 Ethiopia demographic health and survey.

Individual and community Variables	Categories	Weighted (No_)	Weight (%)
Place of residence	Urban	13	0.75
	Rural	1641	99.25
Age in years	20-29	329	19.87
	30-34	441	26.66
	35-39	413	25.00
	40-49	471	28.47
	Mean ±SD	35±6.7	
Educational status	Have formal education	532	32.16
	No formal education	1122	67.84
Wealth index	Low	912	55.14
	Middle	357	21.58
	Higher	385	23.28
Current marital status	Other marital statues	110	6.66
	Married	1544	93.34
Polygamy	No	1205	77.09
	Yes	357	22.91
Women currently working	No	942	56.94
	Yes	712	43.04

Religion	Orthodox Catholic Protestant Muslim	16 27 1535 76	0.97 1.63 92.80 4.59
Husband education level	Lack of formal education Primary education Secondary education and above	504 944 114	32.28 60.41 7.31
Husband occupation status	Professionals Merchant Agriculture/Farmer	187 262 1,114	11.96 16.74 71.30
Women supported by husband	No Yes	1216 347	77.82 22.18
Community media exposure	No Yes	1122 532	67.82 32.18

Sexual and reproductive health characteristics of study participants

The mean age (±standard deviation) of women at first delivery was 17.69 ± 2.75 years and at first coital exposure was 16±2.6 years. The women's mean number of living children was 4.9 with a ±1.8 standard deviation. About two-thirds (64.8%) of women had short birth intervals within or less than 36 months. Among participants, a considerable proportion of women (45.81%) did not utilize modern contraceptives. Nearly, one-out of ten women (10.9%) had experienced child death in the survey. Slightly more than three-fourths (80%) of women gave birth at home (table 2).

Table 2: Fertility, sexual and reproductive health characteristics of study participants in Sidama regional state, data from 2016 Ethiopia Demographic and Health Survey.

Individual-level variables	Categories	Frequency	Percent (%)
Age of women at first birth	Less than18 years Greater than or equal to 18 years Mean ±SD	1,077 577 17.69±2.75	65.11 34.89
Age at first sex	Less than or equal to 18 years Greater than 18 years Mean ±SD	1356 298 16± 2.6	81.98 18.02
Number of living children	Mean ±SD	4.9 ±1.8	
Preceding birth interval (months)	Less than or equal to 36 months Greater than 36 months Mean ±SD	844 459 34.47 ± 18.6	64.8 35.2
Contraceptive method used	Not using any methods	758	45.81

	Short-acting family planning	680	41.13
	Long-acting family planning	216	13.06
Unmet need of contraceptive	Unmet of contraceptive	219	13.25
	Met of contraceptive	1,313	68.51
	Infecund/Menopausal	302	18.24
The desire for more children	Wants no more children	1,106	66.84
	Wants more children	548	33.16
Husband desire more child	Husband wants fewer	357	23.02
	Husband wants more	583	37.56
	Both want more	611	39.42
Child is alive	No	181	10.95
	Yes	1473	89.05
Place of delivery	Home	251	80.0
	Health facilities	62	20.0

The magnitude of grand multi-parous women

The prevalence of grand multiparity with the weighted sample was 70.8 % (95 % CI, 68.5 - 72.9), in the 5 years preceding the survey in the Sidama region. Evidence from 2016 EHDS (Figure 1).

The trend of grand multiparous women

The magnitudes of the grand multi-parity were 70.93 % in 2000 EDHS, 68.58 % in 2005 EDHS, 74.23 % in 2011 EDHS, and 70.82 % in 2016 DHS in the Sidama national region state. Over 16 years, the trend of grand multiparous women from four surveys showed no significant change (Extended Mantel-Haenszel chi-square for leaner trend= 1.13 and P-values= 0.29). Likewise, no percentage change was observed between 2000 and 2016 EDHS in the Sidama region (Figure 2).

Bivariate variables association with grand multi-para women

With regards to education status, the lack of formal education (75.8%) was significantly higher in grand multiparous women than in multipara (48.6%), (P<0.001). An enormous number of women in both groups were of the poorest and poorer statuses on the wealth index. The unmet need for contraceptives and underutilization of long-acting family planning utilization was significantly

higher in grand multipara than multipara (p<0.001). Among grand multipara, women in polygamous marriages were significantly higher compared with multipara women, (p<0.001). Likewise, the age of women at first birth, short birth intervals, husband education level, number of living children, and place of residence showed significant associations in both study groups, (p<0.001).

However, no significant differences were observed between grand multipara and multiparous regarding women currently working, place of delivery, the child is alive, current marital status, husband occupation status, and community media exposure, (P> 0.05), (table 3).

Table 3: Bivariate variables association of individual and community level variable with grand multipara and multiparous women in Sidama national region state, Ethiopia, data from EDHS 2016.

Individual and community Variables	Categories	Multiparous No_ (%)	Grand Multipara No_ (%)	P-value
Age in year	Mean ± SD	29.4 ± 0.3	37.7 ± 0.2	p<0.001
Educational level	Lack of formal education Have formal education	234(20.9) 248(46.7)	888(79.1) 283 (53.3)	p<0.001
Wealth Index	Poorest Poorer Middle Richer Richest	134(28.9) 146(32.5) 89(24.8) 54(25.2) 61(35.2)	329(71.1) 303(67.5) 269(75.2) 159(74.8) 112(64.8)	p=0.049
Age of women at first birth	Mean ± SD	18.8±2.9	17.5± 2.6	p<0.001
Number of living children	Mean ± SD	2.8± 0.8	5.8 ±1.4	p<0.001
Current marital status	Other marital statues Married	30(26.8) 453(93.9)	80(73.2) 1,091(93.1)	P=0.74
Polygamy marriage	No Yes	426(35.3) 34(9.6)	780(64.7) 322(90.4)	p<0.001
Age at first sex	Mean ± SD	16.56±2.77	16.13±2.52	P=0.022
The desire for more children	Not want more children Want more children	178(16.1) 305(55.5)	927(83.9) 244(44.5)	p<0.001
Unmet need of contraceptive	Unmet Met Infecund/Menopausal	36(16.6) 414(36.5) 33(10.7)	183(83.4) 719(63.5) 269(89.3)	p<0.001

Women currently working	No Yes	270(28.6) 213(29.9)	672(71.4) 499(70.1)	P= 0.594
Child is alive	No Yes	34(19.0) 448 (30.4)	147(81.0) 1,025(69.6)	P=0.098
Preceding birth interval (months)	Mean ± SD	40±21.9	32.6±16.9	p<0.001
Place of delivery	Home Health facilities	138(54.8) 34(61.5)	114(45.2) 22(38.5)	p=0.262
Religion	Orthodox Protestant Muslim	21(47.3) 428(28.0) 33(43.8)	23(52.7) 1,106(72.0) 43(56.2)	P=0.025
Women supported by husband	No Yes	326(26.8) 132(38.6)	890(73.2) 213(61.4)	P=0.007
Husband education level	Lack of formal education Primary education Secondary education and above	115(22.7) 281(29.8) 65(56.7)	390(77.3) 663(70.2) 50(43.3)	p<0.001
Husband occupation status	Professionals Merchant Agriculture/Farmer	39(21.0) 90(34.5) 331(29.7)	148(79.0) 171(65.5) 783(70.3)	P = 0.064
Husband desire more child	Husband wants fewer Husband wants more Both want more	112(31.2) 123(21.1) 226(37.0)	246(68.8) 460(78.9) 385(63.0)	P =0.012
Contraceptive method used	Not using any methods Short acting family planning Long-acting family planning	196(25.8) 212 (31.1) 75(34.9)	562(74.2) 469(68.9) 141(65.1)	P = 0.167
Place of residence	Urban Rural	11(83.6) 472(28.8)	2(16.4) 1,169(71.2)	P<0.001
Community media exposure	No Yes	337(30.0) 146(27.5)	786(70.0) 386(72.5)	P=0.905

Determinants of grand multiparity

We applied a two-level mixed effect multivariable logistic regression using the extracted data from 2016 DHS for the Sidama national regional state that is aimed at identifying individual and community-level determinants of grand multiparity or women having high parity. Those four models were developed to analyze factors accordingly. According to random-effect analysis; Model-I had no individual- and community-level variables and it observed only the random and intercept variables. In model I, the ICC value was 20%. This indicates that the variation on the grand multiparity occurred at the community level (between-cluster variability) and is

contributable to the community-level factors. The ICC in the null model greater than zero indicates that it guided the researcher to use multilevel modeling than the standard single-level regression model. Also, results in subsequent models, between cluster variability were found to be 14.4% in Model II (individual-level factors), 18.6% in Model III (communities level factors), and 14.5% in Model IV (combined individual and community level factors). In another way, the proportional change in variance (PCV) results indicated that the predictor variables to the null model better explained the factors associated with grand multiparity. The PCV finding for Model-II was (33.7%), for Model-III was (9.6%) and for Model-IV was (33.7%). The final Model (combined individual and community level factors) indicated 34% of the community-level variation on grand multiparity was explained by the combined factors at both the individual and community levels. The result was reported based on Model IV (combined individual and community level factors were fitted simultaneously). As a result, variables such as educational level, age of women at first birth, contraceptive methods used, husband occupation status, polygamy, age of first sex, unmet need for contraception, preceding birth interval, and husband education level was significantly associated with grand multiparous women, according to Model IV findings. .

The odds of grand multiparity compared to multiparity were 2 times [AOR=2; 95 % CI:1.25-3.75] higher among women who were uneducated compared with women who were educated. The odds of grand multiparity compared to those multiparous women not using any contraceptive method were 3.85 times higher compared to those women using long-acting family planning [AOR=3.8; 95% CI:1.2-12.2].

The odd of grand multiparity was 4.5 times higher among women who had their first births before 18 years old compared to those after 18 years old [AOR=4.5; 95% CI: 2.6–7.9]. The odd of grand multiparity was 4.2 times higher for those who were in polygamous marriages compared to those

in monogamy [AOR=4.2; 95% CI: 2.0–9.3]. In addition, the likelihood of grand multiparity was 80% less likely to have met contraceptive compared to those women who have met contraceptive) [AOR=0.2; 95% CI: 0.09 -0.83]. The odd of grand multiparity was 2.3 times higher among women who had short birth intervals compared to those women with normal birth intervals [AOR=2.3; 95% CI: 1.4-3.5]. The odd of grand multiparity was 5.8 times higher among women whose husbands had primary education compared to those who attended secondary schools and above [AOR=5.8; 95%CI: 2.1–16.1]. Also, the odd of grand multiparity was 3.4 times higher among women whose husbands lack formal education compared to those women husbands who had a secondary level of education and above [AOR=3.4; 95%CI: 1.2-9.9].

(table 4).

Table 4: Multilevel logistic regression model of individual and community-level factors associated with grand multiparous women in Sidama national region state, Ethiopia using data from the 2016 EDHS.

Individual- and community-level variables	Model 1	Model 2	Model 3	Model 4
	Empty (Null)model	Individual-level variables AOR (95% CI)	Community-level variables AOR (95% CI)	Individual- and community-variables AOR (95% CI)
Educational level				
Have formal education		Ref.		Ref.
Lack of formal education		2 (1.24-3.74) **		2.2(1.3 -3.4) **
Sex of household head				
Female		Ref.		Ref.
Male		0.3(0.1 - 0.8) **		0.3(0.1-0.8) *
Wealth index combined				
Low		0.5(0.24 – 0.99) *		0.5(0.2-1)
Middle		1.4 (0.66 – 2.96)		1.4 (0.7-3.0)
High		Ref.		Ref.
Age of women at first birth				
Greater than or equal to 18 years		Ref.		Ref.
Less than18 years		4.5 (2.6 – 7.9) ***		4.5(2.6 –7.9) ***
Contraceptive methods used				
Not using any methods		3.8(1.2 -12.2) *		3.8 (1.2- 12.2) *
Short-acting family planning		2.2(1.1– 4.5) *		2.2(1.1 -4.4) *
Long-acting family planning		Ref.		Ref.
Husband occupation status				
Professionals		2.2(1.0 -4.7)		2.2(1.03 -4.8) *
Merchant		0.5(0.3 – 0.9) *		0.5(0.3-0.9) *
Agriculture/Farmer		Ref.		Ref.
Husband desire more child				
Husband wants fewer		Ref.		Ref.
Husband wants more		1.4(0.7- 2.6)		1.3(0.7-2.6)
Both want more		1.3(0.7- 2.4)		1.3(0.7-2.4)

Polygamy/ number of other wives No Yes		Ref. 4.2 (1.9 -9.3) ***			Ref. 4.2 (2.0 – 9.3) *
Age at first sex Less than or equal to 18 years Greater than 18 years		Ref. 3.8(1.9 - 7.9) ***			Ref. 3.9(1.9- 8.1) ***
Unmet need for contraceptive Unmet Met Infecund/Menopausal		Ref. 0.2 (0.07- 0.5) *** 1.1 (0.3 -3.3)			Ref. 0.2(0.1 -0.5) *** 1.1(0.34-3.26)
Preceding birth interval (months) Greater than 36 months Less than or equal to 36 months		Ref. 2.3(1.4- 3.5) ***			Ref. 2.3(1.4 -3.5) ***
Husband education level Lack of formal education Primary education Secondary education and above		3.4 (1.2- 10.0) * 5.9(2.2 – 16.2) *** Ref.			3.4(1.2-9.9) * 5.8(2.1 – 16.1) *** Ref.
Religion Orthodox Protestant Muslim			Ref. 4.9(1.8 -13.4) ** 2.6 (0.8 - 8.4)		
Type of place of residence Urban Rural			Ref. 6.6(1.29 -33.8) *		Ref. 1.2(0.2- 10.7)
Random effect Community-level variance (SE) ICC (%) MOR PCV	0.83*** (0.4) 20% 2.4 Reference	0.55***(0.3) 14.4% 2.0 33.7%	0.75*** (0.4) 18.6% 2.3 9.6%		0.56 *** (0.3) 14.5% 2.0 33.7%

Model fit statistics				
Log-likelihood	-523	-281	-513	-281
AIC	1050	602	1036	604
BIC	1059	692	1059	698

Note: *significant at *P < 0.05; ** P < 0.01; *** P < 0.001; AOR =Adjusted Odds Ratio, CI =Confidence Interval, AIC =Akaike information criterion, BIC =Bayesian information. criterion, Model 1-Empty (null) model; Model 2- Only individual-level explanatory variables included in the model; Model 3-Only community-level explanatory variables included in the model; Model 4-Combined model; PCV= Proportional Change in Variance, MOR= Median Odds Ratio and Ref.=reference.

Discussion

Seven out of ten reproductive-age women had experienced grand multi-parity. Age at marriage, literacy status of women, age of women at first birth, modern contraceptive method utilization, polygamy, husband education level, preceding birth interval, and unmet need for contraceptives were significantly associated with women having high parity.

During the analysis, the ICC value was found to be 14.5% in the combined Model. This indicates that 14.5% of the chances of grand multiparous women were explained through cluster differences. The ICC in the null model greater than zero indicates that it guided the researcher to use multilevel modeling than the standard single-level regression model [37, 39, 40]. Similarly, the study indicates that the proportion change in variance of the final model was accountable for about 33.7% of the log odds of high parity in the communities. In addition to that, the results of the median odds ratio, a measure of unexplained cluster heterogeneity, are 2.48, 3.51, 2.43, and 3.34 in models 1, 2, 3, and 4, respectively. Hence, the results of the median odds ratio showed that there is unexplained variation between the clusters of the community.

In the present study, the magnitude of grand multiparity was 70.8 %. This is similar to a study conducted community-based in Gedeo Zone 69.1 % and Tigray region, Ethiopia 51 % [25, 29]. This figure was quite higher than the prevalence reported by other investigators ranging from 9.4 % to 27% in Gambian, Cameroon, Nigeria, Tanzania, and India [2, 33, 34, 41, 42]. The fact that later studies were all carried out in health facilities and urban catchment areas could explain these low prevalence rates. The educational backgrounds, socioeconomic, sociodemographic, and cultural settings of these studies are different from the current findings[31]. Similarly, there are many contributing factors to high fertility, among which are early marriage, the perceived ideal number of children, and mass media exposure by women [14, 25]. While the prevalence of grand

multiparity in developed countries has significantly declined ranging from 3 to 4 % [43], it has increased in the current study and this could be explained by lack of formal education (75.8%) and a high number of early marriages. As individual health implications, the women are given more subsequent births while they get more maternal and child health risks and many socioeconomic challenges in their lifetime in low resource setting areas [24, 35, 44, 45].

The trends of grand multiparity over study periods showed no significant change. This finding was consistent with a previous study done in rural Cameroon[31]. However; in Tanzania, the previous study's findings showed a significant change in the trend of grand multiparity [26]. This decline could have been explained by the availability of higher education to women and increased community awareness of the health risks of giving birth at an advanced maternal age and the benefits of family planning and empowerment of women in reproductive health decision-making [26].

This study revealed that grand multiparity was higher among women who had their first births before 18 years old compared to those women who started after 18 years. We realized that in the study community where women start birth before 18 years, the period of fertility is longer, and they have many ever-born children. As a result of these, women have high parity. Similarly, the women not using modern family planning appropriately and timely for spacing and limiting the number of births have high fertility. This is similar to the previous study done in Gedeo Zone, Ethiopia [25], Nigeria[46], Nepal [14], and Pakistan [28]. Nevertheless, the problem of early age at first delivery is significantly more alarming in the present study area than in the previous findings.

The odds of grand multiparity compared to that of multiparity were higher among women who were illiterate compared with literate women. This finding is in line with previous studies

conducted in Nigeria[46], Kenya[27], Nepal[14], and the Tigray region in Ethiopia[29]. In this study, almost all of the women were rural dwellers (99%). Women who are rural inhabitants are less likely to spend much time in school and would rather get married early. A possible explanation is that women residing in the urban area stay longer in school, thereby postponing the time for marital engagement[25]. On the other hand, researchers found that education is an important factor for high parity with several causal relationships from a theoretical perspective[47]. To sum up, education generally results in an improvement in the status of individuals in society in the form of a better understanding of health issues, and employment status [48]. The low social class found among the grand multiparous women is usually associated with illiteracy and low socioeconomic status which may be an encouraging factor to produce more children[11]

The grand multiparity was higher among women with short birth intervals (less than or equal to 36 months). This finding is also consistent with a study conducted in Wonago District, Gedeo Zone, Ethiopia [25]. The possible explanation might be due to women utilizing modern contraceptives that lead the women to get more children in a short period of time.

In our study, it was found that grand multiparity is significantly associated with polygamous marriage compared with monogamous marriage. This finding is similar to other studies conducted in Nigeria[1]. The variation could be due to competition amongst wives to have many children and to build large family sizes.

The grand multiparity among women not using any contraceptive and using short-acting contraceptive methods was higher compared to those women using long-acting contraceptives. Similar findings were reported in Nigeria [46], Cambodia[49], Pakistani [28], and Wonago District, Gedeo Zone[25]. Most factors in this study are directly or indirectly associated with the low utilization of contraceptives which indicated that it is the root cause of high fertility in the

study setting. In addition, in one study, the women were not using contraceptives because their husbands did not allow them to make contraceptive decisions[49].

Conclusions

This study revealed that seven of ten women had experienced grand multiparity and the magnitude did not show significant change over the last sixteen years. Early marriage and early age of first birth, low literacy level, low family planning utilization, polygamy marital status, short birth interval, and unmet need for family planning were determinants of grand multiparity. We recommended to the stakeholder's design new strategies to address the root cause of high fertility factors in communities. Ministry of health should focus on health education and create awareness about maternal health risks related to grand multiparity in the community. Furthermore, special attention should be given to improving the utilization of contraceptives in the community to reduce the prevalence of grand multiparity.

Contributions

TTD, MAK, and YD conceptualized the idea and designed the study; TTD and YD carried out the execution, data acquisition, analysis, interpretation, and wrote the draft manuscript; MAK and YD provided intellectual comments and contributed to revising the manuscript. All authors contributed to the revision of the manuscript's content and approved the final version. TTD accepts responsibility for the study's conduct, has access to the data, and has control over the decision to publish and the overall content of the manuscript.

Abbreviations

AIC, Akaike's Information Criterion; AOR, Adjusted Odd Ratio; BIC, Bayesian Information Criterion; CI, Confidence Interval; DHS, Demographic and Health Survey; EDHS, Ethiopia

Demographic Health Survey; LR, Likelihood Ratio; MOR, Median Odds Ratio; PCV, Proportional Change Variance; SD, Standard Deviation; VIF, Variance Inflation Factors and WHO, World Health Organization.

Data Sharing Statement

The data retrieved for this research are available upon request from the (DHS) program's official database website (***http://dhsprogram.com***). All relevant data are in the paper and its Supporting Information files.

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Ethical approval

Not applicable

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Disclosure

The authors report no conflicts of interest in this work.

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Fig 1: *The magnitude of grand multiparity in Sidama region, data from EDHS 2016.*

Fig 2: Trend of grand multiparous women in Sidama national regional state, Ethiopia, DHS data from years 2,000 to 2016.

Fig 1:

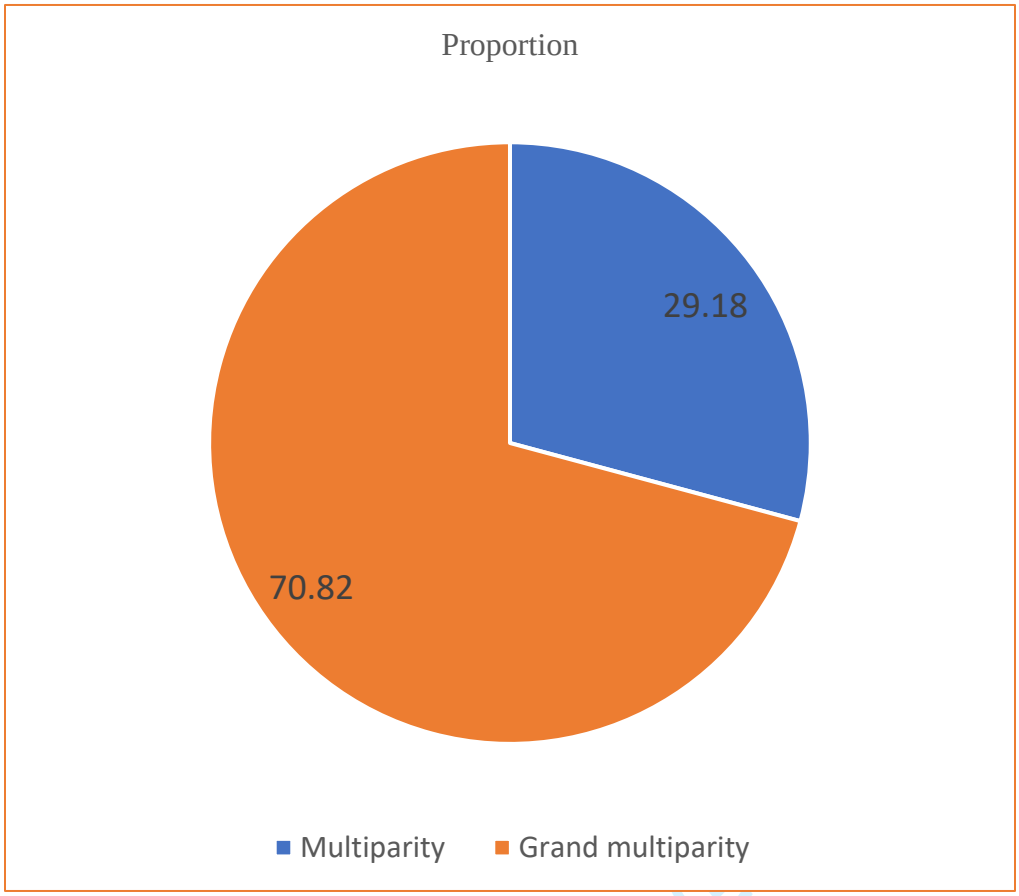
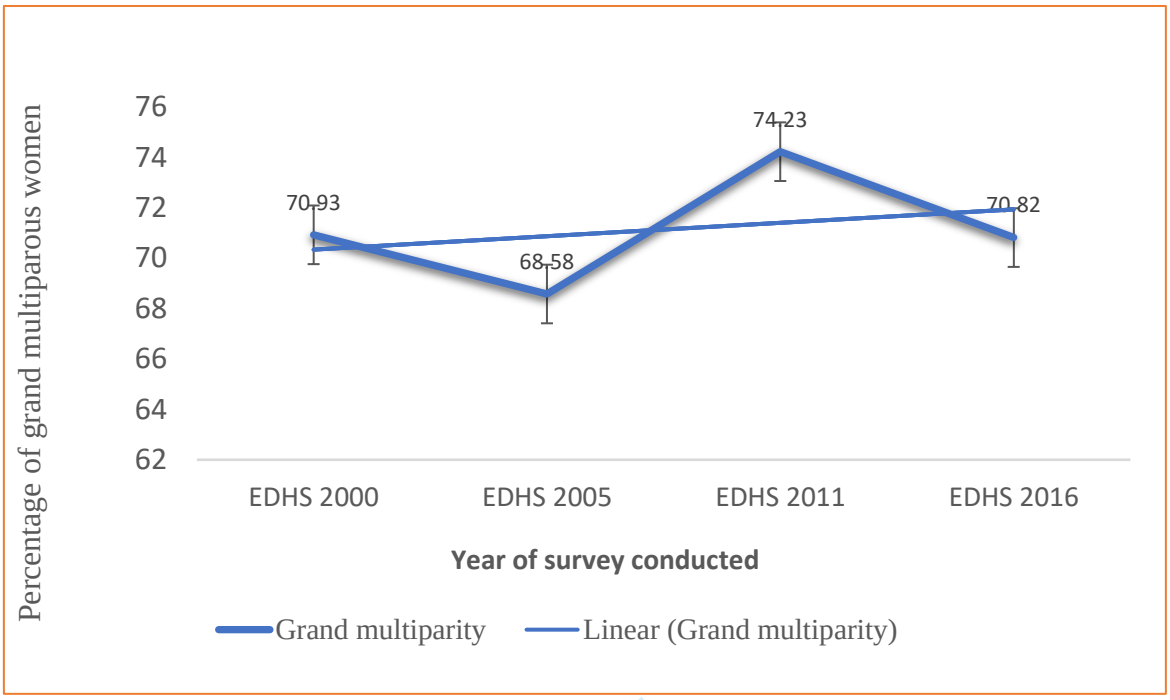


Fig 2:



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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	5
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4&5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5&6
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	5

Bias	#9	Describe any efforts to address potential sources of bias	NA
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	6
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7
Statistical methods	#12c	Explain how missing data were addressed	NA
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	7
Statistical methods	#12e	Describe any sensitivity analyses	NA
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	8
Participants	#13b	Give reasons for non-participation at each stage	NA

Participants	#13c	Consider use of a flow diagram	NA
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	9
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	11
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15
Main results	#16b	Report category boundaries when continuous variables were categorized	12
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	#18	Summarise key results with reference to study objectives	18

Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	2
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	18,19 & 20
Generalisability	#21	Discuss the generalisability (external validity) of the study results	21
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

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A Multilevel Analysis of Grand Multiparity: Trend and its determinants in the Sidama National Region State of Ethiopia: A Cross-Sectional Study Design from Demographic and Health Survey 2000 to 2016.

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Abstract

Objective: The study was aimed at examining the magnitude, trends, and determinants of grand multiparity in the Sidama regional state of Ethiopia.

Design: We retrieved cross-sectional data from the Ethiopian demographic health survey from 2000 to 2016.

Setting: Community-based demographic health survey was conducted in Ethiopia.

Participants: The study population was women (aged 15 to 49 years) who had delivered children with the available DHS data set.

Outcomes: Multilevel multivariate logistic regression analyses assessed the relationship between grand multiparity and its determinants.

Results: The magnitude of grand multiparity was 70.8% (95% CI: 68.5-72.9). The multilevel multivariable logistic regression model showed illiteracy [AOR=2; 95%CI:1.25-3.75], non-use of any contraceptive [AOR=3.8; 95% CI:1.2-12.2], early marriage [AOR=4.5; 95% CI: 2.6-7.9], polygamous marriage [AOR=4.2; 95% CI:2.0-9.3], short birth intervals [AOR=2.3; 95% CI:1.4-3.5] and husband low education status [AOR=5.8; 95%CI:2.1-16.1] were significantly associated with grand multiparity.

Conclusions: This study revealed that seven of ten women were grand multipara, and the magnitude did not show significant change over the last sixteen years. Early marriage and early age of first birth, low literacy level, low family planning utilization, polygamy, short inter-birth interval, and unmet need for family planning were determinants of grand multiparity. We

recommended to the stakeholders to design new strategies to address the root cause of high fertility factors in communities.

Keywords: High parity, High fertility, Grand multiparity, Multilevel analysis, Sidama, Ethiopia.

Strengths and Limitations of this study

- The strength of this study included analyzing the most recent nationally representative data sets aided in providing a broad comparative picture of grand multiparity in the study setting, as well as significant predictors of children ever born among ever-married women.
- To avoid misleading inferences and thus valid interpretation of the results, clustering effects were considered using a mixed modeling approach.
- Despite the above strengths, the study may have had recall bias because participants were asked about events that occurred 5 years or more before the survey.
- Also, we used secondary datasets, we were limited in our ability to select exposure variables for statistical analysis.

Background

Grand multiparty, a situation when a woman has at least five deliveries at gestational age greater than or equal to 20 weeks, is a major public health concern in developing countries, particularly in sub-Saharan Africa [1-3]. Its obstetric performance is considered as high risk which is defined as the one in which the woman, fetus, and/or newborn are at increased risk of morbidity or mortality prenatal, intrapartum or postpartum [4]. In this regard, there is a high disparity in the fertility rates between the developed and developing countries [5]. The factors responsible for the huge disparity are usually neglected in existing family planning and reproductive health programs, which causes

the grand multi-parity to be a serious public health problem worldwide, particularly in developing countries including Ethiopia [6, 7].

While the global fertility rate declined from 3.2 live births per woman in 1990 to 2.5 in 2019, the magnitude increased to 4.6 in 2019 in sub-Saharan Africa including Ethiopia, which indicates a high fertility rate [8-10].

Various factors have been identified to be associated with the grand multi-parity and these include early age at first marriage, low socioeconomic status, polygamous marriage [11], husband's preference, culture, religion, and residence in a rural area. Others are low literacy level, poor mass media exposure, low level of awareness of health, and lack of access to modern contraceptives especially in most sub–Saharan Africa [1, 12, 13].

According to studies conducted in some developing countries, grand multipara women have a higher number of children than women in developed countries. Indeed, many factors contribute to grand multiparity, but some published literature identified the factors for grand multiparity in low and lower-middle-income countries [1, 14-16]. Still, grand multiparity has not been well-addressed, as there is a dearth of evidence on a larger scale. Also, there were inadequate studies carried out on the trend, magnitude, and associated factors of grand multiparity by using national representative demographic health survey data (DHS). Therefore, this study was carried out to assess the trend and associated factors of grand multiparity using demographic and health survey data for the Sidama region from 2000 to 2016. The findings will assist program managers and policymakers in developing appropriate intervention strategies to effectively address the challenges and problems of grand multipara women in order to prevent high parity in the community in terms of reproductive health services at all levels.

Methods and materials

Study area and period

Sidama national regional state is one of the 10 national regional states in Ethiopia. The region is divided into 36 Districts (6 urban districts and 30 rural districts). Hawassa city is the capital of the region, and it is situated in the Southern part, about 273 Kilometers away from Addis Ababa, Ethiopia's capital. The Sidama people number 8.8 million (4.01% of the national population) and are the fifth most populous ethnic group in Ethiopia. Sidama national region state has 123 health centers and 17 hospitals[10, 17-20]. For this study, we used secondary data from the 2000 to 2016 Ethiopia demographic health and survey (DHS). The DHS data had been collected from January 18, 2016, to June 27, 2016, by the Ethiopian Central Statistical Agency (ECSA)[10].

Study design, data source, and sampling techniques

A cross-sectional survey data were obtained from 2000 to 2016 (EDHS). The data were retrieved from the (DHS) program's official database website (***http://dhsprogram.com***). It is a nationally representative household survey that collects information about population, health, and other important indicators. The sample of the EDHS study was designed to collect up-to-date information from each of the ten regions and the two administrative cities. Each region was stratified into urban and rural areas, 21 sampling strata were obtained. Samples of enumeration areas (EAs) were selected independently in each stratum in two stages. In the first stage, a total of EAs was selected with a proportional sampling technique and with independent selection in each sampling stratum. The selection of households was the second stage. A fixed number of households per cluster were selected with an equal probability proportional allocation to sample size was done [10].

This study used the birth record dataset, and the study population was women (aged 15 to 49 years) who had delivered children with the available DHS data set. From the birth record dataset, the total number of multiparous (para 2 to 4) and grand multiparous (para 5 to 9) women was extracted for Sidama national region state from 2016 EDHS. The total sample was extracted for women who gave birth (parity 2 to 9) from the birth record dataset. The total number of women whose parity (2 to 9) in the study region of Ethiopia was included in 1,654 weighted samples. For trend analysis, grand multipara in all the four DHS data from 2000 to 2016 were extracted by using the quantitative method [10, 21-23].

Study variables

Dependent variable: The outcome variable of this study was grand multiparity which was categorized in to "Yes = 1/ No = 0" form. These include all women who have five to nine deliveries as grand multi-parity categories [1, 2, 24].

$$Yi = \begin{cases} 0; \text{ Multiparity, for the women had given birth 2 to 4 times.} \\ 1; \text{ Grand multiparity, for the women who had given birth 5 to 9 times.} \end{cases}$$

Yi = represent the parity of the i^{th} ever born children.

Independent variables: The independent variables for this study were identified based on previous studies conducted on the factors affecting grand multiparity at the different places that were reviewed from the literature as associated factors of grand multiparity [11, 14, 25-35]. The independent variables selected for analysis from the available dataset were the place of residence, maternal age, educational status of women, wealth index, current marital status, polygamy marriage, women currently working, religion, husband education level husband occupation status, women supported by husband, community media exposure, age of women at first birth, age at first sex, number of living children, preceding birth interval (months), the contraceptive method

used, unmet need of contraceptive, the desire for more children, the child being alive, place of delivery, and husband's desire for more children. In this analysis, independent variables were categorized into individual-level variables and community-level variables. Individual-level variables were the age of women, women's education status, wealth index, women's age of first birth, number of living children, current marital status, polygamy marriage, women's age at first sex, desire for more children, contraceptive method, unmet need of contraceptive, women currently working, the child is alive, preceding birth interval (months), place of delivery, women supported by husband, husband education status, husband occupation status, husband desire for more children. Community-level variables were religion, place of residence (rural or urban), and community media exposure.

Data Analysis

For analysis, the weighted sample data were used to ensure the survey results were representative of the regions. Based on each weighted variable, the descriptive statistics were reported with summary indices, frequency, and proportion. The trend analysis of grand multiparity was assessed using the Extended Mantel-Haenszel Chi-square test for linear trend using the OpenEpi (version 3.01)- Response program[36]. A P-value of less than 0.05 was used to declare a 95% significant probability of the existence of a trend. The degree of crude association for individual and community variables was checked by employing a χ^2 test.

For the nested structure of the EDHS data, multilevel multivariable logistic regression analysis was used. Also, for the mixed effect (fixed effect for both the individual and community level factors and a random effect for the between cluster-variation), a two-level mixed-effect logistic regression analysis was used. The final findings were measured using an adjusted odds ratio (AOR). Within the multilevel multivariable logistical regression analysis, four models were fitted

for the result variable. The primary model (null or empty model) was fitted without explanatory variables. The second model (individual model), third model (community model), and fourth model (final model) variables were fitted for individual level, community-level, and each individual- and community-level variable respectively. The final model was used to check for the independent effect of the individual and community level variables on grand multiparity. To show cluster correlation within a model, the Intra-Cluster Correlation (ICC) was calculated. The Proportional Change in Variance (PCV) was also calculated to determine the predictive power of the variables included in each model. To identify the factors associated with grand multiparity, the model with the highest PCV value was used.

The model fitness was assessed using Akaike Information Criterion (AIC), the Bayesian information criterion (BIC), and the Likelihood Ratio (LR) test. The values for each model of AIC and BIC were compared, the lowest one assumed to be a better explanatory model[37]. Multicollinearity between the individual- and community-level variables was checked using the Variance Inflation Factor (VIF). The mean value of VIF < 10 was the cut-off point[38]. In the present study, the mean VIF value was estimated to be 2.44 showing the absence of multicollinearity in the models. The data were analyzed using the STATA statistical software system package version 14.0 (StataCorp., College Station, TX, USA). It was considered statistically significant if the P-values were less than 0.05 with the 95% confidence intervals.

Patient and Public Involvement

No patient was involved in this study.

Results

Sociodemographic characteristics of study participants

In this study, a total weighted sample of 1,654 women was included in the analysis from the latest EDHS data (2016). The mean age (±SD) of the women was 35±6.7 years, with the majority of women aged between 40-49 years. Almost all (99%) of women lived in a rural setting, and close to two-thirds (67%) of women were illiterate. Slightly more than half (55%) of the women were under a low level of socio-economic status. Almost all of them were married (93%) and follow the protestant religion (92%). More than three-fourths (77%) of the women were not supported by their husbands to do day-to-day chores. In addition, the majority of husbands had attended formal education and had different types of occupations. The summarized information on the sociodemographic background is displayed below (table 1).

Table 1: Sociodemographic characteristics of study participants in the Sidama national region state, data from 2016 Ethiopia demographic health and survey.

Individual and community Variables	Categories	Weighted (No_)	Weight (%)
Place of residence	Urban	13	0.75
	Rural	1641	99.25
Age in years	20-29	329	19.87
	30-34	441	26.66
	35-39	413	25.00
	40-49	471	28.47
	Mean ±SD	35±6.7	
Educational status	Have formal education	532	32.16
	No formal education	1122	67.84
Wealth index	Low	912	55.14
	Middle	357	21.58
	Higher	385	23.28
Current marital status	Other marital statues	110	6.66
	Married	1544	93.34
Polygamy	No	1205	77.09
	Yes	357	22.91
Women currently working	No	942	56.94
	Yes	712	43.04

Religion	Orthodox Catholic Protestant Muslim	16 27 1535 76	0.97 1.63 92.80 4.59
Husband education level	Lack of formal education Primary education Secondary education and above	504 944 114	32.28 60.41 7.31
Husband occupation status	Professionals Merchant Agriculture/Farmer	187 262 1,114	11.96 16.74 71.30
Women supported by husband	No Yes	1216 347	77.82 22.18
Community media exposure	No Yes	1122 532	67.82 32.18

Sexual and reproductive health characteristics of study participants

The mean age (±standard deviation) of women at first delivery was 17.69 ± 2.75 years and at first coital exposure was 16±2.6 years. The women's mean number of living children was 4.9 with a ±1.8 standard deviation. About two-thirds (64.8%) of women had short birth intervals within or less than 36 months. Among participants, a considerable proportion of women (45.81%) did not utilize modern contraceptives. Nearly, one-out of ten women (10.9%) had experienced child death in the survey. Slightly more than three-fourths (80%) of women gave birth at home (table 2).

Table 2: Fertility, sexual and reproductive health characteristics of study participants in Sidama regional state, data from 2016 Ethiopia Demographic and Health Survey.

Individual-level variables	Categories	Frequency	Percent (%)
Age of women at first birth	Less than18 years Greater than or equal to 18 years Mean ±SD	1,077 577 17.69±2.75	65.11 34.89
Age at first sex	Less than or equal to 18 years Greater than 18 years Mean ±SD	1356 298 16± 2.6	81.98 18.02
Number of living children	Mean ±SD	4.9 ±1.8	
Preceding birth interval (months)	Less than or equal to 36 months Greater than 36 months Mean ±SD	844 459 34.47 ± 18.6	64.8 35.2
Contraceptive method used	Not using any methods	758	45.81

	Short-acting family planning	680	41.13
	Long-acting family planning	216	13.06
Unmet need of contraceptive	Unmet of contraceptive	219	13.25
	Met of contraceptive	1,313	68.51
	Infecund/Menopausal	302	18.24
The desire for more children	Wants no more children	1,106	66.84
	Wants more children	548	33.16
Husband desire more child	Husband wants fewer	357	23.02
	Husband wants more	583	37.56
	Both want more	611	39.42
Child is alive	No	181	10.95
	Yes	1473	89.05
Place of delivery	Home	251	80.0
	Health facilities	62	20.0

The magnitude of grand multiparous women

The prevalence of grand multiparity with the weighted sample was 70.8 % (95 % CI, 68.5 - 72.9), in the 5 years preceding the survey in the Sidama region. Evidence from 2016 EHDS (Figure 1).

The trend of grand multiparous women

The magnitudes of the grand multi-parity were 70.93 % in 2000 EDHS, 68.58 % in 2005 EDHS, 74.23 % in 2011 EDHS, and 70.82 % in 2016 DHS in the Sidama national region state. Over 16 years, the trend of grand multiparous women from four surveys showed no significant change (Extended Mantel-Haenszel chi-square for leaner trend= 1.13 and P-values= 0.29). Likewise, no percentage change was observed between 2000 and 2016 EDHS in the Sidama region (Figure 2).

Bivariate variables' association with grand multi-para women

Regarding education status, the lack of formal education (75.8%) was significantly higher in grand multiparous women than in multipara (48.6%), (P<0.001). An enormous number of women in both groups were of the poorest and poorer statuses on the wealth index. The unmet need for contraceptives and underutilization of long-acting family planning utilization was significantly

higher in grand multipara than multipara (p<0.001). Among grand multipara, women in polygamous marriages were significantly higher compared with multipara women, (p<0.001). Likewise, the age of women at first birth, short birth intervals, husband education level, number of living children, and place of residence showed significant associations in both study groups, (p<0.001).

However, no significant differences were observed between grand multipara and multiparous regarding women currently working, place of delivery, the child is alive, current marital status, husband occupation status, and community media exposure, (P> 0.05), (table 3).

Table 3: Bivariate variables association of individual and community level variables with grand multipara and multiparous women in Sidama national region state, Ethiopia, data from EDHS 2016.

Individual and community Variables	Categories	Multiparous No_ (%)	Grand Multipara No_ (%)	P-value
Age in year	Mean ± SD	29.4 ± 0.3	37.7 ± 0.2	p<0.001
Educational level	Lack of formal education Have formal education	234(20.9) 248(46.7)	888(79.1) 283 (53.3)	p<0.001
Wealth Index	Poorest Poorer Middle Richer Richest	134(28.9) 146(32.5) 89(24.8) 54(25.2) 61(35.2)	329(71.1) 303(67.5) 269(75.2) 159(74.8) 112(64.8)	p=0.049
Age of women at first birth	Mean ± SD	18.8±2.9	17.5± 2.6	p<0.001
Number of living children	Mean ± SD	2.8± 0.8	5.8 ±1.4	p<0.001
Current marital status	Other marital statues Married	30(26.8) 453(93.9)	80(73.2) 1,091(93.1)	P=0.74
Polygamy marriage	No Yes	426(35.3) 34(9.6)	780(64.7) 322(90.4)	p<0.001
Age at first sex	Mean ± SD	16.56±2.77	16.13±2.52	P=0.022
The desire for more children	Not want more children Want more children	178(16.1) 305(55.5)	927(83.9) 244(44.5)	p<0.001
Unmet need of contraceptive	Unmet Met Infecund/Menopausal	36(16.6) 414(36.5) 33(10.7)	183(83.4) 719(63.5) 269(89.3)	p<0.001

Women currently working	No Yes	270(28.6) 213(29.9)	672(71.4) 499(70.1)	P= 0.594
Child is alive	No Yes	34(19.0) 448 (30.4)	147(81.0) 1,025(69.6)	P=0.098
Preceding birth interval (months)	Mean ± SD	40±21.9	32.6±16.9	p<0.001
Place of delivery	Home Health facilities	138(54.8) 34(61.5)	114(45.2) 22(38.5)	p=0.262
Religion	Orthodox Protestant Muslim	21(47.3) 428(28.0) 33(43.8)	23(52.7) 1,106(72.0) 43(56.2)	P=0.025
Women supported by husband	No Yes	326(26.8) 132(38.6)	890(73.2) 213(61.4)	P=0.007
Husband education level	Lack of formal education Primary education Secondary education and above	115(22.7) 281(29.8) 65(56.7)	390(77.3) 663(70.2) 50(43.3)	p<0.001
Husband occupation status	Professionals Merchant Agriculture/Farmer	39(21.0) 90(34.5) 331(29.7)	148(79.0) 171(65.5) 783(70.3)	P = 0.064
Husband desire more child	Husband wants fewer Husband wants more Both want more	112(31.2) 123(21.1) 226(37.0)	246(68.8) 460(78.9) 385(63.0)	P =0.012
Contraceptive method used	Not using any methods Short acting family planning Long-acting family planning	196(25.8) 212 (31.1) 75(34.9)	562(74.2) 469(68.9) 141(65.1)	P = 0.167
Place of residence	Urban Rural	11(83.6) 472(28.8)	2(16.4) 1,169(71.2)	P<0.001
Community media exposure	No Yes	337(30.0) 146(27.5)	786(70.0) 386(72.5)	P=0.905

Determinants of grand multiparity

We applied a two-level mixed effect multivariable logistic regression using the extracted data from 2016 DHS for the Sidama national regional state that is aimed at identifying individual and community-level determinants of grand multiparity or women having high parity. Those four models were developed to analyze factors accordingly. According to random-effect analysis; Model-I had no individual- and community-level variables, and it observed only the random and intercept variables. In the model I, the ICC value was 20%. This indicates that the variation on the grand multiparity occurred at the community level (between-cluster variability) and is

contribute to the community-level factors. The ICC in the null model greater than zero indicates that it guided the researcher to use multilevel modeling than the standard single-level regression model. Also, results in subsequent models, between cluster variability were found to be 14.4% in Model II (individual-level factors), 18.6% in Model III (communities level factors), and 14.5% in Model IV (combined individual and community level factors). In another way, the proportional change in variance (PCV) results indicated that the predictor variables to the null model better explained the factors associated with grand multiparity. The PCV finding for Model-II was (33.7%), for Model-III was (9.6%) and Model-IV was (33.7%). The final Model (combined individual and community level factors) indicated that 34% of the community-level variation on grand multiparity was explained by the combined factors at both the individual and community levels. The result was reported based on Model IV (combined individual and community level factors were fitted simultaneously). As a result, variables such as educational level, age of women at first birth, contraceptive methods used, husband occupation status, polygamy, age of first sex, unmet need for contraception, preceding birth interval, and husband education level were significantly associated with grand multiparous women, according to Model IV findings.

The odds of grand multiparity compared to multiparity were 2 times [AOR=2; 95 % CI:1.25-3.75] higher among women who were uneducated compared with women who were educated. The odds of grand multiparity compared to those multiparous women not using any contraceptive method were 3.85 times higher compared to those women using long-acting family planning [AOR=3.8; 95% CI:1.2-12.2].

The odd of grand multiparity was 4.5 times higher among women who had their first births before 18 years old compared to those after 18 years old [AOR=4.5; 95% CI: 2.6–7.9]. The odd of grand multiparity was 4.2 times higher for those who were in polygamous marriages compared to those

in monogamy [AOR=4.2; 95% CI: 2.0–9.3]. In addition, the likelihood of grand multiparity was 80% less likely to have met contraceptive compared to those women who have met contraceptive) [AOR=0.2; 95% CI: 0.09 -0.83]. The odd of grand multiparity was 2.3 times higher among women who had short birth intervals compared to those women with normal birth intervals [AOR=2.3; 95% CI: 1.4-3.5]. The odd of grand multiparity was 5.8 times higher among women whose husbands had primary education compared to those who attended secondary schools and above [AOR=5.8; 95%CI: 2.1–16.1]. Also, the odd of grand multiparity was 3.4 times higher among women whose husbands lack formal education compared to those women husbands who had a secondary level of education and above [AOR=3.4; 95%CI: 1.2-9.9].

(table 4).

Table 4: Multilevel logistic regression model of individual and community-level factors associated with grand multiparous women in Sidama national region state, Ethiopia, using data from the 2016 EDHS.

Individual- and community-level variables	Model 1	Model 2	Model 3	Model 4
	Empty (Null)model	Individual-level variables AOR (95% CI)	Community-level variables AOR (95% CI)	Individual- and community-variables AOR (95% CI)
Educational level				
Have formal education		Ref.		Ref.
Lack of formal education		2 (1.24-3.74) **		2.2(1.3 -3.4) **
Sex of household head				
Female		Ref.		Ref.
Male		0.3(0.1 - 0.8) **		0.3(0.1-0.8) *
Wealth index combined				
Low		0.5(0.24 – 0.99) *		0.5(0.2-1)
Middle		1.4 (0.66 – 2.96)		1.4 (0.7-3.0)
High		Ref.		Ref.
Age of women at first birth				
Greater than or equal to 18 years		Ref.		Ref.
Less than18 years		4.5 (2.6 – 7.9) ***		4.5(2.6 –7.9) ***
Contraceptive methods used				
Not using any methods		3.8(1.2 -12.2) *		3.8 (1.2- 12.2) *
Short-acting family planning		2.2(1.1– 4.5) *		2.2(1.1 -4.4) *
Long-acting family planning		Ref.		Ref.
Husband occupation status				
Professionals		2.2(1.0 -4.7)		2.2(1.03 -4.8) *
Merchant		0.5(0.3 – 0.9) *		0.5(0.3-0.9) *
Agriculture/Farmer		Ref.		Ref.
Husband desire more child				
Husband wants fewer		Ref.		Ref.
Husband wants more		1.4(0.7- 2.6)		1.3(0.7-2.6)
Both want more		1.3(0.7- 2.4)		1.3(0.7-2.4)

Polygamy/ number of other wives No Yes		Ref. 4.2 (1.9 -9.3) ***			Ref. 4.2 (2.0 – 9.3) *
Age at first sex Less than or equal to 18 years Greater than 18 years		Ref. 3.8(1.9 - 7.9) ***			Ref. 3.9(1.9- 8.1) ***
Unmet need for contraceptive Unmet Met In fecund/Menopausal		Ref. 0.2 (0.07- 0.5) *** 1.1 (0.3 -3.3)			Ref. 0.2(0.1 -0.5) *** 1.1(0.34-3.26)
Preceding birth interval (months) Greater than 36 months Less than or equal to 36 months		Ref. 2.3(1.4- 3.5) ***			Ref. 2.3(1.4 -3.5) ***
Husband education level Lack of formal education Primary education Secondary education and above		3.4 (1.2- 10.0) * 5.9(2.2 – 16.2) *** Ref.			3.4(1.2-9.9) * 5.8(2.1 – 16.1) *** Ref.
Religion Orthodox Protestant Muslim			Ref. 4.9(1.8 -13.4) ** 2.6 (0.8 - 8.4)		
Type of place of residence Urban Rural			Ref. 6.6(1.29 -33.8) *		Ref. 1.2(0.2- 10.7)
Random effect Community-level variance (SE) ICC (%) MOR PCV	0.83*** (0.4) 20% 2.4 Reference	0.55***(0.3) 14.4% 2.0 33.7%	0.75*** (0.4) 18.6% 2.3 9.6%		0.56 *** (0.3) 14.5% 2.0 33.7%

Model fit statistics				
Log-likelihood	-523	-281	-513	-281
AIC	1050	602	1036	604
BIC	1059	692	1059	698

Note: *significant at *P < 0.05; ** P < 0.01; *** P < 0.001; AOR =Adjusted Odds Ratio, CI =Confidence Interval, AIC =Akaike information criterion, BIC =Bayesian information. criterion, Model 1-Empty (null) model; Model 2- Only individual-level explanatory variables included in the model; Model 3-Only community-level explanatory variables included in the model; Model 4-Combined model; PCV= Proportional Change in Variance, MOR= Median Odds Ratio and Ref.=reference.

Discussion

Seven out of ten reproductive-age women had experienced grand multi-parity. Age at marriage, literacy status of women, age of women at first birth, modern contraceptive method utilization, polygamy, husband education level, preceding birth interval, and unmet need for contraceptives were significantly associated with women having high parity.

During the analysis, the ICC value was found to be 14.5% in the combined Model. This indicates that 14.5% of the chances of grand multiparous women were explained through cluster differences. The ICC in the null model greater than zero indicates that it guided the researcher to use multilevel modeling than the standard single-level regression model [37, 39, 40]. Similarly, the study indicates that the proportion change in variance of the final model was accountable for about 33.7% of the log odds of high parity in the communities. In addition to that, the results of the median odds ratio, a measure of unexplained cluster heterogeneity, are 2.48, 3.51, 2.43, and 3.34 in models 1, 2, 3, and 4, respectively. Hence, the results of the median odds ratio showed that there is unexplained variation between the clusters of the community.

In the present study, the magnitude of grand multiparity was 70.8 %. This is similar to a study conducted community-based in Gedeo Zone 69.1 % and Tigray region, Ethiopia 51 % [25, 29]. This figure was quite higher than the prevalence reported by other investigators ranging from 9.4 % to 27% in Gambian, Cameroon, Nigeria, Tanzania, and India [2, 33, 34, 41, 42]. The fact that later studies were all carried out in health facilities and urban catchment areas could explain these low prevalence rates. The educational backgrounds, socioeconomic, sociodemographic, and cultural settings of these studies are different from the current findings[31]. Similarly, there are many contributing factors to high fertility, among which are early marriage, the perceived ideal number of children, and mass media exposure by women [14, 25]. While the prevalence of grand

multiparity in developed countries has significantly declined ranging from 3 to 4 % [43], it has increased in the current study and this could be explained by lack of formal education (75.8%) and a high number of early marriages. As individual health implications, the women are given more subsequent births while they get more maternal and child health risks and many socioeconomic challenges in their lifetime in low resource setting areas [24, 35, 44, 45].

The trends of grand multiparity over study periods showed no significant change. This finding was consistent with a previous study done in rural Cameroon[31]. However, in Tanzania, the previous study's findings showed a significant change in the trend of grand multiparity [26]. This decline could have been explained by the availability of higher education to women and increased community awareness of the health risks of giving birth at an advanced maternal age and the benefits of family planning and empowerment of women in reproductive health decision-making [26].

This study revealed that grand multiparity was higher among women who had their first births before 18 years old compared to those women who started after 18 years. We realized that in the study community where women start birth before 18 years, the period of fertility is longer, and they have many ever-born children. As a result of these, women have high parity. Similarly, the women not using modern family planning appropriately and timely for spacing and limiting the number of births have high fertility. This is similar to the previous study done in Gedeo Zone, Ethiopia [25], Nigeria[46], Nepal [14], and Pakistan [28]. Nevertheless, the problem of early age at first delivery is significantly more alarming in the present study area than in the previous findings.

The odds of grand multiparity compared to that of multiparity were higher among women who were illiterate compared with literate women. This finding is in line with previous studies

conducted in Nigeria[46], Kenya[27], Nepal[14], and the Tigray region in Ethiopia[29]. In this study, almost all the women were rural dwellers (99%). Women who are rural inhabitants are less likely to spend much time in school and would rather get married early. A possible explanation is that women residing in the urban area stay longer in school, thereby postponing the time for marital engagement[25]. On the other hand, researchers found that education is an important factor for high parity, with several causal relationships from a theoretical perspective[47]. To sum up, education generally results in an improvement in the status of individuals in society in the form of a better understanding of health issues, and employment status [48]. The low social class found among the grand multiparous women is usually associated with illiteracy and low socioeconomic status, which may be an encouraging factor to produce more children[11]

The grand multiparity was higher among women with short birth intervals (less than or equal to 36 months). This finding is also consistent with a study conducted in Wonago District, Gedeo Zone, Ethiopia [25]. The possible explanation might be due to women not utilizing modern contraceptives that lead the women to get more children in a short period.

In our study, it was found that grand multiparity is significantly associated with polygamous marriage compared with monogamous marriage. This finding is similar to other studies conducted in Nigeria[1]. The variation could be due to competition amongst wives to have many children and to build large family sizes.

The grand multiparity among women not using any contraceptive and using short-acting contraceptive methods was higher compared to those women using long-acting contraceptives. Similar findings were reported in Nigeria [46], Cambodia[49], Pakistani [28], and Wonago District, Gedeo Zone[25]. Most factors in this study are directly or indirectly associated with the low utilization of contraceptives, which indicated that it is the root cause of high fertility in the

study setting. In addition, in one study, the women were not using contraceptives because their husbands did not allow them to make contraceptive decisions[49].

Strengths and Limitations of this study

The strength of this study included analyzing the most recent nationally representative data sets aided in providing a broad comparative picture of grand multiparity in the study setting, as well as significant predictors of children ever born among ever-married women. in addition, to avoid misleading inferences and thus valid interpretation of the results, clustering effects were considered using a mixed modeling approach. Despite the above strengths, the study may have had recall bias because participants were asked about events that occurred 5 years or more before the survey. Also, we used secondary datasets, we were limited in our ability to select exposure variables for statistical analysis.

Conclusions

This study revealed that seven of ten women had experienced grand multiparity and the magnitude did not show significant change over the last sixteen years. Early marriage and early age of first birth, low literacy level, low family planning utilization, polygamy marital status, short birth interval, and unmet need for family planning were determinants of grand multiparity. We recommended to the stakeholders design new strategies to address the root cause of high fertility factors in communities. The Ministry of health should focus on health education and create awareness about maternal health risks related to grand multiparity in the community. Furthermore, special attention should be given to improving the utilization of contraceptives in the community to reduce the prevalence of grand multiparity.

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Contributions

TTD, MAK, and YD conceptualized the idea and designed the study; TTD and YD carried out the execution, data acquisition, analysis, interpretation, and wrote the draft manuscript; MAK and YD provided intellectual comments and contributed to revising the manuscript. All authors contributed to the revision of the manuscript's content and approved the final version. TTD accepts responsibility for the study's conduct, has access to the data, and has control over the decision to publish and the overall content of the manuscript.

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Competing Interests

No, there are no competing interests for any author.

Ethical approval

This study does not involve human participants. The data were retrieved from the DHS website (http://www.measuredhs.com) after permission was obtained. The accessed data were used for this registered research only. The data were preserved as confidential, and no effort was made to detect any household or individual respondents.

Data availability statement

The data retrieved for this research are available upon request from the demographic and health survey (DHS) program's official database website (***http://dhsprogram.com***). All relevant data are in the paper and its Supporting information files.

Abbreviations

AIC, Akaike's Information Criterion; AOR, Adjusted Odd Ratio; BIC, Bayesian Information Criterion; CI, Confidence Interval; DHS, Demographic and Health Survey; EDHS, Ethiopia Demographic Health Survey; LR, Likelihood Ratio; MOR, Median Odds Ratio; PCV, Proportional Change Variance; SD, Standard Deviation; VIF, Variance Inflation Factors and WHO, World Health Organization.

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Fig 1: *The magnitude of grand multiparity in Sidama region, data from EDHS 2016.*

Fig 2: Trend of grand multiparous women in Sidama national regional state, Ethiopia, DHS data from years 2,000 to 2016.

Fig 1:

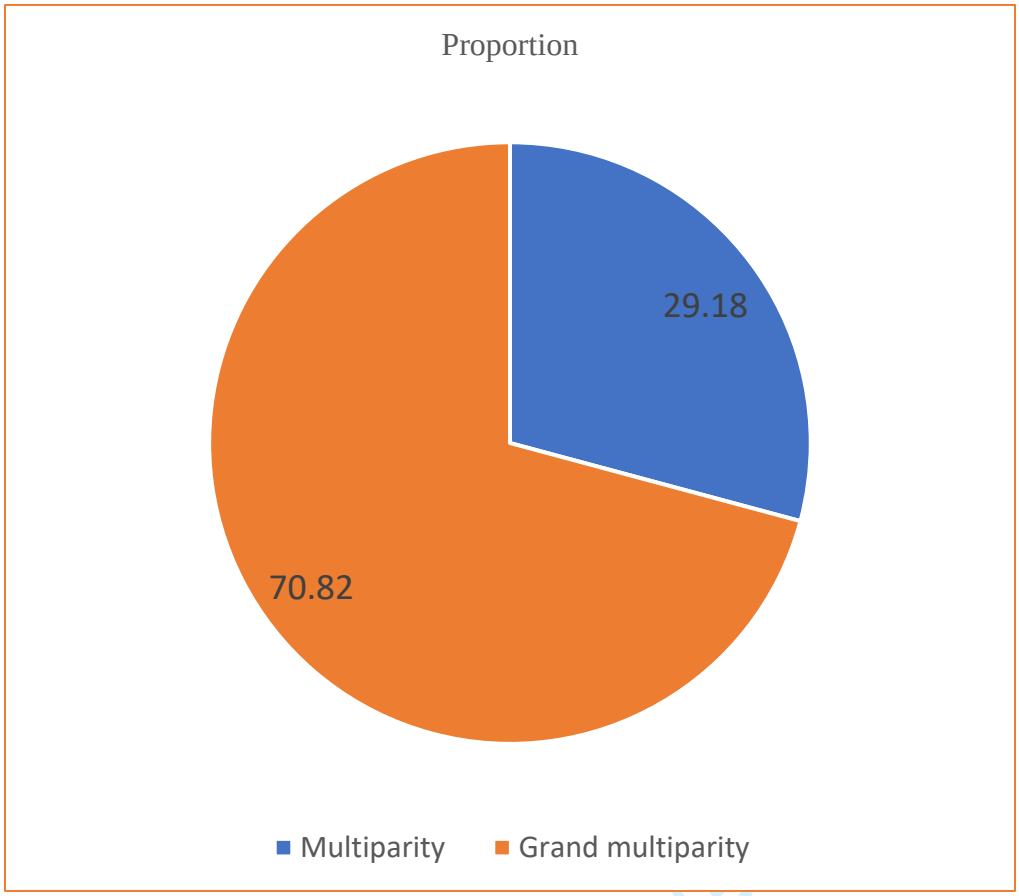
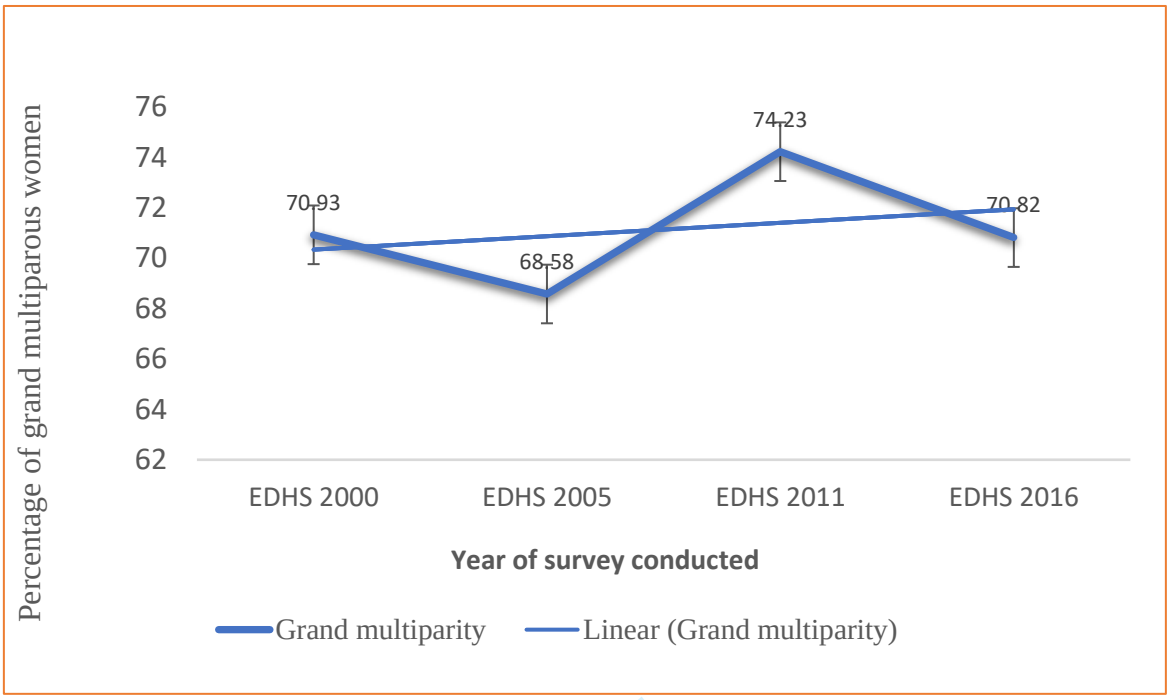


Fig 2:



Reporting checklist for cross sectional study.

Based on the STROBE cross sectional guidelines.

Instructions to authors

Complete this checklist by entering the page numbers from your manuscript where readers will find each of the items listed below.

Your article may not currently address all the items on the checklist. Please modify your text to include the missing information. If you are certain that an item does not apply, please write "n/a" and provide a short explanation.

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In your methods section, say that you used the STROBE cross sectionalreporting guidelines, and cite them as:

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		Reporting Item	Page Number
Title and abstract			
Title	#1a	Indicate the study's design with a commonly used term in the title or the abstract	1

Abstract	#1b	Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background / rationale	#2	Explain the scientific background and rationale for the investigation being reported	3
Objectives	#3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	#4	Present key elements of study design early in the paper	5
Setting	#5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4&5
Eligibility criteria	#6a	Give the eligibility criteria, and the sources and methods of selection of participants.	5
	#7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5&6
Data sources / measurement	#8	For each variable of interest give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group. Give information separately for for exposed and unexposed groups if applicable.	5

Bias	#9	Describe any efforts to address potential sources of bias	NA
Study size	#10	Explain how the study size was arrived at	5
Quantitative variables	#11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	6
Statistical methods	#12a	Describe all statistical methods, including those used to control for confounding	7
Statistical methods	#12b	Describe any methods used to examine subgroups and interactions	7
Statistical methods	#12c	Explain how missing data were addressed	NA
Statistical methods	#12d	If applicable, describe analytical methods taking account of sampling strategy	7
Statistical methods	#12e	Describe any sensitivity analyses	NA
Results			
Participants	#13a	Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed. Give information separately for for exposed and unexposed groups if applicable.	8
Participants	#13b	Give reasons for non-participation at each stage	NA

Participants	#13c	Consider use of a flow diagram	NA
Descriptive data	#14a	Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders. Give information separately for exposed and unexposed groups if applicable.	9
Descriptive data	#14b	Indicate number of participants with missing data for each variable of interest	
Outcome data	#15	Report numbers of outcome events or summary measures. Give information separately for exposed and unexposed groups if applicable.	11
Main results	#16a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	15
Main results	#16b	Report category boundaries when continuous variables were categorized	12
Main results	#16c	If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15
Other analyses	#17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	#18	Summarise key results with reference to study objectives	18

Limitations	#19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias.	2
Interpretation	#20	Give a cautious overall interpretation considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence.	18,19 & 20
Generalisability	#21	Discuss the generalisability (external validity) of the study results	21
Other Information			
Funding	#22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22