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Knowledge and Attitudes About Emergency Contraception in Among Pharmacy Users in El Alto, Bolivia: Sociocultural Factors and Use Practices

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ABSTRACT **Original Research Article**

Objective: To analyze knowledge and attitudes regarding the use and mechanism of action of emergency contraception (EC) among users of a pharmaceutical network in El Alto, Bolivia.

Methods: A cross-sectional, descriptive, and observational study was conducted in five pharmacy branches during the second semester of 2023. An anonymous, self-administered questionnaire was applied to a non-probabilistic convenience sample of 490 participants. Data were analyzed using descriptive statistics and exploratory residual analysis (Haberman residuals) to identify associations between educational level and EC-related knowledge.

Results: The sample had a mean age of 33.7 years (±8.43), with only 17.1% of participants in the 18–25 age group. Male participants represented 15.5% of the sample, and 12% declined to state their sex. While 40.8% reported university-level education, 41.6% reported incomes below the Bolivian minimum wage (Bs 2,220). Although 67% reported previous use of EC and 66% stated familiarity with the method, significant gaps were identified: 51% did not know if EC could replace regular contraception, and responses regarding fertilization were fragmented. Nausea and vomiting were the most perceived side effects (37%). Residual analysis indicated significant associations between education level and knowledge accuracy. All participants (100%) agreed that more EC information should be disseminated.

Conclusion: Frequent use of EC coexists with critical limitations in reproductive health literacy. The study population, primarily composed of adults in their 30s rather than adolescents, exhibits economic vulnerability and uncertainty regarding the appropriate role of EC. Community pharmacies are strategic settings for educational interventions, provided that counseling involves both partners and addresses identified knowledge gaps. Methodological limitations, such as the convenience sampling and lack of local cultural validation, must be considered.

Keywords: Reproductive Health, Pharmacist, Surveys, Questionnaires.

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Introduction

Hormonal emergency contraception (EC) comprises pharmacological methods intended to prevent unplanned pregnancy in the immediate period following unprotected intercourse, under contraceptive misuse or in cases of sexual assault (WHO, 2021). Various international bodies, including

the World Health Organization (WHO) and the International Federation of Gynecology and Obstetrics (IFGO), have established that promoting and facilitating access to EC is a key public health strategy to reduce rates of unintended pregnancy and, thus, recourse to unsafe abortion (IFGO, 2018; WHO, 2021).

The clinical efficacy of EC is time-dependent, being able to prevent more than 95% of pregnancies if administered within five days after intercourse; however, its optimal effectiveness is reached in the first 24 to 72 hours (WHO, 2021). This availability is critical for women with unmet contraceptive needs and to guarantee the right to reproductive health after situations of sexual violence (WHO, 2018).

In the context of Latin America, regulation and access to EC present a heterogeneous panorama influenced by regulatory tensions, cultural barriers and socioeconomic disparities (Morán-Faúndes, 2016). In Bolivia, the State has integrated contraception within the free benefits of the public system through the Universal Maternal and Child Insurance (SUMI). This legal backing is consolidated in the *National Standard: Rules, Protocols and Procedures in Contraception* (2012) and in the *National Strategic Plan for Sexual and Reproductive Health* (2009-2015), both of which protocolize the use of EC within 72 hours after unprotected vaginal intercourse (Bolivia, 2010; Bolivia, 2012).

However, the existence of this guarantor regulatory framework has not necessarily translated into effective health literacy. A critical gap persists between the availability of the method and the actual knowledge of the population: according to the *National Demographic and Health Survey* (Bolivia, 2017), only 13% of women and 14% of men with a partner reported knowing the fundamental characteristics of EC, evidencing an information deficit that compromises reproductive autonomy.

This cognitive vulnerability is particularly acute in adolescents and adult female (10-30 years), who face greater exposure to unplanned pregnancies due to early sexual debut and inconsistent use of barrier or long-acting methods (Palacios et al., 2022). Despite programmatic efforts, levels of technical knowledge about EC in this age group remain insufficient (Palacios et al., 2022). This misinformation, frequently fed by unofficial sources and by persistent social stigmatization that erroneously identifies the method as abortive, constitutes a structural barrier that limits the adequate and timely use of this health technology (Palacios et al., 2022).

Given this scenario of misinformation and structural barriers, the present study analyzed the knowledge and attitudes regarding the use and mechanism of action of EC among users of a network of pharmacies in El Alto, Bolivia. The purpose was to generate evidence to support pharmaceutical intervention strategies aimed at promoting rational use and reproductive health literacy in this population.

Methods

Design and Scope

The study was conducted in five branches of the Bolivia Pharmacy Network, located in the city of El Alto, department of La Paz, which has an estimated population of 1,109,048 inhabitants (Bolivia M.P.D., 2020).

A quantitative, cross-sectional, observational, and descriptive design was adopted to characterize the levels of knowledge and attitudes regarding the use of hormonal emergency contraception (EC) among users of community pharmacies. The study aimed to identify patterns of perception, understanding, and behavior related to EC use without establishing causal relationships, focusing instead on describing the magnitude and trends of the observed phenomena. Although the study was initially intended to focus on adult female users, the final sample included participants of different sexes and age groups due to the voluntary and non-probabilistic recruitment process. Therefore, the findings should be interpreted considering the limitations related to sample representativeness and potential selection bias.

Population and Sample

The reference population consisted of users attending branches of the pharmacy network during the second half of 2023. An estimated population of approximately 6,000 clients was considered for a three-month period.

A non-probabilistic convenience sampling approach was used, including participants who voluntarily agreed to complete the survey when requesting hormonal emergency contraceptives. Although the study was initially intended to focus on adult female users, the final sample included participants of different sexes and age groups according to availability and willingness to participate during the data collection process. Due to this recruitment approach, the findings are not intended to be representative of the general population and should be interpreted considering the potential selection bias inherent to the sampling method employed.

Data Collection Instrument

Data were collected using an anonymous self-administered questionnaire. After the screening and data-cleaning process, 490 valid responses were included in the final analysis.

The questionnaire consisted of multiple-choice questions adapted from instruments previously used in related studies (Bandeira, 2003; United Kingdom, 2022; United States of America, 2021). Although these instruments had been applied in other contexts, no formal cultural validation or pilot testing was conducted specifically for the population of El Alto, Bolivia. Therefore, the findings should be interpreted considering the potential limitations related to cultural adaptation, comprehension of items, and self-reported responses.

The instrument was organized into three main sections: (1) sociodemographic characteristics of participants, including sex, age, educational level, income, ethnicity, and marital status; (2) knowledge and attitudes regarding the use and mechanism of action of hormonal emergency contraception (EC), including perceptions related to fertilization, pregnancy, and contraceptive effectiveness; and (3) sexual experience and contraceptive history, with emphasis on EC use patterns. The inclusion of broader reproductive health knowledge items aimed to contextualize participants' understanding of EC within general concepts of sexual and reproductive health.

Because participant recruitment was voluntary and conducted at pharmacy settings, the final sample included individuals of different sexes and age groups. Responses from all participants were retained in the descriptive analysis to provide an overall characterization of knowledge and attitudes related to EC use among pharmacy users. The analysis was primarily descriptive and focused on reporting frequencies and distributions of responses; no inferential statistical analyses were performed to assess associations between sociodemographic variables and EC-related knowledge or behaviors.

Data Processing and Analysis

Prior to data collection, pharmacists from each participating branch received standardized training to ensure uniformity in questionnaire administration and compliance with ethical procedures for participant protection. Free, Prior, and Informed Consent (FPIC) was obtained from all participants in accordance with national ethical regulations (Bolivia, 2008).

Data were processed using descriptive statistical methods, including absolute and relative frequencies to characterize sociodemographic variables, knowledge and attitudes toward hormonal emergency contraception (EC), and contraceptive use practices. Questionnaire items were organized into three analytical domains: (1) sociodemographic characteristics; (2) knowledge and attitudes regarding EC; and (3) practices related to EC use. Broader reproductive health questions were included to contextualize participants' understanding of EC within general sexual and reproductive health knowledge. In addition to descriptive statistics, an exploratory residual analysis based on adjusted standardized residuals (Haberman residuals) was performed to identify specific associations between categorical variables in contingency tables. Residuals values greater than +1.96 or lower than -1.96 were considered indicative of statistically significant deviations between observed and expected frequencies at the 5% significance level. This analysis was applied particularly to explore associations between educational level and EC-related knowledge. No additional inferential statistical analysis were conducted.

The interpretation of findings was guided by the social determinants of health framework proposed by Göran Dahlgren and Margaret Whitehead, considering the influence of structural, economic, and cultural factors on reproductive health behaviors. Given the composition of the final sample, interpretations were directed toward pharmacy users in general rather than exclusively toward young women or adolescents. Information regarding the minimum wage in Bolivia was obtained from the DatosMacro platform.

Results

The findings reveal a population of pharmacy users with a relatively high educational profile, with 40.8% reporting university-level education, but also marked economic vulnerability, as 41.6% reported incomes below the Bolivian minimum wage Although 67% reported previous use of emergency contraception (EC) and 66% stated that they had knowledge about its use, important gaps in understanding were identified. In particular, 51% of participants reported not knowing whether EC could replace regular monthly contraception, indicating uncertainty regarding its appropriate use (Table 1).

Table 1. Sociodemographic Characteristics.

Question Description	
Mean age (years)	
Total respondents (n = 453)	33.7 years (SD 8.43)
18 - 25 years	84 (17.14)
26 -35 years	194 (39.59)
36 – 51 years	175 (35.71)
Declined (n = 37)	7.55% did not respond
Sex (n = 490)	**n (%)**
Female	355 (72.44)
Male	76 (15.51)
Declined	59 (12.00)
Ethnicity (n = 490)	
Ethnic minority	135 (27.55)
White	72 (14.69)
Declined	283 (57.76)
Education level (n = 490)	
University	200 (40.82)
High school	73 (14.90)
Primary education	71 (14.49)
Declined	146 (29.80)
Has a partner (n = 490)	
No	228 (46.53)
Yes	136 (27.76)
Declined	126 (25.71)
Marital status (n = 490)	
Single	216 (44.08)
Married	77 (15.71)
Separated	77 (15.71)
Widowed	0 (0)
Declined	120 (24.49)
Income in Bolivianos Bs (US$) (n = 490)	
Less than 2,220 Bs (US$ 317.14)	204 (41.63)
Between 1–2 minimum wages (Bs 2,221–4,440) (US$ 317.15–634.28)	71 (14.49)
Between 2–3 minimum wages (Bs 4,441–6,660) (US$ 634.29–951.42)	0 (0)
Between 3–4 minimum wages (Bs 6,661–8,880) (US$ 951.43–1,268.57)	43 (8.78)
Between 4–5 minimum wages (Bs 8,881–11,100)	35 (7.14)
Declined	137 (27.96)

Note: SM = Minimum wage

Despite the economic constraints identified, a relatively high prevalence of use and awareness of hormonal emergency contraception (EC) was observed among participants. Sixty-seven percent reported having used EC at least once, while 66% stated that they had knowledge about its use or mechanism of action. In addition, 67% considered EC effective in preventing unintended pregnancies. Regarding perceptions of the method, 44% evaluated EC positively, classifying it as “very good” (23%) or “good” (21%), whereas 18% evaluated it negatively and 18% preferred not to respond. These findings indicate generally positive perceptions of EC among a substantial proportion of participants, although important uncertainties and divergent views remain.

Table 2. Survey responses on knowledge and perceptions regarding contraception and sexual health.

Question Description	**Number of Respondents (n, %)**
What are the basic conditions for fertilization?	
Sperm	102 (21)
Ovary	100 (20)
Genital tract	92 (19)
Uterus	93 (19)
All of the above	103 (21)
The essential condition for choosing a contraceptive method is:	n (%)
Safety of the contraceptive method	182 (37)
Effectiveness of the contraceptive method	151 (31)
Sensation/comfort of using a contraceptive method	1 (0)
Convenience of purchasing or using the method	0
Emergency contraception (ECP)	156 (32)
Which contraceptive methods do you believe are most effective?	n (%)
Male condom	141 (29%)
Oral contraceptive pills	139 (28%)
Rhythm method	76 (15%)
Subdermal hormonal implant (Norplant)	74 (15%)
Intrauterine device (IUD)	60 (12)
Emergency contraception method	0
Withdrawal method	0
Female condom	0
Vaginal contraceptive ring	0
Do not know	0
Do you believe there may be an impact on female health?	n (%)
Not at all	194 (40)
Slightly	95 (19)
Severe	200 (41)
Uncertain	1 (0)
Do you believe there may be an impact on pregnancy?	n (%)
Yes	338 (69)
No	152 (31)
Do you think it is necessary to understand contraceptive methods?	n (%)
Necessary	342 (70)
Unnecessary	148 (30)
Do you believe that adolescents and young women need sexual education?	n (%)
They need it	353 (72)
They do not need it	137 (28)
Do you agree that "sexual education is important"?	n (%)
Agree	488 (100)
Disagree	2 (0)
What is your attitude toward premarital sexual behavior?	
If I have a boyfriend/girlfriend	106 (22)
It does not matter; if I have feelings for him/her, I can accept it	97 (20)
If I am prepared to marry him/her, I can accept it	89 (18)
I do not agree with premarital sexual relationships	80 (16)
Declined	118 (24)
Who should be responsible for contraception?	
Both partners share responsibility	256 (52)
Woman	123 (25)
Man	111 (23)
Neither partner assumes responsibility	0

However, important gaps and uncertainties regarding the correct use of EC were identified. The majority of respondents (51%) answered "Don't know" when asked whether EC could completely replace regular contraception, while only 27% correctly stated that it could not. These findings suggest limited understanding regarding the appropriate role of EC within regular contraceptive practices. Regarding perceived side effects, nausea and vomiting were the most frequently reported responses (37%), followed by concerns related to fertility, weight gain, and menstrual cycle irregularities (Table 3).

In addition to descriptive statistics, an exploratory residual analysis based on adjusted standardized residuals (Haberman residuals) was performed to identify specific associations between categorical variables within contingency tables. Residual values greater than +1.96 or lower than −1.96 were considered indicative of statistically significant deviations between observed and expected frequencies at the 5% significance level. This approach allowed the identification of categories contributing most strongly to the observed associations, particularly in the analysis of educational level and EC-related knowledge.

Table 3. Practices related to the use of emergency contraception among study participants (n=490).

Question Description	**Number of respondents (n;%)**
Do you have knowledge about the use of emergency contraceptives?	
Yes	324 (66)
No	166 (34)
Do you consider that emergency contraception serves to prevent unwanted pregnancies?	
Yes	327 (67)
No	163 (33)
Do you believe that the emergency contraceptive method can completely replace monthly contraception?	
Can	106 (22)
Cannot	132 (27)
Don't know	252 (51)
Do you believe that more information should be disseminated about the use of emergency contraception?	
Yes	490 (100)
No	0
Have you ever used emergency contraception?	
Yes	328 (67)
No	162 (33)
Do you consider the use of emergency contraception to be useful?	
Yes	261 (53)
No	229 (47)
What is your opinion on emergency contraception?	
Very good	111 (23)
Good	103 (21)
Regular	101 (21)
Bad	87 (18)
PND	88 (18)
What are the side effects of oral emergency contraception?	
Nausea/vomiting	180 (37)
Affects fertility	107 (22)
Risk of weight gain	102 (21)
Affects menstrual cycle regularity	101 (21)
Has no side effects	0
Note: PND: prefer not to say.	

Finally, the findings reinforce the perceived importance of sexual education and access to reliable information regarding emergency contraception. Participants demonstrated broad support for educational initiatives and recognized shared responsibility in contraceptive practices. These results suggest that educational and counseling strategies in community pharmacy settings may contribute to improving reproductive health literacy and promoting informed contraceptive decision-making

Discussion

The high prevalence of emergency contraception (EC) use observed in this sample (67%) may reflect not only the accessibility of the method, but also important gaps in reproductive health literacy and limitations in access to consistent family planning information. Health literacy encompasses the knowledge, skills, and motivations that enable individuals to access, understand, and apply information in health-related decision-making processes (Sørensen et al., 2012). In the present study, although most participants reported previous use or knowledge of EC, substantial uncertainty regarding its appropriate role was identified, as 51% stated that they did not know whether EC could replace regular monthly contraception. These findings suggest limitations in participants' understanding of the appropriate indications and use of EC.

The results also indicate difficulties related to basic reproductive health knowledge. Responses regarding the biological conditions necessary for fertilization were fragmented across different alternatives, including spermatozoa (21%), ovaries (20%), genital tract (19%), uterus (19%), and "all of the above" (21%). Such variability may indicate limited understanding of reproductive physiology, which can affect comprehension of the mechanism of action and appropriate use of EC. In this context, EC may be perceived primarily as an immediate preventive measure rather than as part of broader contraceptive planning.

An additional aspect observed in this study was the participation of male respondents (15.5% of the sample). Although the study was initially designed to focus on adult female users, the inclusion of men may reflect their participation in the acquisition of EC within pharmacy settings, as previously described in the literature (Rafie et al., 2017). This finding highlights the potential importance of involving both partners in reproductive health education and counseling strategies.

International evidence reinforces that EC should not be considered a regular maintenance contraceptive method (safe2choose.org, 2024). In addition, previous studies have shown that cultural barriers, misinformation, and social stigma may influence perceptions regarding EC, including misconceptions about its mechanism of action and its association with abortive practices (Palacios et al., 2022; Rodríguez, 2013). The findings of the present study are consistent with this broader context and suggest the need for educational strategies aimed at improving reproductive health literacy and informed contraceptive decision-making among pharmacy users.

Considering that community pharmacies are frequently one of the first points of access for EC, pharmacists may play an important role in providing evidence-based information, counseling on correct use, and guidance regarding regular contraceptive options. However, this study did not directly assess the quality of pharmacist counseling or pharmacist-patient interactions, and therefore conclusions regarding the effectiveness of pharmaceutical interventions should be interpreted cautiously.

Socioeconomic Impact and Cultural Determinants in Access to EC

The sociodemographic profile observed in this study suggests that social and economic conditions may influence access to reproductive health information and contraceptive practices. A substantial proportion of participants reported monthly incomes below the Bolivian minimum wage (41.6%), indicating potential economic vulnerability within the sample. According to the social determinants of health model proposed by Göran Dahlgren and Margaret Whitehead (1991), living conditions and socioeconomic factors can directly affect health behaviors and access to healthcare resources. In this context, emergency contraception (EC) may represent a more immediately accessible option for some users when compared with regular contraceptive methods that require continuous follow-up or additional healthcare access.

The findings also suggest challenges related to access to reliable reproductive health information. Participants reported different sources of information regarding EC, including internet-based resources and health professionals. Reliance on digital information sources may increase exposure to misinformation when users have limited opportunities for evidence-based counseling or difficulties in critically evaluating online content. These results may reflect barriers related to accessibility, communication, or perceived stigma within formal healthcare services.

In addition, a high proportion of participants preferred not to report their ethnicity. This pattern may be associated with concerns related to privacy, stigma, or social discrimination, factors that have historically affected indigenous populations in reproductive healthcare contexts in Bolivia (Duran& Edgar, 2020). The omission of ethnic self-identification may also limit the interpretation of social inequalities and their relationship with reproductive health outcomes within the study population.

The Community Pharmacist as an Agent of Literacy and Public Health

Community pharmacists may play an important role in improving access to evidence-based information regarding emergency contraception (EC), particularly in settings where pharmacies represent one of the first points of contact with reproductive health services. In the present study, the high prevalence of EC use (67%) coexisted with important uncertainties regarding its appropriate use, especially considering that 51% of participants reported not knowing whether EC could replace regular contraception (Rafie et al., 2017). In addition, all respondents indicated that more information about EC should be disseminated, suggesting a perceived need for educational support and counseling.

International guidelines emphasize that EC should be used as an emergency contraceptive method and does not provide protection against sexually transmitted infections (WHO, 2015; Safe2choose.org, 2024). In this context, pharmacists may contribute to reproductive health literacy by providing information about correct use, timing, effectiveness, possible adverse effects, and the importance of regular contraceptive methods. Counseling activities may also help reduce misconceptions and fears associated with EC use, including concerns related to side effects such as nausea and vomiting, which were among the most frequently reported perceptions in this study (Soriano et al., 2010; WHO, 2015).

The participation of male respondents in the sample (15.5%) also suggests that reproductive health counseling strategies could benefit from involving both partners in contraceptive education. Previous studies have indicated that men may participate in the acquisition of EC within pharmacy settings, potentially influencing access to information and decision-making processes related to contraceptive use (Rafie et al., 2017).

From the perspective of the social determinants of health proposed by Göran Dahlgren and Margaret Whitehead (1991), economic vulnerability and limitations in health literacy may contribute to unequal access to reproductive health resources. In the present study, 41.6% of participants reported incomes below the Bolivian minimum wage, suggesting that socioeconomic conditions may influence contraceptive choices and access to healthcare information. In this context, community pharmacies may represent accessible environments for educational interventions aimed at promoting informed contraceptive decision-making and improving reproductive health literacy.

Nevertheless, the present study did not directly evaluate pharmacist-patient interactions, counseling quality, or the effectiveness of pharmaceutical interventions. Therefore, conclusions regarding the specific impact of pharmacists on EC-related knowledge and behaviors should be interpreted cautiously and considered as potential implications for future public health and pharmaceutical care strategies rather than direct findings of the study.

Limitations of the Study

The present study has several limitations that should be considered when interpreting the findings. First, although the questionnaire was adapted from instruments previously used in related studies, no formal cross-cultural validation or pilot testing was conducted specifically in the context of El Alto, Bolivia. This limitation may have affected item comprehension, cultural adequacy, and the comparability of responses with those obtained in other sociocultural settings.

Second, the study was conducted exclusively in pharmacy branches located in the municipality of El Alto, which limits the geographic representativeness of the findings and restricts their transferability to other regions of Bolivia with different socioeconomic, cultural, or healthcare access characteristics.

In addition, the use of a non-probabilistic convenience sampling strategy limits the representativeness of the sample and prevents statistical generalization of the results to the broader population. Although the study was initially intended to focus on adult female users, the voluntary recruitment process resulted in the inclusion of participants of different sexes and age groups, including male respondents. This variability should be considered when interpreting the findings related to knowledge, attitudes, and perceptions regarding emergency contraception (EC).

Another limitation relates to the exclusively descriptive nature of the analysis. No inferential statistical analyses were performed to explore associations between sociodemographic variables and EC-related knowledge, attitudes, or use patterns. Therefore, the study does not allow the identification of predictors or causal relationships associated with reproductive health literacy or contraceptive practices.

Finally, because the data were self-reported, the results may be subject to social desirability bias and recall bias, particularly considering the sensitive and potentially stigmatized nature of sexual and reproductive health issues in the study context. In addition, possible cultural and linguistic differences in the interpretation of questionnaire items should be considered when analyzing self-reported knowledge and perceptions. These limitations are common in studies involving perceptions, attitudes, and health-related behaviors.

Conclusion

The findings of this study indicate a high prevalence of emergency contraception (EC) use among participants, accompanied by important gaps in knowledge regarding its appropriate use and mechanism of action. Although most respondents reported previous use or awareness of EC, substantial uncertainty persisted concerning its role as an emergency method and its distinction from regular contraceptive practices. In particular, 51% of participants

reported not knowing whether EC could replace regular contraception, suggesting limitations in reproductive health literacy within the study population.

The results also suggest that socioeconomic conditions may influence access to reproductive health information and contraceptive practices. A considerable proportion of participants reported incomes below the Bolivian minimum wage, indicating potential economic vulnerability that may affect access to regular family planning methods and healthcare services. In addition, the use of internet-based information sources highlights the importance of improving access to reliable and evidence-based reproductive health information.

Community pharmacies may represent strategic settings for health education and counseling regarding EC, particularly because they are frequently one of the first points of access for contraceptive products. In this context, pharmacists may contribute to improving reproductive health literacy by providing guidance on the correct use of EC, possible adverse effects, and the importance of regular contraceptive methods. The participation of male respondents in the study also suggests that educational strategies involving both partners may be relevant for promoting shared responsibility in reproductive health decision-making.

However, the findings should be interpreted considering the methodological limitations of the study, including the non-probabilistic sampling strategy, the absence of local cultural validation of the questionnaire, and the descriptive nature of the analysis. Therefore, the conclusions are not intended to be generalized to the broader Bolivian population.

Finally, the study highlights the importance of strengthening reproductive health education and access to reliable contraceptive counseling in community settings. Future research using validated instruments and analytical approaches capable of exploring associations between sociodemographic factors and contraceptive knowledge may contribute to a more comprehensive understanding of emergency contraception use and reproductive health literacy in Bolivia.

Participation Statement

WLTM is responsible for conceptualization and formulation of ideas; data curation; formal analysis; research; methodology; visualization and writing (original draft and revision).

PAES is responsible for conceptualization and formulation of ideas; formal analysis; methodology; visualization; supervision and writing (review and editing).

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