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Prevalence and predictors of mother and newborn skin-to-skin contact at birth in Papua New Guinea

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ABSTRACT

Objective This study examined the prevalence and predictors of maternal and newborn skin-to-skin contact at birth in Papua New Guinea.

Design Data for the study was extracted from the 2016–18 Papua New Guinea Demographic and Health Survey. We included 6,044 women with birth history before the survey in the analysis. Percentages were used to summarise the prevalence of maternal and newborn skin-to-skin contact. A multivariable multilevel binary logistic regression was adopted to examine the predictors of maternal and newborn skin-to-skin contact. The results were presented using adjusted ORs (aORs), with their respective 95% confidence intervals (CIs). Statistical significance was set at p<0.05.

Setting The study was conducted in Papua New Guinea.

Participant Mothers with children under 5 years.

Outcome measures Mother and newborn skin-to-skin contact.

Results The prevalence of mother and newborn skin-to-skin contact was 45.2% (95% CI=42.4 to 48.0). The odds of mother and newborn skin-to-skin contact was higher among women with primary education (aOR=1.38; 95% CI=1.03 to 1.83), women with four or more antenatal care attendance (aOR=1.27; 95% CI=1.01 to 1.61), those who delivered at the health facility (aOR=1.27; 95% CI=1.01 to 1.61), and women from communities with high socioeconomic status (aOR=1.45; 95% CI=1.11 to 1.90).

Conclusion The study has demonstrated that the prevalence of mother and newborn skin-to-skin contact in Papua New Guinea is low. Factors shown to be associated with mother and newborn skin-to-skin contact were maternal level of education, antenatal care attendance, health facility delivery, and community socioeconomic status. A concerted effort should be placed in improving maternal health service utilisation such as antenatal care attendance and skilled birth delivery, which subsequently lead to the practice of skin-to-skin contact. Also, women should be empowered through education as it has positive impact on their socioeconomic status and health service utilisation.

STRENGTH AND LIMITATIONS OF THIS STUDY

⇒ The major strength of the study is the use of nationally representative data and the adoption of rigorous multilevel regression analysis to examine the predictors of mother and newborn skin-to-skin contact.
⇒ The analysis was limited to the variables found in the dataset because the study relied on secondary data; as a result, interpretation and inference from the study should be confined to the variables used.
⇒ The Demographic and Health Survey uses a cross-sectional design, which limits the study's capacity to draw causal inferences.
⇒ The variables were assessed using women's self-reporting, which might increase the risk of recall and other social desirability biases.

BACKGROUND

Promoting the health and well-being of both the mother and child is necessary for the attainment of positive maternal and child health outcomes. To this end, the United Nations through its ratification of the 17 Sustainable Development Goals (SDGs) laid out the roadmap and milestones that member states must endeavour to attain by the year 2030.[1] Specifically, SDG targets 3.1 and 3.2 seek to reduce maternal mortality and neonatal mortality, respectively.[1] To achieve these goals and targets, evidence-based interventions are required. One of such interventions is the practice of skin-to-skin contact (SSC) immediately after delivery between the mother and newborn.

SSC denotes a process whereby immediately after childbirth, the newborn is positioned directly on the mother's bare abdomen or chest for them to have direct ventral-to-ventral skin contact.[2] In other words, SSC refers to placing a naked newborn on the mother's bare chest. Central to SSC is the criterion that there should be no barrier between the skin of the child and that of the mother.[3] The international gold standard for practising SSC is that it must commence immediately after vaginal birth.[2] However, in the case of birth by ceasarean section, SSC

must be initiated immediately when the mother is alert and responsive.[4]

Previous studies have established the importance of practising SSC in promoting healthy maternal behaviours and ensuring better child health outcomes. For instance, there is evidence to show that when SSC is practised effectively, it has implications on increasing breastfeeding self-efficacy,[5] facilitating early expulsion of the placenta,[6] lowering maternal stress levels,[7] and promoting mother-infant bonding.[8] For example, Nissen *et al*[9] indicated that the surge of oxytocin that runs through the mother's blood vessels as a result of the bond created by SSC with the newborn facilitates placental discharge and significantly reduces blood loss. There is also compelling evidence that suggests that SSC predicts early breastfeeding initiation, which is vital to the development and survival of the newborn.[6 10 11] Additionally, SSC serves as an efficient thermoregulatory mechanism for the newborn.[12] Hence, it is affirmative from the literature that SSC is quintessential to both the newborn and mother.

Despite all the aforementioned benefits that characterise the practice of SSC, there exist some bottlenecks that inhibit women from practising SSC. Evidence suggests that newborns are often separated from their mothers at birth; some are wrapped and kept in cribs while others are kept in warmers.[13] Such mother-newborn separation at birth can be stressful and compromise the possibility of having successful breast feeding.[14] Notwithstanding the challenge that confronts SSC, there seems to be sparse empirical evidence to show clearly the prevalence of SSC particularly among women from Papua New Guinea. Hence, the following questions remain unanswered: What is the prevalence of SSC in Papua New Guinea? What factors predict the practice of SSC in Papua New Guinea? To the best of our knowledge after an extensive literature search, no study has been conducted in Papua New Guinea to investigate this phenomenon using a nationally representative data. We, therefore, provide answers to the questions raised by estimating the prevalence and examining the factors that predict SSC at birth in Papua New Guinea.

METHODS

Data source and study design

We performed a secondary analysis of data from the 2016–2018 Papua New Guinea Demographic and Health Survey (DHS). The data for the study was extracted from the Kid's recode file (KR File) of the DHS. The DHS is a nationally representative survey conducted in over 85 countries worldwide.[15] The survey captures data on men, women, and child indicators including SSC.[15] The DHS employed a cross-sectional design. Standardised structured interviewer-administered questionnaires were used to collect the data from the respondents. A stratified two-stage cluster sampling design was used to recruit the samples for the survey. In the first stage, clusters were selected using a probability proportional to size sampling technique. In the second stage, a predetermined number of households (usually 28–30) were selected using a systematic sampling technique. The detailed study methodology can be found in the DHS report.[16] We included 6,044 women with birth history before the survey who had complete data on all variables of interest in the study. The dataset can be assessed freely at https://dhsprogram.com/data/dataset/Papua-New-Guinea_Standard-DHS_2017.cfm?flag=1.[17]

Variables

Mother and newborn SSC was the outcome variable in the present study. This variable was assessed using the question '*Was child put on mother's chest and bare skin after birth*?'. With this question, the response options were *0=no; 1=put on chest, touching bare skin; 2=put on chest, no touching of bare skin; 3=put on chest, do not know/missing on touching on bare skin and 8=do not know*. For this study's purpose and with reference to literature,[18–20] the response options were further recoded into '1=practiced SSC' for women who response category was "put on chest, touching bare skin" whilst the remaining response options were categorised as '0=not practiced SSC'.

We included 20 explanatory variables in the study. We selected the variables based on their availability in the DHS dataset as well as their significant association with mother and newborn SSC from literature.[18–22] The variables were grouped into individual level and community level. The individual level variables consisted of sex of child, birth order, birth weight, caesarean delivery, type of birth, mother's age, maternal educational level, marital status, current working status, number of antenatal care visits, place of delivery, health insurance coverage, exposure to watching television, exposure to listening to radio, exposure to reading newspaper or magazine and wealth index. We maintained the existing coding as found in the DHS for sex of child, type of birth, mothers age, caesarean delivery, health insurance coverage, and wealth status. The remaining individual-level variables were coded as birth order (first, second, third, fourth, and fifth or more); birth weight (normal and low birth weight); maternal educational level (no education, primary, and secondary or higher), marital status (never married, married, cohabiting, and previously married); number of antenatal care visits (below four visits and four or more visits); place of delivery (home, health facility, and other); exposure to watching television (no and yes); exposure to listening to radio (no and yes) and exposure to reading newspaper or magazine (no and yes). The DHS devised a wealth index as a proxy measure of socioeconomic position. It was calculated using component rankings derived from principal component analysis on family asset ownership, such as access to drinking water, kind of toilet, type of cooking fuel and possession of a television and refrigerator. The community level variables consisted of place of residence (urban and rural), region (Southern, Highlands, Momase, and Islands), community literacy level (low, medium, and high) and community socioeconomic status (low, medium, and high).

Statistical analyses

We performed the statistical analyses using Stata software V.16.0 (Stata, College Station, Texas, USA). The extracted data was cleaned and all the missing observations were dropped while subcategories of variables with small observations were merged. Percentages were used to present the prevalence of mother and newborn SSC. Later, we examined the distribution of mother and newborn SSC across the explanatory variables using a cross-tabulation. We adopted a binary logistic regression to select significant variables for the multivariable multilevel logistic regression. All the variables that had a p value <0.05 were considered statistically significant and included in the multilevel regression model. Four models of the multilevel regression analysis were built to examine the predictors of mother and newborn SSC. Model O (empty model) was built to examine the variation of the outcome variable (maternal and newborn SSC) attributed to the clustering of the primary sample units. Models I and II were fitted to include variables at the individual and community levels, respectively. The last model (model III) was fitted to include all the statistically significant explanatory variables from the binary logistic regression. The result of the multilevel binary logistic regression analysis was presented using the adjusted ORs (aORs), with their corresponding 95% confidence intervals (CIs). We used the Akaike Information Criterion (AIC) to assess the fitness of each model and for comparing the fitness across the models. All the analyses were weighted. The Stata command 'svyset' was employed in all the analyses to adjust for over-and-under sampling, nonresponse and to improve the generalisability of the findings. In writing the manuscript, we followed the guidelines from the Strengthening the Reporting of Observational Studies in Epidemiology statement (online supplemental table S1).[23]

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

Prevalence of mother and newborn skin-to-skin contact and its distribution across the explanatory variables

The results from table 1 show that the prevalence of mother and newborn SSC was 45.2% (95% CI=42.4 to 48.0). The prevalence of SSC was high among newborns who were males (45.4%), firstborn (50.3%), those with low birth weight (67.4%), those who were delivered through normal delivery (45.5%), and children who were not twins (45.3%). Also, the practice of maternal and newborn SSC was prevalent among mothers aged 25–29 years (47.7%), those whohad attained secondary or higher education (61.3%), previously married women (45.9%), those currently working (50.5%), those with four or more antenatal care attendance (56.3%), those who delivered at health facilities (64.4%), and those with health insurance (62.2%). In the area of mass media, the prevalence of maternal and newborn SSC was high among women exposed to watching television (62.2%), those exposed to listening to radio (56.7%), and those exposed to reading newspaper or magazine (58.3%). Additionally, the prevalence was high among women with the richest wealth index (66.6%), those residing in urban areas (63.1%), those in the Southern region (53.7%), those with high community literacy level (63.6%), and those with high community socioeconomic status (60.3%) (table 1).

Fixed effect and random effect analyses of the predictors of mother and newborn skin-to-skin contact in Papua New Guinea

Fixed effect results

Table 2 presents the results of the association between explanatory variables and maternal and newborn SSC. Women with primary level of education (aOR=1.38; 95% CI=1.03 to 1.83) were more likely to practise SSC compared with those without education. The odds of SSC was higher among women with four or more antenatal care attendance (aOR=1.27; 95% CI=1.01 to 1.61) as against their counterparts with less than four attendance. With the place of delivery, the odds of SSC was highest among those who delivered at the health facility (aOR=6.66; 95% CI=5.11 to 8.68) compared with those with home delivery. Additionally, women from communities with high socioeconomic status were more likely to practise SSC (aOR=1.45; 95% CI=1.11 to 1.90) comparative to those from low socioeconomic communities.

Random effect results

As indicated in table 2, the results in model O showed that mother and newborn SSC varied significantly across the clusters (σ2=1.607, 95% CI=1.310 to 1.971). Approximately 33% of the prevalence of SSC was attributed to the variations between the clusters (intraclass correlation (ICC)=0.328). The between-cluster difference decreased to 22.6% in model I and rose again to 24.0% in model II before finally decreasing to 22.3% in model III. These ICC results imply that the differences in the probability of practising SSC can be explained by the variances across the clusters. The AIC values experienced the same U-shape as the ICC values with the least value recorded in model III. Hence, model III was selected as the best-fitted model for examining the predictors of mother and newborn SSC.

DISCUSSION

This study examined the prevalence and predictors of mother and newborn SSC at birth in Papua New Guinea using data from the 2016–18 DHS. The prevalence of mother and newborn SSC in Papua New Guinea is 45.2%. This prevalence observed in this study is relatively higher than the prevalence of mother and newborn SSC reported in previous studies in Gambia (35.7%),[20] Ethiopia (28.1%),[21] Nigeria (12.1%),[18] and Bangladesh (28%).[24] Also, another recent study conducted in Southern Ethiopia found the prevalence of mother and

Table 1 Prevalence and distribution of mother and newborn skin-to-skin contact across the explanatory variables

Variables	Weighted N (%)	Mother and newborn SSC % (95% CI)	cOR (95% CI)
Prevalence		45.2 (42.4 to 48.0)	
Sex of child			
Male	3147 (52.1)	45.4 (41.9 to 48.9)	1.00
Female	2897 (47.9)	45.1 (41.8 to 48.4)	0.99 (0.84 to 1.16)
Birth order			
First	1430 (23.7)	50.3 (46.0 to 54.7)	1.00
Second	1203 (19.9)	45.7 (41.2 to 50.4)	0.83 (0.66 to 1.05)
Third	1085 (17.9)	45.5 (40.8 to 50.3)	0.82 (0.66 to 1.02)
Fourth	808 (13.4)	46.9 (41.9 to 51.8)	0.87 (0.69 to 1.10)
Fifth or more	1517 (25.1)	38.9 (34.4 to 43.7)	0.63*** (0.49 to 0.81)
Birth weight			
Normal (≥2.5 kg)	5608 (92.8)	43.5 (40.8 to 46.2)	1.00
Low birth weight (<2.5 kg)	436 (7.2)	67.4 (60.1 to 74.0)	2.69*** (1.96 to 3.68)
Delivery by caesarean section			
No	5824 (96.4)	45.5 (42.8 to 48.3)	1.00
Yes	220 (3.6)	36.8 (22.1 to 54.4)	0.70 (0.34 to 1.42)
Type of birth			
Single	5973 (98.8)	45.3 (42.5 to 48.1)	1.00
Multiple	71 (1.2)	37.3 (25.4 to 51.0)	0.72 (0.41 to 1.25)
Mother's age (years)			
15–19	255 (4.2)	47.0 (37.5 to 56.7)	1.00
20–24	1326 (21.9)	46.5 (41.4 to 51.8)	0.98 (0.64 to 1.51)
25–29	1618 (26.8)	47.7 (42.9 to 52.6)	1.03 (0.70 to 1.50)
30–34	1223 (20.2)	43.9 (39.6 to 48.2)	0.88 (0.58 to 1.35)
35–39	1006 (16.6)	42.1 (36.7 to 53.4)	0.82 (0.53 to 1.26)
40–44	454 (7.5)	45.3 (37.4 to 53.4)	0.93 (0.58 to 1.50)
45–49	162 (2.7)	36.3 (27.4 to 46.2)	0.64 (0.37 to 1.10)
Maternal educational level			
No education	1532 (25.4)	28.5 (24.7 to 32.6)	1.00
Primary	2976 (49.2)	45.5 (42.3 to 48.7)	2.09*** (1.70 to 2.58)
Secondary or higher	1536 (25.4)	61.3 (56.9 to 65.6)	3.98*** (3.04 to 5.21)
Marital status			
Previously married	420 (6.9)	45.9 (38.4 to 53.5)	1.00
Never married	199 (3.3)	44.1 (36.1 to 52.4)	0.93 (0.59 to 1.45)
Married	4433 (73.4)	45.6 (42.8 to 48.5)	0.99 (0.73 to 1.35)
Cohabiting	992 (16.4)	43.3 (36.6 to 50.3)	0.90 (0.60 to 1.35)
Current working status			
No	4165 (68.9)	42.9 (39.9 to 45.9)	1.00
Yes	1879 (31.1)	50.5 (45.5 to 55.4)	1.36** (1.09 to 1.69)
Number of antenatal care visits			
Below four visits	2931 (48.5)	33.4 (30.3 to 36.38)	1.00
Four or more visits	3113 (51.5)	56.3 (53.0 to 59.5)	2.56*** (2.16 to 3.04)
Place of delivery			
Home	2414 (40.0)	20.4 (17.6 to 23.5)	1.00

Continued

Table 1 Continued

Variables	Weighted N (%)	Mother and newborn SSC % (95% CI)	cOR (95% CI)
Health facility	3435 (56.8)	64.4 (61.4 to 67.3)	7.05*** (5.65 to 8.78)
Other	195 (3.2)	14.7 (9.2 to 22.7)	0.67 (0.39 to 1.16)
Health insurance coverage			
No	5861 (97.0	44.5 (41.8 to 47.2)	1.00
Yes	183 (3.0)	69.2 (57.5 to 78.8)	2.80*** (1.72 to 4.55)
Exposed to watching television			
No	4769 (78.9)	40.7 (37.8 to 43.6)	1.00
Yes	1275 (21.1)	62.2 (56.5 to 67.5)	2.39*** (1.84 to 3.11)
Exposed to listening to radio			
No	4015 (66.4)	39.4 (36.5 to 42.5)	1.00
Yes	2029 (33.6)	56.7 (52.4 to 60.8)	2.01*** (1.64 to 2.45)
Exposed to reading newspaper/magazine			
No	4044 (66.9)	38.7 (35.7 to 41.9)	1.00
Yes	2000 (33.1)	58.3 (54.2 to 62.3)	2.21*** (1.80 to 2.71)
Wealth index			
Poorest	1292 (21.4)	27.8 (23.4 to 32.6)	1.00
Poorer	1205 (19.9)	38.6 (34.2 to 43.2)	1.64** (1.24 to 2.16)
Middle	1190 (19.7)	43.8 (39.3 to 48.3)	2.03*** (1.55 to 2.66)
Richer	1205 (19.9)	51.5 (46.7 to 56.3)	2.76*** (2.04 to 3.73)
Richest	1151 (19.1)	66.6 (60.8 to 72.0)	5.19*** (3.69 to 7.14)
Place of residence			
Urban	674 (11.2)	63.1 (55.2 to 70.4)	1.00
Rural	5370 (88.8)	43.0 (40.0 to 46.0)	0.44*** (0.31 to 0.62)
Region			
Southern region	1194 (19.8)	53.7 (49.0 to 58.3)	1.00
Highlands region	2292 (37.9)	42.3 (37.3 to 47.5)	0.63** (0.48 to 0.84)
Momase region	1692 (28.0)	39.1 (33.5 to 45.0)	0.55*** (0.41 to 0.75)
Islands region	866 (14.3)	53.3 (48.3 to 58.1)	0.98 (0.75 to 1.29)
Community literacy level			
Low	2549 (42.2)	31.3 (27.7 to 35.1)	1.00
Medium	1925 (31.8)	48.6 (43.9 to 53.4)	2.08*** (1.60 to 2.69)
High	1570 (26.0)	63.6 (59.0 to 68.0)	3.84***(2.95 to 4.99)
Community socioeconomic status			
Low	3211 (53.1)	35.4 (32.1 to 39.0)	1.00
Medium	876 (14.5)	47.3 (40.5 to 54.2)	1.64** (1.19 to 2.25)
High	1956 (32.4)	60.3 (55.8 to 64.7)	2.77*** (2.17 to 3.53)

1.00=reference category. *p<0.05; **p<0.01; ***p<0.001.
cOR, crude OR; SSC, skin-to-skin contact.

newborn SSC to be 35.3%.[22] However, the prevalence observed in our study is lower than the prevalence found in a study conducted in Singapore, which reported SSC to be 84.0%.[10] The discrepancy in the prevalence could be attributed to a progressive increase in knowledge or awareness among mothers about the perceived importance and the benefits of mother and newborn SSC through mass media and education by health professionals.[25–27]

The mixed-effect analysis results from our study found a statistically significant association between maternal education and newborn SSC. The findings indicated that mothers with primary level of education have higher odds

Table 2 Mixed-effect analysis of predictors of maternal and newborn skin-to-skin contact among women in Papua New Guinea

Variables	Model O	Model I aOR (95% CI)	Model II aOR (95% CI)	Model III aOR (95% CI)
Fixed effect results				
Birth order				
First		1.00		1.00
Second		0.87 (0.67 to 1.12)		0.86 (0.67 to 1.12)
Third		1.12 (0.85 to 1.48)		1.11 (0.85 to 1.46)
Fourth		1.24 (0.91 to 1.69)		1.22 (0.90 to 1.67)
Fifth or more		1.03 (0.74 to 1.42)		1.01 (0.73 to 1.39)
Birth weight				
Normal (≥2.5 kg)		1.00		1.00
Low birth weight (<2.5 kg)		1.24 (0.78 to 1.97)		1.23 (0.77 to 1.96)
Maternal educational level				
No education		1.00		1.00
Primary		1.42* (1.08 to 1.87)		1.38* (1.03 to 1.82)
Secondary or higher		1.43 (0.96 to 2.14)		1.36 (0.89 to 2.07)
Current working status				
No		1.00		1.00
Yes		1.01 (0.82 to 1.26)		1.00 (0.81 to 1.24)
Number of antenatal care visits				
Below four visits		1.00		1.00
Four or more visits		1.30* (1.03 to 1.63)		1.27* (1.01 to 1.61)
Place of delivery				
Home		1.00		1.00
Health facility		6.89*** (5.32 to 8.93)		6.66*** (5.11 to 8.68)
Other		0.96 (0.47 to 1.97)		0.94 (0.46 to 1.93)
Exposed to reading newspaper/magazine				
No		1.00		1.00
Yes		0.86 (0.63 to 1.17)		0.84 (0.62 to 1.15)
Exposed to listening to radio				
No		1.00		1.00
Yes		1.21 (0.91 to 1.61)		1.19 (0.90 to 1.59)
Exposed to watching television				
No		1.00		1.00
Yes		1.13 (0.80 to 1.60)		1.10 (0.77 to 1.57)
Health insurance coverage				
No		1.00		1.00
Yes		0.89 (0.56 to 1.41)		0.84 (0.52 to 1.36)
Wealth index				
Poorest		1.00		1.00
Poorer		1.43* (1.01 to 2.03)		1.40 (0.99 to 1.99)
Middle		1.20 (0.88 to 1.65)		1.14 (0.83 to 1.57)
Richer		1.17 (0.84 to 1.63)		1.02 (0.72 to 1.45)
Richest		1.53* (1.06 to 2.22)		1.22 (0.81 to 1.84)
Place of residence				
Urban			1.00	1.00
Rural			0.47*** (0.36 to 0.63)	0.87 (0.61 to 1.25)

Continued

Table 2 Continued

Variables	Model O	Model I aOR (95% CI)	Model II aOR (95% CI)	Model III aOR (95% CI)
Region				
Southern region			1.00	1.00
Highlands region			0.88 (0.66 to 1.14)	0.82 (0.62 to 1.10)
Momase region			0.64** (0.47 to 0.89)	0.91 (0.66 to 1.25)
Islands region			0.84 (0.63 to 1.14)	0.76 (0.56 to 1.04)
Community literacy level				
Low			1.00	1.00
Medium			1.95*** (1.49 to 2.56)	1.19 (0.90 to 1.58)
High			2.35*** (1.70 to 3.25)	1.31 (0.92 to 1.87)
Community socioeconomic status				
Low			1.00	1.00
Medium			1.23 (0.86 to1.76)	1.04 (0.73 to 1.48)
High			2.21*** (1.73 to 2.84)	1.45** (1.11 to 1.90)
Random effect model				
PSU variance (95% CI)	1.607 (1.310 to 1.971)	0.961 (0.752 to 1.227)	1.040 (0.823 to 1.313)	0.942 (0.725 to 1.205)
ICC	0.328	0.226	0.240	0.223
Wald χ^2	Reference	390.73 (<0.001)	202.60 (<0.001)	482.58 (<0.001)
Model fitness				
Log-likelihood	−3754.3735	−3328.6937	−3663.4694	−3319.7777
AIC	7512.747	6699.387	7346.939	6697.555
N	6044	6044	6044	6044
Number of clusters	757	757	757	757

1.00=reference category. p<0.05; **p<0.01; ***p<0.001.
AIC, Akaike Information Criterion; aOR, adjusted ORs; ICC, intraclass correlation; PSU, primary sampling unit.

of initiating the mother and SSC of delivery. This observation in our study is congruent with findings from the previous studies.[18 28–30] This finding could be explained by the fact that mothers who have at some level of education could have been more informed and have adequate knowledge of the importance of the mother and newborn SSC in the health outcome of their newborns. This finding also proves the substantial positive role of mother's education plays on infant health, well-being and development.[11 29 31–33]

Further, mothers with had four or more antenatal care visits had higher odds to initiate mother and newborn SSC. This observation is consistent with findings from previous literature, which suggested that antenatal care visits is significantly associated with mother and newborn SSC practice.[19–21 34] Antenatal care serves as an avenue to educate, counsel, and prepare pregnant women for future delivery. As a result, by attending more antenatal care sessions, women are likely to receive more advice about healthy behaviours to adopt during pregnancy, delivery, and post partum. This level of awareness could increase women's knowledge and understanding of the purpose of mother and newborn SSC and compliance to the education received could have influenced mothers to practise SSC after delivery.[21 33–36]

Additionally, our study revealed that mothers' place of delivery is associated with the practice of SSC. We found that women who delivered at the health facility had a higher probability of practising mother and newborn SSC. This finding is congruent with the findings from previous studies, which indicated that the practice of mother and newborn SSC was significantly more common in health facility-based delivery compared with home birth.[19 20 34 37] The presence of skilled birth attendants who have been educated to ensure that mothers follow optimum maternal and neonatal practices is critical while giving birth in a health institution. As a result, health professionals may have ensured that mothers followed the SSC practice at delivery, which could have accounted for the finding in our study.[38]

We found a positive association between community socioeconomic status and mother and newborn SSC. Mothers from higher socioeconomic backgrounds had higher odds of practising mother and newborn SSC. The finding is comparable with the results from previous studies.[18 19 39] Women from higher socioeconomic status may be more educated and had financial resources that allowed them to use maternal health services such as antenatal care and skilled birth delivery. As a result, they might have received education and the imperative importance

of mother and newborn SSC from the healthcare professionals; hence, the higher likelihood of women from high socioeconomic communities practising SSC.[40–43]

Strength and limitations

The major strength of the study is the use of the most recent DHS dataset, which is a nationally representative population-based survey, thereby making our findings generalisable to mothers and newborns in Papua New Guinea. We also employed a rigorous statistical analysis generate the results in the current study. The study is limited by the DHS's cross-sectional design. Additionally, we were unable to draw causal conclusions about the predictors of mother-to-newborn SSC due to the cross-sectional nature of the DHS dataset. Furthermore, because the DHS data were collected retrospectively, there is a chance of recall bias. Moreover, data on health system-related factors were not collected and this limits our findings to only individual level and community level variables.

CONCLUSION

The prevalence of mother and newborn SSC in Papua New Guinea was low (45.2%). Factors shown to be associated with maternal and newborn SSC were the maternal level of education, antenatal care attendance, health facility delivery and the community's socioeconomic status. To increase maternal and newborn SSC, a concerted effort should be placed in improving maternal health service utilisation such as antenatal care attendance and skilled birth delivery, which subsequently leads to the practice of SSC. Additionally, women should be empowered through education as it has positive effects on wealth and health service utilisation.

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Contributors RGA is the guarantor and accepts full responsibility for the work. RGA, A-AS and BOA conceived the study. RGA, A-AS and BOA wrote the methods section and performed the data analysis. JO, RKD, LAA and VT were responsible for the initial draft of the manuscript. All the authors reviewed and approved the final version of the manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval No ethical approval was required for this study since the dataset is freely available in the public domain. However, the 2016-18 PDHS stated that the ICF Institutional Review Board granted ethical clearance. During the data collection process, written informed consent was obtained. We followed the guidelines for using secondary data for publication in this study. More information about the data and ethical standards can be found at http://goo.gl/ny8T6X.

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Table S1: STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Page 5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 5
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	N/A
Bias	9	Describe any efforts to address potential sources of bias	Page 6
Study size	10	Explain how the study size was arrived at	Page 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 6
		(*b*) Describe any methods used to examine subgroups and interaction	Page 6
		(*c*) Explain how missing data were addressed	Page 6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Page 6
		(*e*) Describe any sensitivity analyses	N/A
Results			

Participants	13*	(a) 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	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Page 7
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	N/A
Main results	16	(*a*) 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	Page 9-12
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 13-14
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	Page 14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 14
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 14
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	N/A

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.