ปัจจัยที่สัมพันธ์กับการดูแลทารกโดยมารดาในมารดาที่คลอดลูกน้ำหนักน้อย ในโรงพยาบาลส่งต่อในบอตสวานา: การศึกษาเชิงความสัมพันธ์ภาคตัดขวาง
Factors Influencing Maternal-Infant Care Among Mothers with Low Birthweight Infants in Referral Hospitals in Botswana: A Cross-sectional Correlational Study

นิพนธ์ต้นฉบับ **Original Article**

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วารสารไทยเภสัชศาสตร์และวิทยาการสุขภาพ 2568;20(3):302-310.

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Thai Pharmaceutical and Health Science Journal 2025;20(3):302-310.

บทคัดย่อ

วัตถุประสงค์: เพื่อทดสอบความสัมพันธ์ระหว่างการดูแลทารกของมารดากับปัจจัยต่าง ๆ ในมารดาที่คลอดทารกน้ำหนักน้อยในบอตสวานา **วิธีการศึกษา:** ดำเนินการช่วงมีนาคมถึงพฤษภาคม 2567 รวบรวมมารดาที่คลอดลูกน้ำหนักน้อย 165 ราย ที่แผนกกุมารเวชและแผนกทารกแรกเกิดของโรงพยาบาล Princess Marina Hospital และ Scottish Livingstone Hospital บอตสวานา รวบรวมข้อมูลโดยใช้แบบสอบถาม Multidimensional Scale of Perceived Social Support Scale, Parental Stress Scale, Parental Health Literacy Questionnaire, Perceived Maternal Parenting Self-Efficacy Questionnaire และ Maternal Infant Care Questionnaire ทดสอบความสัมพันธ์ด้วยการวิเคราะห์ความถดถอย **ผลการศึกษา:** คะแนนการดูแลทารกของมารดาอยู่ระดับปานกลาง พบ 5 ปัจจัยร่วมทำนายความแปรปรวนของการดูแลทารกของแม่ได้ร้อยละ 45.6 พบว่ามีเพียงการรับรู้ความสามารถแห่งตนเท่านั้นที่สัมพันธ์กับการดูแลทารกของมารดา ส่วนอายุมารดา ความรอบรู้ของมารดา การสนับสนุนทางสังคม และความเครียดของมารดาไม่สัมพันธ์กับการดูแลทารกของแม่ **สรุป:** การดูแลทารกของมารดากับปัจจัยต่าง ๆ ในมารดาที่คลอดทารกน้ำหนักน้อยในบอตสวานาอยู่ระดับปานกลาง และสัมพันธ์กับการรับรู้ความสามารถแห่งตน ควรสร้างโปรแกรมที่ส่งเสริมการรับรู้ความสามารถแห่งตนเพื่อกระตุ้นการดูแลทารกของมารดา

คำสำคัญ: การดูแลทารกของมารดา; ลูกน้ำหนักน้อย; การสนับสนุนทางสังคม; การรับรู้ความสามารถแห่งตนของมารดา; ความเครียดของมารดา; ความรอบรู้ด้านสุขภาพของมารดา; บอตสวานา

Editorial note
Manuscript received in original form: June 27, 2025;
Revision notified: August 3, 2025;
Revision completed: September 24, 20255;
Accepted in final form: September 24, 2025;
Published online: September 30, 2025.

Abstract

Objective: To examine factors influencing maternal infant care among mothers with low birthweight infants in Botswana. **Methods:** From March to May 2024, a simple random sampling was applied to recruit 165 mothers of low birthweight infants from the pediatric outpatient and neonatal department in two referral hospitals, Princess Marina Hospital and Scottish Livingstone Hospital, Botswana. Data were collected using Multidimensional Scale of Perceived Social Support Scale, Parental Stress Scale, Parental Health Literacy Questionnaire, Perceived Maternal Parenting Self-Efficacy ๐ Questionnaire, and Maternal Infant Care Questionnaire. Multiple regression analysis was used to analyze data. **Results:** Maternal-infant care scores were at a moderate level. The five factors could together explain the variance of maternal-infant care for 45.6%. Only maternal self-efficacy significantly predicted maternal-infant care ($\beta = 0.663$, P-value < 0.001); while mother's age, maternal health literacy, social support, and maternal stress did not. **Conclusion:** Maternal-infant care among mothers with low birthweight infants in Botswana was a moderate level and significantly associated with self-efficacy. Maternal-infant care could be enhanced through programs promoting maternal self-efficacy.

Keywords: maternal-infant care; low birthweight infant; social support; maternal self-efficacy; maternal stress; maternal health literacy; Botswana

Journal website:
http://ejournals.swu.ac.th/index.php/pharm/index

Introduction

Infants with low birthweight are more prone to experience exceptionally high rates of infection-related mortality and morbidity as well as underweight, stunted growth, or wasting throughout infancy to childhood.[1] An estimated 14.7% of all infants born worldwide in 2020 had low birthweights.[2] Low birth weight is estimated to be 28% in South Asia, 6% in East Asia and the Pacific, and 9% in Latin America.[3] In Africa; Senegal, Burkina Faso, Malawi, Ghana, and Uganda, the incidence of low birthweight was 15.7%, 13.4%, 12.1%, 10.2%, and 10%, respectively.[4] In addition, in Morocco, 15% of babies had LBW and the percentages of LBW in Algeria and Tunisia do not surpass 7%.[5] Low birthweight affected 13.9% of infants in the African region and 16.4% of all infants in the Southern Africa region.[2]

Low birthweight (LBW) is defined by the World Health Organization (WHO) as newborns who are born weighing less than 2,500 grams, regardless of gestational age.[6] According to the World Health Organization (2010), infants who are born

weighing less than 2,500 grams are further categorized as having LBW of 1,500 - 2499 grams, very low birthweight (VLBW) of 1,000 – 1,499 grams, and extremely low birthweight (ELBW) of less than 1,000 grams.[6] Low birthweight is one of the major public health concerns in Botswana.[7] The prevalence of LBW in Botswana accounts for 25% of all the births in the country.[8] From 5% in Tlokweng to 15% in Gantsi, according to districts.[8] However, in towns to more rural areas of the nation, the proportion rises.[3] Nevertheless, the infant mortality rate in Botswana is still high at 28.3 deaths per 1,000 live births.[2] Infants born with LBW have a higher rate of readmission to the hospital following discharge from the newborn critical care unit, exhausting rare health resources in developing countries like Botswana and exposing themselves to the danger of severe damage and hospital-acquired illnesses.[7]

In Botswana, several mothers present with LBW-associated problems in infants at the hospital of which inadequate maternal-infant care can be suspected. The quality of maternal infant care could contribute to the infant's health. However, some low birthweight infants get re-admission as they present health problems like jaundiced skin, poor weight gain, and diarrhea and they are malnourished, especially low birthweight infants. In Botswana, infants under the age of six months are affected by various nutritional deficiencies, poor weight gain and malnutrition. The infants receive insufficient amounts of supplementary food perhaps too early and inadequate feeding because of recurrent episodes of diarrhea. Low birthweight infants are more likely to experience serious health problems, slower development from birth to later life, underweight, stunting or wasting from the neonatal period through childhood, and an extremely high rate of mortality and morbidity from infectious disease.[1] Septicemia, pneumonia, other specific non-infectious gastroenteritis, and volume depletion are also the main causes of these fatalities, and colitis was also discovered to be the main factor in infant mortality.[8] Inadequate maternal-infant care includes the practice of breastfeeding infants who are not breastfed for the full six months, delayed breastfeeding initiation, and interrupted breastfeeding until six months.

Mother's age influences maternal-infant care, according to an Argentinean descriptive retrospective cross-sectional study involving 170 mothers and infants.[9] Mother's age positively correlates with maternal-infant care. The likelihood of adequate maternal-infant care practices is increasingly influenced by the mother's age. Higher family income has been linked to better results for maternal-infant care and development.[10] Many studies confirm a positive relationship between maternal-infant care and family income.[10] An increasing amount of data in China indicates a positive correlation between family income and maternal-infant care.[11] Challenges resulting from a lack of social support worsen already unfavorable health outcomes of low birthweight infants.[12] Pearson's correlation showed that social support and maternal-infant care had a positive association ($r = 0.157$, P-value < 0.05) with one another.[12] Maternal infant care and maternal health literacy were significantly positively correlated ($r = 0.18$, P-value < 0.05).[13] Consistent with the study conducted by Sokefun and Atulomah (2020), a significant association was found between maternal-infant care and maternal health literacy ($r = 0.101$, P-value < 0.05).[12] Mothers who experience significant levels of stress themselves and their infants suffer a decline in their quality of life.[14] As a result, infants who have stressed-out mothers are more likely to grow up with social, emotional, behavioral, and cognitive issues. Maternal self-efficacy in prior studies analysis revealed that self-efficacy was the major predictor of maternal infant care ($R = 0.466$, $R^2 = 0.217$, P-value < 0.05).[11]

There is currently limited to no data in Botswana about studies regarding factors associated with maternal-infant care on mothers with low birthweight infants. This study intended to raise awareness about factors linked with maternal-infant care of LBW infants. The study aimed to examine the predictive relationship between a mother's age, family income, social support, maternal health literacy, maternal stress, maternal self-efficacy, and maternal-infant care among mothers with low birthweight infants in Botswana. Accordingly, it was hypothesized that mother's age, family income, social support, maternal health literacy, maternal stress, maternal self-efficacy, and maternal-infant care among mothers with low birthweight infants in Botswana.

Methods

This study was a cross-sectional, correlational predictive study on factors influencing maternal-infant care among mothers with low birthweight infants in Botswana. The data collection period was from March to May 2024. Participants

were mothers of infants with low birthweight who visited the hospital for an infant's health check-up or immunization at two referral hospitals namely Princess Marina Hospital and Scottish Livingstone Hospital in Botswana. To be eligible, participants had to be a mother with an age of 18 years old or older, be a primary caregiver of the infant, be able to speak Setswana language, have the infant's aged 1 - 6 months, have the infant's birthweight of 1,500g – 2,499 g. We excluded individuals who were mothers with known psychiatric illness (from medical record), mothers with medical constraints for exclusive breastfeeding (i.e., breast cancer and breast infections), or mothers with an infant that is critically ill with respiratory distress syndrome or congenital abnormalities.

The sample size was calculated using G*Power version 3.1.9.4. With a power to test of 95%, a type I error of 5%, an effect size of 0.15[15], and 6 independent variables, at least 150 participants were needed. To compensate for a 10% incomplete or missing data, a total of 165 participants were needed. After the survey, only 156 participants were used for final results analysis because 9 participants were excluded because of being outliers in data analysis. A simple random sampling method was used to recruit participants. Eligible mothers with low birthweight infants were identified from the hospital appointment register book, and participants were then randomly selected using a lottery method to ensure each had an equal chance of being included in the study. About 10 – 12 participants were recruited per day. Participants willing to participate signed the consent and data were collected until 165 participants were reached.

Research instruments

The questionnaire collected demographic and clinical characteristics of the participant and her infant. These included the mother's age, family income, marital status, occupation, level of education, religion, number of children, number of infants died, infant's age, gender, birth weight, current weight, and type of hospital visit.

The questions assessing **maternal infant care** (i.e., dependent variable) were modified from the Infant Care Questionnaire[16] by the researcher. The concept of maternal infant care included the mother's perceived and expressed parenting abilities. The scale measured the maternal care including maternal (i.e., the mother's ability to care for her infant), emotional (i.e., how frustrated the mother feels about her infant's negative behavior such as crying), and reactivity (i.e., how the infant responds to the mother). The scale included 22 items on a 5-point Likert-tyle scale ranging from 1 - strongly disagree to 5 - strongly agree). Higher total scores indicated a higher level of maternal infant care.

The rest of the questionnaire consisted of questions assessing the study independent variables. The Multidimensional Scale of Perceived Social Support (MSPSS) scale[17] was used to measure social support. The MSPSS was specifically designed to focus on perceived or subjective evaluation of social support adequacy from 3 sources namely family, friends, and significant others. These 12 items were rated using the response of a Likert-type scale ranging from 1-very strongly disagree, to 7-very strongly agree. The MSPSS used positive and negative phrasing to limit response set bias of agreement. The possible total scores ranged from 12 to 84 points where higher scores represented a higher level of social support.

Parental stress level was evaluated by the Parental Stress Scale (PSS).[18] The PSS describes mothers' feelings and their perceptions as a parent, both positive and negative aspects.[18] The instrument is permission-free. Each of the 18 items was rated on a 5-point Likert-type scale of 1-strongly disagree to 5-strongly agree. Scores of items of 1, 2, 5, 6, 7, 8, 17, and 18 (i.e., items with positive aspects) were reversed. With the possible total scores of 18 to 90 points, higher scores indicated a higher level of parental stress which could be further categorized as suggested by Berry and Jones (1995) to low, moderate, and high based on the normal distribution curve of the observed data.

Parental Health Literacy Questionnaire (PHLQ)[19] was used to measure **maternal health literacy**. The questionnaire consisted of 39 items within three subscales of health care health literacy (HC-HL), disease prevention health literacy (DP-HL), and health promotion health literacy (HP-HL) (12, 16 and 11 items, respectively). The response was a 4-point Likert-type rating scale ranging from 1-strongly disagree, to 2-disagree, 3-agree, and 4-strongly agree. The total score was transformed into a percentage grading system, with a full score of 100 where higher scores indicated a higher level of health literacy of the caregiver. The overall 39-question PHLQ had high internal consistency reliability (Cronbach's alpha coefficient of 0.89), high spilt-half reliability (Spearman-Brown coefficient of 0.92) and high test-retest reliability (Pearson's

correlation coefficient of 0.82). Regarding the three subscales (i.e., health care health literacy, disease prevention health literacy, and health promotion health literacy), internal consistency reliability (Cronbach's alpha coefficients of 0.72, 0.86 and 0.61, respectively), split-half reliability (Spearman-Brown coefficients of 0.75, 0.90 and 0.68, respectively), and test-retest reliability (coefficients of 0.69, 0.82 and 0.68, respectively) were at acceptable to high levels.[19]

Perceived Maternal Parenting Self-Efficacy (PMP S-E)[20] scale was used to measure the mother's perceived self-efficacy in providing infant care. Each of the 20 items was rated on a 4-point Likert-type scale ranging from 1-strongly disagree to 4-strongly agree. With the possible total scores of 20 to 80 points, higher scores reflected greater parental self-efficacy. Based on the distribution of the possible scores of 20 to 80 points found in our data, levels of self-efficacy of the PMP S-E was interpreted as the 4 subscales of caretaking procedures (range: 4 - 16 points), evoking behaviors (range: 6 - 24 points), reading behaviors and signaling (range: 7 - 28 points), and situational beliefs (range: 3 - 12 points). These 4 subscales represent perceptions about parents' ability to 1) perform tasks to meet their baby's basic needs (caretaking procedures), 2) elicit a change in the baby's behavior (evoking behaviors), 3) understand and identify changes in their baby's behavior (reading behaviors and signaling), and 4) judge their overall interaction with their baby (situational beliefs). Barnes and Adamson-Macedo (2007) reported acceptable internal consistency reliability and test-retest reliability for the total PMP S-E (Cronbach's alpha coefficient of 0.91 and Spearman r of 0.96) and the 4 subscales (Cronbach's alpha coefficients of 0.72 - 0.89 and Spearman r of 0.88 - 0.93).[20]

Research instrument quality assurance

Internal consistency reliability was tested in 30 individuals with characteristics comparable to the participants. It was found that the internal consistency reliability of maternal infant care scale, the Multidimensional Scale of Perceived Social Support (MSPSS) scale, Parental Stress scale, Parental Health Literacy Questionnaire, and Perceived Maternal Parenting Self-Efficacy scale was acceptable to high (Cronbach's alpha coefficients of 0.846, 0.887, 0.75, 0.961 and 0.964, respectively).

Human protection for participants

This research was approved by the faculty of nursing in Burapha University IRB, Ministry of Health IRB of Botswana, and the two referral hospitals. The participants were explained about the research details, objectives of the study, research procedure, and protection of human subjects. The study's anonymity, confidentiality, and voluntary nature were ensured. Signed informed consent was individual participants was obtained before the questionnaire completion.

Data collection procedure

After permitted by the Ethics Committee of Burapha University, the participants at the two study hospitals in Botswana were recruited using the hospital registry. They were randomly selected using simple random sampling. All participants who met the criteria were selected until the sample size was met. Research assistants, being the nurses working at each hospital were trained in data collection procedures and research ethics compliance. The mothers who met the inclusion criteria were invited to participate in the study. Prospective participants were provided with objectives, process, and voluntary and confidential nature of the study. After written informed consent was obtained, the participants were instructed to complete the questionnaire in a private room. The survey took 20 to 30 minutes to complete.

Statistical analysis

Descriptive statistics including mean with standard deviation and frequency with percentage were used to summary demographic and clinical characteristics of the participants and study variables. Standard multiple regression analysis was conducted to test the associations between dependent variable and independent variables. Statistical significance was set at a type I error of 5%. All statistical analyses were done using the software program SPSS version 20.

Results

Of the 156 mother participants, their age was in the range of 18 – 43 years old (Table 1). Most mothers were single (80.1%) and Christians (76.9%). The majority were self-employed mothers (37.8%) followed by student (19.9%), unemployed (17.9%), civil/private organization employee (17.3%) and housewife (7.1%). The most frequently found

education level of the mothers was tertiary level (38.5%) followed by college level (30.8%). The majority had one child (50.0%) followed by 2 children (27.6%). The average number of children was 1.87 ± 1.15. As high as 19.9% of the mothers had one infant died. The majority had family income of 1,501 – 10,000 BWP (45.5%) followed by less than 15,00 BWP (43.6%). The average family income was 3,855.38 ± 4,765.569 BWP (Table 1).

Table 1 Characteristics of the mothers (N = 156).

Characteristics	N	%
Mother age (years) (mean = 28.06, SD = 6.948, min = 18, max = 43)		
18 - 25 years	60	38.5
26 - 35 years	67	42.9
> 36	29	18.6
Marital status		
Single (mothers living with partners included)	125	80.1
Married	27	17.3
Separated	2	1.3
Widowed	1	0.6
Divorced	1	0.6
Occupational status		
Unemployed	28	17.9
Self-employed	59	37.8
Civil/Private organization	27	17.3
Housewife	11	7.1
Student	31	19.9
Religion		
Christianity	120	76.9
Islam	5	3.2
Traditional belief	14	9.0
Others	17	10.9
Education level		
Non-formal	13	8.3
Primary	10	6.4
Secondary	25	16.0
College	48	30.8
Tertiary	60	38.5
Number of children (mean = 1.87, SD = 1.15, min = 1, max = 7)		
One child	78	50.0
Two children	43	27.6
More than two children	35	22.4
Number of died infants (mean = 0.22, SD = 0.448, min = 0, max = 2)		
None	123	78.8
One child	31	19.9
Two children	2	1.3
Family income (BWP) (mean = 3,855.38, SD = 4,765.569, min = 200, max = 24,800 BWP)		
< 1,500 (110.45 USD)	68	43.6
1,501 – 11,000 (110.52 – 809.97 USD)	71	45.5
> 11,001 (810.05 USD)	17	10.9

The highest infant age was two months (35.3%) followed by 3 months (26.9%) (Table 2). There were more male infants (55.1%) than female ones. Majority of the infants weighted 2,201 – 2,499 grams (38.5%) while those with the weight of 1,801 – 2,000 grams comprised 14.7%. The average birthweight was 2,083.08 ± 283.517 grams with a range of 1,510 – 2,490 grams. The average current weight was 3,616.66 ± 1,206.29 grams with a range of 1,800 to 6,500 grams. During the hospital visit, 79.4% of the infants was well while the rest 20.6% was sick (Table 2).

Table 2 Characteristics of the Infants (N = 156).

Characteristics	N	%
Infant's age (months) (mean = 2.70, SD = 1.14, min = 1, max = 6)		
1	21	13.5
2	55	35.3
3	42	26.9
4	28	17.6
5	8	5.1
6	2	1.3
Infant's gender		
Male	86	55.1
Female	70	44.9
Infant's birthweight (grams) (mean = 2,083.08, SD = 283.52, min = 1,510, max = 2,490)		
1,500 – 1,800	32	20.5
1,801 – 2,000	23	14.7
2,001 – 2,200	41	26.3
2,201 – 2,499	60	38.5
Infant's current weight (M= 3616.66, SD= 1206.289, min= 1800, max= 6500 grams)		
Normal weight	21	13.5
Under weight	135	86.7
Type of hospital visit		
Well infant	125	80.1
Sick infant	31	19.9

Mean score of Maternal infant was at 79.56 points of 72.33% of the possible highest score of 110 points (Table 3). Among independent variables the highest mean score was maternal self-efficacy (77.19% of 80 points), followed by social support (68.83% of 84 points), maternal stress (51.82% of 90 points), and maternal health literacy (45.42% of 156 points). By average, the mother's age was 28.06 years old, and the monthly family income was 3,855.38 BWP (Table 3).

Table 3 Mean scores of study variables (N = 156).

Variables	Possible score	Actual score	Mean	SD	% of mean to possible total score
Maternal infant care	22 - 110	61 - 104	79.56	6.805	72.33%
Mother's age	≥ 18	18 - 43	28.06	6.948	n/a
Monthly family income	≥ 0	200 – 25,000	3,855.38	4,765.60	n/a
Social support	12 - 84	20 - 84	57.82	13.37	68.83%
Maternal self-efficacy	20 - 80	39 - 80	61.75	8.83	77.19%
Maternal health literacy	39 - 156	46 - 100	70.85	9.50	45.42%
Maternal stress	18 - 90	22 - 62	46.64	9.48	51.82%

Maternal infant care was significantly positively correlated with mother's age, health literacy, social support, and self-efficacy and negatively correlated with maternal stress with P-value of < 0.001 for all except for mother's age which was < 0.05. Maternal infant care was positively correlated with monthly family income with no statistical significance (Table 4).

Table 4 Pearson's correlation coefficients for studied variables (N = 156).

Variables	1	2	3	4	5	6	7
1. Maternal infant care	1.000						
2. Mother's age	0.189*	1.000					
3. Monthly family income	0.138	0.265†	1.000				
4. Maternal health literacy	0.479†	0.231†	0.347†	1.000			
5. Social support	0.281†	0.068	0.476†	0.455†	1.000		
6. Maternal self-efficacy	0.677†	0.297†	0.336†	0.670†	0.349†	1.000	
7. Maternal stress	-0.305†	-0.343†	-0.579†	-0.669†	-0.519†	-0.531†	1.000

* P-value < 0.05; † P-value < 0.01.

For regression analysis on maternal infant care with various predictive independent variables, all assumptions of regression analysis were met. However, family income did not fulfill all the assumptions of multiple regression as it had 9 outliers which later were excluded from the analysis. Notably, multicollinearity was absence as suggested by variance of inflation factor (VIF) values of all independent variables which were less than 10 (i.e., 1.190 – 2.469) (Table 5). No autocorrelation was evident with Durbin-Watson index of 1.784 which was within acceptable range of 1.5 - 2.5.

All independent variables together explained 45.6% for the variance of maternal-infant care (adj. R^2 = 0.456, F = 26.996, P-value < 0.001). However, only maternal self-efficacy served as a significant predictor of maternal-infant care at (β = 0.663, P-value < 0.001); while mother's age, health literacy social support and maternal stress did not predict (Table 5).

Table 5 Factors influencing maternal infant care* (N = 156).

Variables	B	SE	β	t	P-value	VIF
Constant	34.307	7.290	-	4.706	0.000	-
Mother's age	0.020	0.063	0.021	0.320	0.750	1.190
Maternal health literacy	0.069	0.067	0.096	1.031	0.304	2.469
Social support	0.046	0.036	0.091	1.281	0.202	1.439
Maternal self-efficacy	0.511	0.063	0.663	8.096	< 0.001	1.950
Maternal stress	0.120	0.063	0.166	1.884	0.062	2.496

* Multiple regression analysis: R = 0.688, R^2 = 0.474, adj. R^2 = 0.456, F = 26.996, P-value < 0.05.

Discussions and Conclusion

Among mothers with low birthweight infants in Botswana, we found that the mean score of maternal-infant care was 79.56 points which was 72.33% of the possible highest score of 110 points. This mean score suggests that the mother's maternal infant care was relatively moderate. Despite the score of maternal infant care subscale "the ability to care for the infant" which was higher than other subscales, majority of the infants were underweight (86.7%) while only 13.5% were with normal weight. As majority of mothers had tertiary level education (38.5%), this could have contributed to the significant score of mother's ability to care for the infant. Higher education level achievers are more likely to comprehend the depth of maternal health literacy guidelines and may be able to pinpoint their family needs for improved support and infant care.[12] Positive early maternal-infant care practices have been shown to positively impact infant's early health childhood development and cognitive development in previous research.[21] According to several studies, maternal infant care practices matter for public health because of how they contribute to outcomes for infant's health.[21]

Mothers' age could not significantly predict maternal infant care among mothers with low birthweight infants. The possible reason could be that mothers whose marital status was single was abundant (80.1%) and the number of mothers whose family income was below the minimum wage of Botswana was high (43.6%). Many mothers who are not married can have difficulties in upbringing the infant alone due to extra activities associated with childcare which can result in unsatisfactory maternal infant care. Mothers who are married have shared household responsibilities with their husbands. This could ease the maternal infant care on the mother's side. This study is not in line with other studies that confirm that mother's age influences maternal infant care. Mothers age had positive association with maternal infant care.[22]

Family income did not significantly predict maternal-infant care among mothers with low birthweight. It might be because family income builds up with age and work experience, allowing mothers to use their higher incomes to acquire better and more food and better housing for their infants. This establishes the conditions for optimal maternal-infant care. This result contradicts with a previous study as they found an increasing amount of data in China, which indicates a positive correlation between income and maternal infant care.[11] This could be that Botswana is a middle-income country as compared with countries like China, hence lower socioeconomic status which could explain no relationship between family income and maternal-infant care. Many studies confirm a positive relationship between maternal-infant care and family income.[10]

Maternal self-efficacy was a significant predictor of maternal-infant care among mothers with low birthweight infants. Maternal self-efficacy is a strong predictor because it affects a mother's behavior and relationship with her infant.

Mothers with high maternal self-efficacy are more likely to feel confident in their ability to raise their children, which can lead to more loving and positive interactions with their infants. This can therefore enhance benefits for both mother and child and encourage positive bonding and developmental process in the infant.

In Botswana, it is customary for first-time mothers to receive education from their mothers or elders regarding the care of their infant. This includes teaching them how to nurse, clean, and tend to the infant. Culturally, when new mothers have their firstborn, their mothers or elderly women educate the new mothers about maternal-infant care aspects which entail breastfeeding, cleaning the baby, and caring for the baby.[23] Higher maternal self-efficacy mothers are more likely to practice positive parenting techniques, provide their infants with more attentive and responsive care, and have more positive outcomes for the health and development of their infants. Therefore, scores for maternal self-efficacy could have been high because of one believing in their capacity, depth of knowledge and experience attained from the elders or courses from tertiary education. However, this increases maternal self-efficacy which can relate to effective and improved maternal infant care.

This finding supports the PRECEDE model which posits that maternal self-efficacy serves as a predisposing factor in predicting maternal-infant care behaviors.[24] Maternal self-efficacy in prior studies revealed that self-efficacy was the major predictor of maternal infant care ($R = 0.466$, $R^2 = 0.217$, P-value < 0.05).[11] Mothers with high levels of maternal self-efficacy are more likely to persevere, initiate practical action plans, and make flexible adjustments when faced with challenges when parenting their children.[23]

Maternal self-efficacy in caring for infants is an important means that mothers can change inadequate care into nurturing support which enables infants to achieve desired outcomes. Maternal self-efficacy was used as an enabling factor on the PRECEDE model, however, this factor facilitates the behavior occurrence to enable effective maternal infant care.[24] One path to successful maternal-infant care involves improving maternal self-efficacy. It was found that maternal self-efficacy has the strongest correlation with maternal-infant care.

Maternal stress could not significantly predict maternal-infant care among mothers with low birthweight infants. A variety of stressors can trigger the maternal stress response system. Nevertheless, it is possible that the mothers were already feeling the impact of stress from other stressors when they filled out the questionnaire in alongside caring for their infants. Parents who encounter low levels of support, health issues in their infants, family conflict, or long-term socio-environmental stressors such as deprivation are more likely to exhibit moderate to high levels of stress.

Also, majority of mothers were novice mothers with one child and were single, as a result this can overwhelm the mother and contribute to increased levels of stress thus effect maternal infant care. Low birthweight babies with health issues may contribute to maternal stress resulting in a vicious cycle of unsatisfactory mother-child relations that has a detrimental impact on everyone involved. Maternal stress has a variety of long-term adverse effects on the mother and infant care practices with the infant.[14] However, mothers who experience significant levels of stress themselves and their infants suffer a decline in their quality of life.[14] In addition, due to the mutual effects mothers and infants have on one another, the relationship between maternal stress and maternal-infant care is complex.

Maternal health literacy could not significantly predict maternal-infant care among mothers with low birthweight infants. Therefore, this study indicates that even if an abundance of mothers has reached the highest level of education, this does not imply that they are competent in maternal-infant care and health. Many mothers were new mothers with one child lacking experience in effective maternal-infant care. Inadequate postnatal care or a lack of assistance in implementing maternal-infant care practices which may contribute to the inability of health literacy to predict outcomes. Mothers with lower maternal health literacy struggle to understand essential components of pediatric anticipatory guidance, such as dealing with common child emergencies, assessing the risks and benefits of routine immunizations, and doing home safety inspections.[19]

Low maternal health literacy in parents can also relate to several negative health behaviors, such as not breastfeeding, and difficulty in giving prescribed medicine, all of which could have an adverse influence on an infant's health.[19] According to the PRECEDE model, with more education about maternal infant care, health literacy is a personal-level attribute that motivates the mother to perform effective maternal infant care

behavior prior to or during the occurrence of that behavior. However, the result is in line with another study that found a significant correlation between mothers' health literacy and maternal infant care ($r = 0.101$, P-value < 0.05).[12]

Social support could not significantly predict maternal-infant care of mothers with low birthweight infants. The mothers who receive insufficient social support may feel less capable of caring for their infants. This is in line with the notion that maternal-infant care and social support are positively correlated. This finding does not support the PRECEDE model which posits that social support serves as the reinforcing factor in predicting maternal-infant care behaviors.[24] Social support as a reinforcing factor in the PRECEDE model should influence maternal-infant care repetitively through the input of family, friends, and significant others to facilitate effective maternal-infant care.[24] Furthermore, a mother's well-established relationships with friends and family can support exceptional maternal-infant care by reducing the stress and symptoms of depression related to infant care. This is in line with previous studies, which showed that social support had statistically significant relationships with maternal-infant care practices.[25] However, mothers' stress and anxiety will be decreased if they receive appropriate social support during maternal-infant care from either family, friends or medical professionals.[12]

This study has certain limitations. The sample was drawn from two tertiary hospitals located in the southern part of Botswana which was favorable to the mothers only in the southern location of the country. The generalizability to other settings and cultures in different regions was limited.

Our findings could suggest further research. A similar study should be conducted in other referral hospitals in Botswana. More qualitative research could gain a more in-depth understanding of perceptions in different cultures regarding these factors influencing their maternal-infant care.

In conclusion, only maternal self-efficacy predicted maternal-infant care among mothers with low birthweight infants in Botswana; while social support, mothers' age, maternal stress, and maternal health literacy did not. Maternal-infant care could be enhanced by programs promoting maternal self-efficacy.

Conflict of interest

All the contributing authors declare no conflicts of interest.

Acknowledgements

The authors would like to thank all the participants for their invaluable contribution.

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