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.

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. Specifically, SDG targets 3.1 and 3.2 seek to reduce maternal mortality and neonatal mortality, respectively. 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-ventral skin contact. 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. The international gold standard for practising SSC is that it must commence immediately after vaginal birth. However, in the case of the birth by cesarean 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 al9 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.5,10,11 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 literature18–20 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.16–22 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 fitting 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, non-response 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 who had 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 practice 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%),28 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) |
| Cohabitng                | 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         |

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newborn SSC to be 35.3%. 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%. 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.

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

| 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.
### 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) |                       |                        |

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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 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

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. This 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

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 to 1.76) | 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 χ²                           | 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 mother and newborn SSC from the healthcare professionals; hence, the higher likelihood of women from high socioeconomic communities practising SSC.\textsuperscript{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. J0, 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://goop.my8T6Ex.

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Data availability statement

Data are available in a public, open access repository. The dataset is freely accessible via this link: https://dhsprogram.com/data/dataset/Papua-New-Guinea_Standard-DHS_2017_cfm?flag=1.

Supplemental material

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REFERENCES

1 World Health Organization. Trends in maternal mortality: 1990-2015: estimates from who, UNICEF, UNFPA, world bank group and the United nations population division. World Health Organization, 2015.
2 World Health Organization, Guideline: protecting, promoting and supporting breastfeeding in facilities providing maternity and newborn services. World Health Organization, 2017.
3 Balatero JS, Spilker AJ, McNishi SG. Barriers to skin-to-skin contact after cesarean birth. MCN Am J Matern Child Nurs 2019;44:137–43.
4 Frederick A, Fry T, Clowtis L. Intraoperative mother and baby Skin-to-skin contact during cesarean birth: systematic review. MCN Am J Matern Child Nurs 2020;45:296–305.
5 Aghdas K, Taltal K, Sepideh B. Effect of immediate and continuous mother-infant skin-to-skin contact on breastfeeding self-efficacy of primiparous women: a randomised control trial. Women Birth 2014;27:37–40.
6 Marin Gabriela MA, Llanza Martín I, López Escobar A, et al. Randomized controlled trial of early skin-to-skin contact: effects on the mother and the newborn. Acta Paediatr 2010;99:1630–4.
7 Handlin L, Jonas W, Petersson M, et al. Effects of sucking and skin-to-skin contact on maternal ACTH and cortisol levels during the second day postpartum-influence of epidual analgesia and oxytocin in the perinatal period. Breastfeed Med 2009;4:207–20.
8 Widström A-M, Brimdyr K, Svensson K, et al. Skin-to-skin contact the first hour after birth, underlying implications and clinical practice. Acta Paediatr 2019;108:1190–204.
9 Nissen E, Lilja G, Widström AM, et al. Elevation of oxytocin levels early post partum in women. Acta Obstet Gynecol Scand 1995;74:530–3.
10 Lau Y, Tha PH, Ho-Lim SST, et al. An analysis of the effects of intrapartum factors, neonatal characteristics, and skin-to-skin contact on early breastfeeding initiation. Matern Child Nutr 2018;14:e12492.
11 Safari K, Saeed AA, Hasan SS, et al. The effect of mother and newborn early skin-to-skin contact on initiation of breastfeeding, newborn temperature and duration of third stage of labor. Int Breastfeed J 2018;13:1–8.
Aboagye RG, et al. BMJ Open 2022;12:e062422. doi:10.1136/bmjopen-2022-062422

12 Johar N, Mohamad N, Saddki N, et al. Factors associated with early breastfeeding initiation among women under cesarean delivery at tertiary hospitals in Kelantan, Malaysia. *Korean J Fam Med* 2021;42:40–9.

13 Beiranvand S, Valizadeh F, Hosseinabadi R, et al. The effects of skin-to-skin contact on temperature and breastfeeding successfulness in full-term newborns after cesarean delivery. *Int J Pediatr* 2014;1:1–7.

14 Moore ER, Bergman N, Anderson GC, et al. Early skin-to-skin contact for mothers and their healthy newborn infants. *Cochrane Database Syst Rev* 2016;11:CD003519.

15 Corsi DJ, Neuman M, Finlay JE, et al. Demographic and health surveys: a profile. *Int J Epidemiol* 2012;41:1602–13.

16 National Statistical Office –NSO/Papua New Guinea and ICF. *Papua New Guinea demographic and health survey 2016–18*. Port Moresby, Papua New Guinea, and Rockville, Maryland, USA NSO and ICF; 2019.

17 DHS. DHS data source. Available: https://dhsprogram.com/data/dataset/Papua-New-Guinea_Standard-DHS_2017.cfm?flag=1

18 Ehkoluenetale M, Barrow A, Benefo FO, et al. Coverage and factors associated with mother and newborn skin-to-skin contact in Nigeria: a multilevel analysis. *BMC Pregnancy Childbirth* 2021;21:1–2.

19 Ehkoluenetale M, Onikan A, Ehkoluenetale CE. Prevalence and determinants of mother and newborn skin-to-skin contact in the Gambia: a secondary data analysis. *J Egypt Public Health Assoc* 2020;95:1–9.

20 Bedaso A, Kebede E, Adamu T. Assessment of skin-to-skin contact (SSC) during the postpartum stay and its determinant factors among mothers at public health institutions in Ethiopia. *BMJ Res Notes* 2019;12:1–7.

21 Mose A, Adane D, Abebe H. Skin-to-skin care practice and its associated factors among postpartum mothers in Gurage zone, southern Ethiopia: a cross-sectional study. *Pediatric Med Ther* 2021;12:289–97.

22 von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Int J Surg* 2014;12:1495–9.

23 Ali NB, Priyanka SS, Bhui BR, et al. Prevalence and factors associated with skin-to-skin contact (SSC) practice: findings from a population-based cross-sectional survey in 10 selected districts of Bangladesh. *BMC Pregnancy Childbirth* 2021;21.

24 Fathi Najafi T, Latifnejad Roudsari R, Ebrahimipour H. The best encouraging persons in labor: a content analysis of Iranian mothers’ experiences of labor support. *PLoS One* 2017;12:e0179702.

25 Bigelow AE, Power M. Mother-infant skin-to-skin contact: short- and long-term effects for mothers and their children born full-term. *Front Psychol* 2020;11:1921.

27 Dutta MJ. Health information processing from television: the role of health orientation. *Health Commun* 2007;21:1–9.

28 Neves PAR, Barros AJD, Gatica-Dominguez G, et al. Maternal education and equity in breastfeeding: trends and patterns in 81 low-and middle-income countries between 2000 and 2019. *Int J Equity Health* 2021;20:1–3.

29 Sanchez-Espino LF, Zuniga-Villanueva G, Ramirez-GarciaLuna JL. An educational intervention to implement skin-to-skin contact and early breastfeeding in a rural hospital in Mexico. *Int Breastfeed J* 2019;14:1–9.

30 Ogbo FA, Page A, Agho KE, et al. Determinants of trends in breast-feeding indicators in Nigeria, 1999-2013. *Public Health Nutr* 2015;18:3287–99.

31 Dueñas-Espin I, León Cáceres Angela, Álava A, et al. Breastfeeding education, early skin-to-skin contact and other strong determinants of exclusive breastfeeding in an urban population: a prospective study. *BMJ Open* 2021;11:e041625.

32 Hansen K. Breastfeeding: a smart investment in people and in economies. *Lancet* 2016;387:416.

33 Chaparro CM, Lutter CK. Increases in breastfeeding duration observed in Latin America and the Caribbean and the role of maternal demographic and healthcare characteristics. *Food Nutr Bull* 2010;31:S117–27.

34 Mallick L, Yourkavitch J, Allen C. Trends, determinants, and newborn mortality related to thermal care and umbilical cord care practices in South Asia. *BMJ Pediatr* 2019:19:1–6.

35 World Health Organization. *Counselling for maternal and newborn health care: a Handbook for building skills*. World Health Organization, 2013.

36 Hill Z, Tawiah-Agyemang C, Manu A, et al. Keeping newborns warm: beliefs, practices and potential for behaviour change in rural Ghana. *Trop Med Int Health* 2010;15:1118–24.

37 Pagel C, Prost A, Hossen M, et al. Is essential newborn care provided by institutions and after home births? analysis of prospective data from community trials in rural South Asia. *BMC Pregnancy Childbirth* 2014;14:1–9.

38 Callaghan-Koru JA, Seluf A, Tholandi M, et al. Newborn care practices at home and in health facilities in 4 regions of Ethiopia. *BMC Pediatr* 2013;13:1.

39 Abdughani N, Edvardsson K, Amir LH. Worldwide prevalence of mother-infant skin-to-skin contact after vaginal birth: a systematic review. *PLoS One* 2018;13:e0205696.

40 Sakelo AN, Assefa N, Olijra L, et al. Newborn care practice and associated factors among mothers of one-month-old infants in Southwest Ethiopia. *Int J Pediatr* 2020;2020:1–7.

41 Wuneh AD, Medhanye AA, Bezabih AM, et al. Wealth-based equity in maternal, neonatal, and child health services utilization: a cross-sectional study from Ethiopia. *Int J Equity Health* 2019;18:201.

42 Obiyan MO, Kumar A. Socioeconomic inequalities in the use of maternal health care services in Nigeria: trends between 1990 and 2008. *Sage Open* 2015;5:215824015614070.

43 Bigelow AE, Power M, Gillies DE, et al. Breastfeeding, skin-to-skin contact, and mother-infant interactions over infants’ first three months. *Infant Ment Health J* 2014;35:51–62.