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SPATIAL MODEL OF DETERMINANTS OF CONTRACEPTION UNMET NEED IN MUARO JAMBI DISTRICT IN 2020-2021

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Abstract—The determinants of unmet need for contraception vary between regions, so they have different influences for each location. Therefore, it is necessary to map cases and risk factors for unmet need for contraception in Indonesia based on the district/city level. This research aims to determine the determinants of the unmet need for contraception by considering spatial aspects. This research was carried out in 155 Muaro Jambi Regency, Jambi Province villages, using secondary for 2020 and 2021, with an analysis unit of 155 villages in Muaro Jambi Regency. This research uses an ecological study research design with analysis of Moran's index, Moran's scatterplot, and spatial regression SAR, which are used to determine the spatial determinants of unmet need for contraception. This research was carried out from March to December 2022. There has been an increasing unmet need for contraception from 16.8% in 2020 to 20.6% in 2021. In addition, there is positive spatial autocorrelation between villages in Muaro Jambi Regency, seen from the p-value <0.05. Based on the results of spatial regression SAR, the variables that are significantly related in 2020 are the number of cadres (0.001), early marriage (0.022), and education level (0.00). Meanwhile, in 2021, education level has a significant influence, with a p-value of 0.000. This research is expected to provide a contribution in the form of information and input for central and regional governments in prioritizing intervention programs to reduce the unmet need for contraception at the district/city level so that the programs designed are more targeted.

Keywords: Unmet need for Contraception, determinants, spatial analysis

1. Introduction

Unmet need for contraception is an unmet need for family planning services in which married women do not want to have more children or want to space out subsequent births but do not use contraceptive contraception(Bradley dkk., 2012; Westoff, 2006). Globally, in 2022, there will be 270 women with unmet needs, and in developing countries, 1 in 3 women of reproductive age will have unmet needs(UNFPA, 2022b; United Nations, 2022). In Indonesia, the trend in the number of unmet needs for contraception continues to increase from 2017 to 2021, with a figure of 11% to 18% and a target of 8.3% in 2021(BKKBN, 2021, 2022). It is the only indicator of BKKBN achievement that has not been achieved, so that in FP 2022 makes unmet needs the main focus of family planning service targets in FP 2030 (UNFPA, 2022b).

The high Unmet Need in Indonesia is, of course, influenced by the high Unmet Need for contraception in the provinces of Indonesia. One of them is Jambi province, with the level of *unmet need* continues to increase from 2018 to 2020 (Badan Pusat Statistik Provinsi Jambi, 2022). Jambi Province consists of 11 regencies/cities. Muaro Jambi Regency is one of the regencies with the highest rate of unmet need for contraception in 2021 in Jambi Province at 14.54% with a total of 71,568 couples of childbearing age.

The unmet need for contraception is a major cause of unintended pregnancy in developing countries(Agyekum dkk., 2022; Alie dkk., 2022; Negash dkk., 2023) Moreover, it causes 121 million unintended pregnancies globally (Harzif dkk., 2022; Machiyama dkk., 2017). In Indonesia, the rate of desired pregnancy was 40 per 1,000 women aged 15-49 in 2015-2019(UNFPA, 2022a). By addressing unmet needs, contraception can prevent more than 141 million unintended pregnancies, 29 million unsafe abortions, and nearly 150,000 maternal deaths each year (UNFPA, 2022a).

Research on the unmet need for contraception in Indonesia has yet to consider regional factors, even though regional factors are one of the important variables related to the unmet need for contraception. Moreover, several other countries have begun to consider regional factors and recommend that intervention models for unmet needs for contraception should consider regional characteristics (Azanaw dkk., 2022; Nyarko, 2020; Oyeronke Alaba dkk., 2015; Pal dkk., 2018; Pezzulo dkk., 2021; Rahaman dkk., 2022; Sharma dkk., 2021; Tegegne dkk., 2020; Yesuf dkk., 2020). Therefore, in an effort to reduce the unmet need for contraception, knowing the prevalence, geographic variations, and distribution of unmet needs across regions is important. This research tries to see the distribution pattern of the spread of the unmet need for contraception and its determinants in 155 villages of Muaro Jambi Regency using spatial analysis

2. Methods

This research uses an ecological study approach with an analysis unit of 155 villages in Muaro Jambi Regency. All data relating to the unmet need for contraception obtained from secondary data from the Muaro Jambi Regency BKKBN was processed into Microsoft Excel and then analyzed with the help of Geo D, a 1.2 software. This research uses a thematic map aimed at showing the distribution of the proportion of unmet need for contraception cases per village, Moran's index analysis to see the distribution pattern of unmet need for contraception, Moran's scatterplot with Local Indicator for Spatial Autocorrelation (LISA) to see the grouping and distribution pattern between locations, both Hot Spots and Low Spot area and spatial regression SAR (Spatial Autoregressive Model) which were used to conduct a spatial model analysis of the determinants of unmet need for contraception in 155 villages in Muaro Jambi Regency in 2020-2021

3. Result

Muaro Jambi is one of the districts in Jambi Province, Indonesia; the population of Muaro Jambi district is 406,799 people. Geographically, Muaro Jambi Regency is located between 1°15'-2°20' Latitude and between 103°10'-104°20' Longitude. Muaro Jambi Regency is one of 11 regencies/cities in Jambi Province with an area of 532,600 Ha (5,326 km^2). It is at an altitude of 0-38 meters above sea level where Muaro Jambi Regency is divided into sub-districts and 155 villages/sub-districts (BPS, Muaro Jambi Regency, 2021).

Figure 1 Administrative Map of Muaro Jambi Regency According to Village/Subdistrict

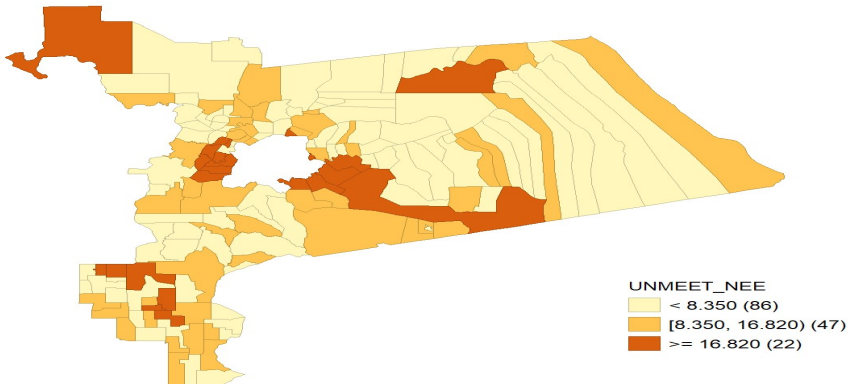

Figure 2. Thematic map of the distribution of contraceptive Unmet Need in Muaro Jambi Regency in 2020

Based on Figure 2 shows the distribution of incidents of unmet need for contraception in Muaro Jambi Regency in 2020, where the incidence rate of unmet need <8.35% is found in 86 villages, the incidence rate is between 8.35%-16.82% in 47 villages and the level The incidence of unmet need was 16.82% in 22 villages.

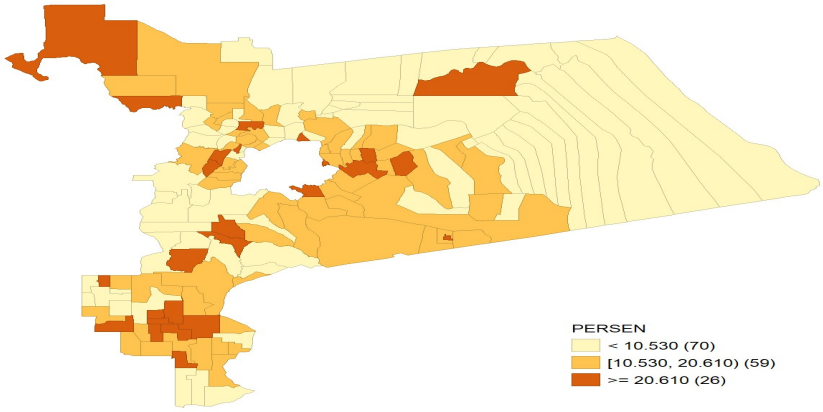

Figure 3 Thematic map of the distribution of Unmet Need for contraception
in Muaro Jambi Regency in 2021

Based on Figure 3 shows the distribution of incidents of unmet need for contraception in Muaro Jambi Regency in 2021, where the incidence rate of unmet need <10.53% is found in 70 villages, the incidence rate is between 10.53%-20.61% in 59 villages and the level The incidence of unmet need was 20.61 in 26 villages.

Based on the results of Moran's test or Moran's Index, it is generally used to measure spatial autocorrelation globally and can be applied to detect the onset of spatial randomness. In the following table are the results of the Moran's Index analysis carried out in Muaro Jambi Regency to see the distribution of Unmet Needs for

contraception in 2020-2021:

Table 1 Distribution Pattern of Unmet Need for contraception in Muaro Jambi Regency 2020-2021

Year	Moran Index	P value	Distribution Pattern
2020	0.201	0.002	Clustered
2021	0.346	0.001	Clustered

The results of spatial autocorrelation analysis of Unmet Need cases in 2020 and 2021 show that there is positive autocorrelation in each year with a p value <0.05. The distribution pattern of Unmet Need cases in 2020 and 2021 shows a clustered distribution pattern .

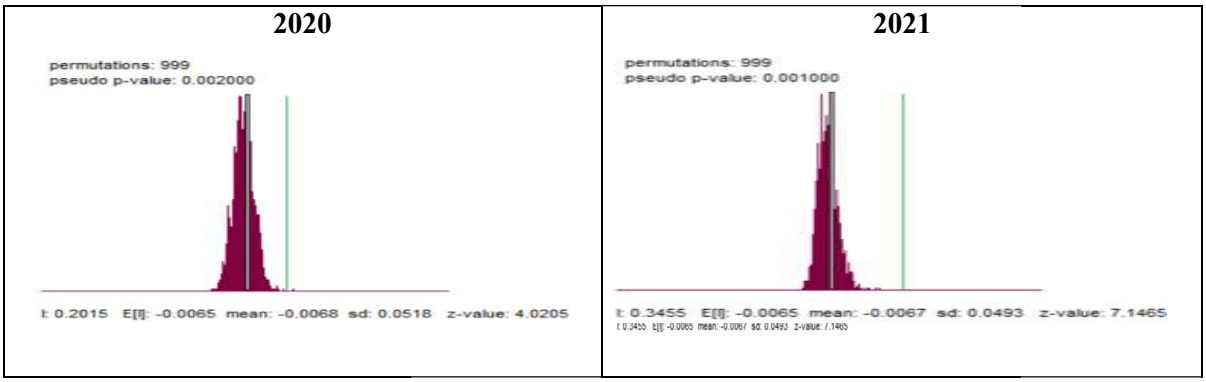

Figure 4 Diagram of Unmet Need Relationship Patterns in Muaro Jambi Regency 2020-2021

Spatial dependence between villages/sub-districts can be proven by the results of Moran's test, where it was concluded that Unmet Need in Muaro Jambi Regency shows that globally, there is a tendency for positive autocorrelation. This can be proven by the results of Moran's Scatterplot in the image below:

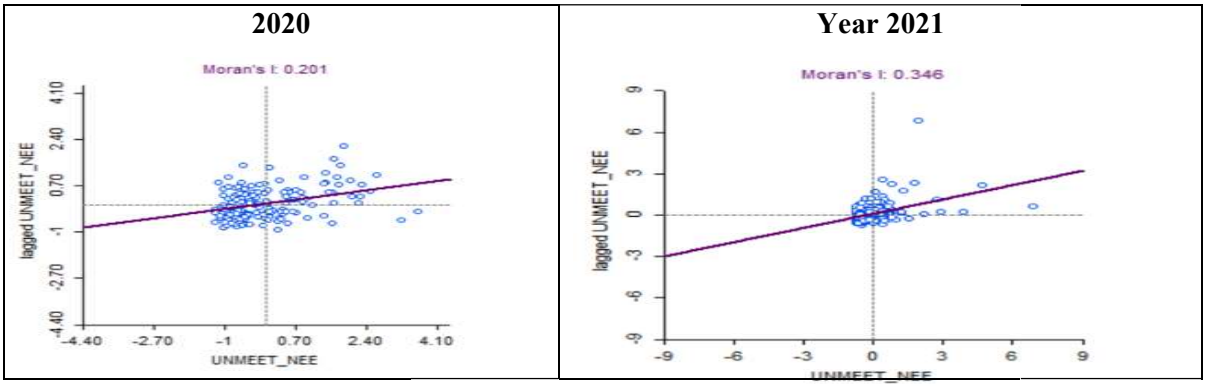

Figure 5 Moran's Scatterplot

1. Local Unmet Need Autocorrelation

The Local Indicator of Spatial Autocorrelation (LISA) test aims to find local area-based Unmet Need distribution/clustering patterns. Clustering of Unmet Need cases according to villages/subdistricts is divided into four quadrants, namely as follows:

1) Quadrant I: Villages/sub-districts with high levels of Unmet Need are surrounded by villages/sub-districts with also high Unmet Need. On the map are villages/subdistricts in bright red, identified as HH (High-High) villages/subdistricts or Hot Spots found in 10 villages/subdistricts in 2020 and 12 villages/subdistricts in 2021.
2) Quadrant II: Villages/sub-districts with a low number of Unmet Need cases but surrounded by villages/sub-districts with a high number of Unmet Need cases. On the map are villages/subdistricts marked in faded blue, identified as LH (Low-High) villages/subdistricts, which were found in 3 villages/subdistricts in 2020 and 3 villages/subdistricts in 2021.
3) Quadrant III: Villages/sub-districts with a low number of Unmet Need cases are surrounded by villages/sub-districts with a low number of Unmet Need cases, also identified as LL (Low- Low) sub-districts or Cold Spot areas. On the map are villages/subdistricts in light blue. Found in 9 villages/sub-districts in 2020 and 12 villages/sub-districts in 2021.
4) Quadrant IV: Villages/sub-districts with a high number of Unmet Need cases are surrounded by villages/sub-districts with a low number of Unmet Need cases. This village is identified as an HL (High-Low) village. On the map are villages/sub-districts in faded red. Found in 2 villages/sub-districts in 2020 and 3 villages/sub-districts in 2021.

2. Spatial Regression Analysis

Spatial Regression Analysis in 2020

a. Spatial Dependency Test

Table 2. Spatial Dependency Testing with LM test

Testing	P-value	Decision
Lagrange Multiplier (lag)	0.03297	Significant
Lagrange Multiplier (error)	0.06694	Not significant

*) significance at α = 5%

From table 2. above, it is found that the probability value of LM-lag is 0.03297 and LM-error is 0.06694, where it is concluded that LM-lag is significant and LM-Error is not significant. The modelling used is the Spatial Autoregressive Model (SAR). The following are the SAR test results:

Table 3. Testing the Significance of SAR Model Parameters

Variable	Coefficient	Z	P-value
Rho (ρ)	0.233563	2.29511	0.02173
Constanta	8.45255	3.15695	0.00159
Education Level (X_1)	0.252661	2.91281	0.00358
Early Marriage (X_4)	-0.0851968	-2.27443	0.02294
Number of children >2 (X_5)	0.00127804	0.0283835	0.97736
Number of Cadres	-0.318539	-3.10644	0.00189

*) significance at α = 5%

From table 3. above, it can be concluded from the spatial lag model equation (Spatial Autoregressive Model) that the number of cadres, early marriage and education level have an influence on unmet need in Muaro Jambi District in 2020.

b. Selection of the Best Model

Table 4. below shows the selection of the best model using the AIC value criteria

Table 4.Comparison of AIC Values from 3 Models

Model	R^2	AIC value
Classical Regression (OLS)	23.73%	938,436
Spatial Autoregressive Model (SAR)	26.33%	935,863

A model can be concluded that the model is a good model if the AIC value is smaller and the R square value is larger. Based on Table 2.6, it is found that the SAR model is the best regression model.

Spatial Regression Analysis in 2021

a. Spatial Dependency Test

Table 5. Spatial Dependency Testing with LM test

Testing	P-value	Decision
Lagrange Multiplier (lag)	0.16257	Not significant
Lagrange Multiplier (error)	0.50719	Not significant

*) significance at α = 5%

From table 5. above, it is found that LM-lag and Error do not meet the requirements so OLS or classical regression is used. The following are the results of the analysis outlined in the table below:

Table 6. Testing the Significance of SAR Model Parameters

Variable	Coefficient	Z	P-value
Constanta	2.48692	0.448221	0.65465
Education Level (X_1)	0.726625	5.25802	0.00000
Percentage of Early Marriage (X_2)	0.0796705	1.16584	0.24555
Percentage of Children >2 (X_3)	-0.0699516	-0.768314	0.44352
Number of Cadres (X_4)	-0.224087	-1.8791	0.06220

*) significance at α = 5%

Based on the results of the analysis above, the variable related to Unmet Need is the level of education.

4. Discussion

This research analyzes the distribution pattern of unmet need for contraception and the determinants of unmet need for contraception spatially in Muaro Jambi Regency using annual report data obtained from the Health and Family Planning Agency (BKKBN) Muaro Jambi Regency for 2020-2021. The unit of analysis in this research is focused on all villages/subdistricts in Muaro Jambi Regency, totalling 155 villages/subdistricts. This study found that the distribution pattern of unmet need for contraception in Muaro Jambi Regency in 2020 and 2021 had a clustered distribution pattern, as evidenced by the Moran Index value, where it was found that the distribution pattern of unmet need for contraception in Muaro Jambi Regency in 2020 and 2021 was in the form of clusters or clusters (1>0, p<0.05). Spatially, there is a correlation between the spread of unmet need for contraception between one village and another, as

indicated by a tendency for positive autocorrelation.

Further analysis using the Local Indicator for Spatial Autocorrelation (LISA) test found that in 2020, there were ten villages/subdistricts, and in 2021 there were 12 villages/subdistricts in the hotspot category. In accordance with the results of research conducted (Nayak dkk., 2021; Nyarko, 2020) in Ghana, it was found that the pattern of unmet family planning needs in Ghana varied between regions. Among other things, the Central Region, Eastern Region, Volta Region and Upper Region. The Eastern Region has the highest unmet need rate between 42% and 55%, while the Upper West region has the lowest unmet need rate <33%. Supported by the results of research conducted (Azanaw dkk., 2022; Pal dkk., 2018; Pezzulo dkk., 2021; Sharma dkk., 2021). In accordance with the research results of Abdu, Kedir Yesuf, et al. 2020 in Ethiopia where there are variations in the incidence of unmet needs between regions and a global Moran's I value of 0.31 (p-value <0.01), indicating that there is a clustering of unmet need for contraception and the occurrence of positive autocorrelation (Nayak dkk., 2021; Tegegne dkk., 2020; Yesuf dkk., 2020)

Based on the results of this research, conducting spatial lag modelling (Spatial Autoregressive Model) shows that the level of education has a specifically significant relationship in each village in Muaro Jambi Regency in 2020 and 2021. In accordance with the results of research (Yesuf dkk., 2020), which was conducted spatially in Ethiopia, more than half of the respondents were 6,253 (61.2%) with no education. Approximately 1,528 (67%) and 1619 (71.0%) unmet need for contraception were among respondents who had no education and no working status—supported by research (Pal dkk., 2018)spatially in India, where the unmet need for contraception generally increases with increasing education, from 19-26% per cent among illiterates. Supported by the results of research in India and Ghana, educational status appears as an important predictor of unmet need for contraception(Alie dkk., 2022; Bolarinwa dkk., 2023; Nyarko, 2020; Pal dkk., 2018). Likewise, in Nigeria spatially, the posterior estimates for women with tertiary and secondary education are (OR: 0.6430, CI: 0.5767, 0.7179) and (OR: 0.8018, CI: 0.7534, 0 .8543) (20). As a woman's education level increases, there is a decrease in the unmet need for contraception compared to uneducated women. Women with primary education (OR: 1.0441, CI: 0.9680, 1.1286) were 4% more likely to have an increased unmet need for contraception than women without education. Likewise, spatial research results(Azanaw dkk., 2022) show that almost half of the respondents, 7,498 (47.8%), did not need contraception and did not have formal education (Harzif dkk., 2022) This is because women with higher education are more open to all information than women without education who believe in myths surrounding the use of contraception.

Additionally, (Azanaw dkk., 2022; Nyarko, 2020; Tamirat dkk., 2023) explained that educational attainment was associated with unmet need for contraception as women who had secondary school or tertiary education had at least 12% lower odds of unmet need for contraception compared to their counterparts who had no education. Formal. This is because higher educational attainment may provide contraceptive benefits in two main ways. First, educational attainment can provide women with accurate knowledge about contraception and contraceptive options and understand the benefits that can be obtained from them. Second, the long duration required by higher educational attainment may encourage sexually active young women to use modern contraception as they seek to delay pregnancy until after school or perhaps work. Supported by research by Guspianto et al., 2021 where unmet need for contraception has a significant relationship with the level of community education in Kumun Debai District, Jambi Province, where women with low education are 1.7 times more at risk of experiencing the unmet need for contraception compared to women with higher education(Guspianto dkk., 2021).

Early marriage has a specifically significant relationship in every village in Muaro Jambi Regency in 2020. In accordance with the results of research conducted (Oyeronke Alaba dkk., 2015; Rahaman dkk., 2022;

Sharma dkk., 2021) spatially in India, women in their teens who have already been in marriage Marriage for less than five years have the highest unmet need for contraception (22.7%), and this is increasing among teenagers who have been married for more than ten years (56.7%). The odds of unmet need for contraception decreased among young married women in the 20 to 24 age group (relative risk [RR] [95% CI]: 0.75 [0.70–0.79]) compared with those in the 15 to 19 years old. They are supported by the results of research (Yesuf dkk., 2020) where the majority of respondents, 7400 (72.39%), with an unmet need for contraception when having sexual relations before the age of 18 years.

Moreover, of all incidents of unmet need for contraception, the majority of respondents, 1732 (76%), were aged 18 years with early marriage (Nayak dkk., 2021; Pardeep, 2019). This means that women who do not marry early have a lower level of unmet need for birth spacing than those who marry early. This is because women who marry at an older age are likely to adopt ideas about birth limitations more easily compared to those who marry young (Belachew dkk., 2023; Sharma dkk., 2021). Research results (Lubis & Djuwita, 2022; Negash dkk., 2023) showed that women who married later at marriage were more likely to discuss family size with their husbands and were also more likely to know about contraceptive methods than those who married young.

The number of cadres has a specifically significant relationship in each village in Muaro Jambi Regency in 2020, in accordance with the results of research conducted by(D'Souza dkk., 2023; Lemani dkk., 2017; Ontiri dkk., 2021; Scott dkk., 2015)The involvement of cadres in family planning services was found to be effective in increasing contraceptive use, attitudes and knowledge. The World Health Organization (WHO) also recommends optimizing the role of health workers to increase access to key maternal and newborn health interventions and train more health cadres, one of which is to increase contraceptive use (WHO, 2012). This can be seen from the success of family planning programs in developing countries around the world for several decades, showing the acceptance and effectiveness of community involvement in the provision of family planning services (Scott dkk., 2015). Especially in low and middle-income countries, which face a shortage of human resources for the provision of health services and areas where access to facilities requires significant travel time, community empowerment is needed to increase access to information and methods. At the same time, reducing user expenditure, which must be taken into account in cost-effectiveness calculations (Kalanda, 2010; Prata dkk., 2011).

The empowerment of cadres must be vigorously fought for to expand access to contraceptive services further. This is because community empowerment can provide convenient services, and the close relationships and trust they develop in the community can produce a greater impact on family planning indicators than that achieved by facility-based services alone(Olawo dkk., 2013; Prata dkk., 2011). In accordance with research results (Sharma dkk., 2021), Spatially in India, the greater number of family planning officers is significantly related to the incidence of unmet need for contraception. This shows that the unmet need for contraception is reduced if women have heard about contraception in the last few months from family planning officers who provide information about family planning methods or family planning discussions. In accordance with the results of a systematic review conducted by Scott et al. (2015), the results obtained were 93% showing that the community empowerment intervention program effectively increased the use of modern contraception by twice as much as the control group and 77% showed that community empowerment had a significant impact—greater incidence of contraceptive use than facility-based services alone (Scott dkk., 2015).

5. Conclusion

The results of the research show that there is an increase in the unmet need for contraception in Muaro Jambi Regency in 2020 and 2021 with a clustered distribution pattern of unmet need for contraception and

show that globally, there is a tendency for positive autocorrelation. The variables that have a significant influence are the level of education, early marriage and the number of cadres who play an important role in increasing the unmet need for contraception in Muaro Jambi Regency. Further findings indicate the need for programs related to efforts to reduce the unmet need for contraception that are regionally based by taking into account regional characteristics to prioritize interventions to reduce the unmet need for contraception so that they are more targeted.

6. References

[1] Agyekum, A. K., Adde, K. S., Aboagye, R. G., Salihu, T., Seidu, A.-A., & Ahinkorah, B. O. (2022). Unmet need for contraception and its associated factors among women in Papua New Guinea: Analysis from the demographic and health survey. *Reproductive Health*, *19*(1), 113. https://doi.org/10.1186/s12978-022-01417-7

[2] Alie, M. S., Abebe, G. F., & Negesse, Y. (2022). Magnitude and determinants of unmet need for family planning among reproductive age women in East Africa: Multilevel analysis of recent demographic and health survey data. *Contraception and Reproductive Medicine*, *7*(1), 2. https://doi.org/10.1186/s40834-022-00168-x

[3] Azanaw, M. M., Fentie, D. T., Bukayaw, Y. A., Lakew, A. M., & Sisay, M. M. (2022). Spatial distribution and determinant factors of unmet need for family planning among all reproductive-age women in Ethiopia: A multi-level logistic regression modelling approach. *Contraception and Reproductive Medicine*, *7*(1), 13. https://doi.org/10.1186/s40834-022-00178-9

[4] Badan Pusat Statistik Provinsi Jambi. (2022). *Provinsi Jambi Dalam Angka 2022*. CV. Salim Media.

[5] Belachew, T. B., Negash, W. D., Bitew, D. A., & Asmamaw, D. B. (2023). Prevalence of married women's decision-making autonomy on contraceptive use and its associated factors in high fertility regions of Ethiopia: A multilevel analysis using EDHS 2016 data. *BMC Public Health*, *23*(1), 83. https://doi.org/10.1186/s12889-023-15009-y

[6] BKKBN. (2021). *Laporan Kinerja Instansi Pemerintah*.

[7] BKKBN. (2022). *Laporan Kinerja Instansi Pemerintah*.

[8] Bolarinwa, O. A., Ajayi, K. V., Okeke, S. R., Hailegebreal, S., & Odimegwu, C. (2023). Spatial distribution and multilevel analysis of factors associated with long-acting reversible contraceptive use among sexually active women of reproductive age in Nigeria. *Archives of Public Health*, *81*(1), 99. https://doi.org/10.1186/s13690-023-01110-6

[9] Bradley, S. E. K., Croft, T. N., Fishel, J. D., & Westoff, C. F. (2012). *Revising Unmet Need For Family Planning, DHS Analytical Studies 25*. ICF International.

[10] D'Souza, P., Phagdol, T., D'Souza, S. R. B., D. S., A., Nayak, B. S., Velayudhan, B., Bailey, J. V., Stephenson, J., & Oliver, S. (2023). Interventions to support contraceptive choice and use: A global systematic map of systematic reviews. *The European Journal of Contraception & Reproductive Health Care*, 1–9. https://doi.org/10.1080/13625187.2022.2162337

[11] Guspianto, G., Rianita, N., Asparian, A., & Ridwan, M. (2021). Determinan tingginya unmet need Keluarga Berencana; Studi kasus di Kecamatan Kumun Debai Provinsi Jambi. *Riset Informasi Kesehatan*, *10*(2), 174. https://doi.org/10.30644/rik.v10i2.536

[12] Harzif, A. K., Maidarti, M., Handayaning, F. N., & Andyra, A. F. (2022). Factors affecting knowledge regarding unmet need on fertile aged women in Indonesia: Evaluation of 2012 and 2017 IDHS. *Reproductive Health*, *19*(1), 26. https://doi.org/10.1186/s12978-022-01338-5

[13] Kalanda, B. (2010). Repositioning family planning through community based distribution agents in Malawi. *Malawi Medical Journal*, *22*(3). https://doi.org/10.4314/mmj.v22i3.62191

[14] Lemani, C., Tang, J. H., Kopp, D., Phiri, B., Kumvula, C., Chikosi, L., Mwale, M., &

Rosenberg, N. E. (2017). Contraceptive uptake after training community health workers in couples counseling: A cluster randomized trial. *PLOS ONE*, *12*(4), e0175879. https://doi.org/10.1371/journal.pone.0175879

[15] Lubis, P. N., & Djuwita, R. (2022). Factors Influencing Unmet Contraceptive Needs In Indonesia. *Jurnal Ilmu Kesehatan Interest*. https://doi.org/doi.org/10.37341/interest.v0i0.518

[16] Machiyama, K., Casterline, J. B., Mumah, J. N., Huda, F. A., Obare, F., Odwe, G., Kabiru, C. W., Yeasmin, S., & Cleland, J. (2017). Reasons for unmet need for family planning, with attention to the measurement of fertility preferences: Protocol for a multi-site cohort study. *Reproductive Health*, *14*(1), 23. https://doi.org/10.1186/s12978-016-0268-z

[17] Nayak, S. R., Mohanty, S. K., Mahapatra, B., & Sahoo, U. (2021). Spatial heterogeneity in discontinuation of modern spacing method in districts of India. *Reproductive Health*, *18*(1), 137. https://doi.org/10.1186/s12978-021-01185-w

[18] Negash, W. D., Eshetu, H. B., & Asmamaw, D. B. (2023). Intention to use contraceptives and its correlates among reproductive age women in selected high fertility sub-saharan Africa countries: A multilevel mixed effects analysis. *BMC Public Health*, *23*(1), 257. https://doi.org/10.1186/s12889-023-15187-9

[19] Nyarko, S. H. (2020). Spatial variations and socioeconomic determinants of modern contraceptive use in Ghana: A Bayesian multilevel analysis. *PLOS ONE*, *15*(3), e0230139. https://doi.org/10.1371/journal.pone.0230139

[20] Olawo, A. A., Bashir, I., Solomon, M., Stanback, J., Ndugga, B. M., & Malonza, I. (2013). "A cup of tea with our CBD agent … ": Community provision of injectable contraceptives in Kenya is safe and feasible. *Global Health: Science and Practice*, *1*(3), 308–315. https://doi.org/10.9745/GHSP-D-13-00040

[21] Ontiri, S., Mutea, L., Naanyu, V., Kabue, M., Biesma, R., & Stekelenburg, J. (2021). A qualitative exploration of contraceptive use and discontinuation among women with an unmet need for modern contraception in Kenya. *Reproductive Health*, *18*(1), 33. https://doi.org/10.1186/s12978-021-01094-y

[22] Oyeronke Alaba, O., Olaomi, J., & Olubusoye, O. E. (2015). Spatial pattern and determinants of unmet need of family planning in Nigeria. *South African Family Practice*, *57*(5), 306–312. https://doi.org/10.1080/20786190.2015.1071536

[23] Pal, A., Yadav, J., . S., & Singh, Kh. J. (2018). Factors associated with unmet need of family planning in Bihar, India: A spatial and multilevel analysis. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, *7*(9), 3638. https://doi.org/10.18203/2320-1770.ijrcog20183768

[24] Pardeep, D. (2019). *Junior Resident, Department of Community Medicine, PT. B. D. Sharma University Of*. *8*(7).

[25] Pezzulo, C., Nilsen, K., Carioli, A., Tejedor-Garavito, N., Hanspal, S. E., Hilber, T., James, W. H. M., Ruktanonchai, C. W., Alegana, V., Sorichetta, A., Wigley, A. S., Hornby, G. M., Matthews, Z., & Tatem, A. J. (2021). Geographical distribution of fertility rates in 70 low-income, lower-middle-income, and upper-middle-income countries, 2010–16: A subnational analysis of cross-sectional surveys. *The Lancet Global Health*, *9*(6), e802–e812. https://doi.org/10.1016/S2214-109X(21)00082-6

[26] Prata, N., Gessessew, A., Cartwright, A., & Fraser, A. (2011). Provision of injectable contraceptives in Ethiopia through community-based reproductive health agents. *Bulletin of the World Health Organization*, *89*(8), 556–564. https://doi.org/10.2471/BLT.11.086710

[27] Rahaman, M., Rana, M. J., Roy, A., & Chouhan, P. (2022). Spatial heterogeneity and socio-economic correlates of unmet need for spacing contraception in India: Evidences from National

Family Health Survey, 2015-16. *Clinical Epidemiology and Global Health*, *15*, 101012. https://doi.org/10.1016/j.cegh.2022.101012

[28] Scott, V. K., Gottschalk, L. B., Wright, K. Q., Twose, C., Bohren, M. A., Schmitt, M. E., & Ortayli, N. (2015). Community Health Workers' Provision of Family Planning Services in Low- and Middle-Income Countries: A Systematic Review of Effectiveness. *Studies in Family Planning*, *46*(3), 241–261. https://doi.org/10.1111/j.1728-4465.2015.00028.x

[29] Sharma, H., Singh, S. K., & Srivastava, S. (2021). Spatial heterogeneity and major correlates of Unmet Need of family planning among young married women aged 15-24 in India: An Exploratory Study. *SAGE Open*, *11*(2), 215824402110246. https://doi.org/10.1177/21582440211024615

[30] Tamirat, K. S., Nigatu, S. G., Tesema, G. A., Sisay, M. M., & Tessema, Z. T. (2023). Spatial and Multilevel Analysis of Unscheduled Contraceptive Discontinuation in Ethiopia: Further analysis of 2005 and 2016 Ethiopia Demography and Health Surveys. *Frontiers in Global Women's Health*, *4*, 895700. https://doi.org/10.3389/fgwh.2023.895700

[31] Tegegne, T. K., Chojenta, C., Forder, P. M., Getachew, T., Smith, R., & Loxton, D. (2020). Spatial variations and associated factors of modern contraceptive use in Ethiopia: A spatial and multilevel analysis. *BMJ Open*, *10*(10), e037532. https://doi.org/10.1136/bmjopen-2020-037532

[32] UNFPA. (2022a). *Seeing The Unseen The case for action in the neglected crisis of unintended pregnancy*. https://www.unfpa.org/sites/default/files/pub-pdf/EN_SWP22%20report_0.pdf

[33] UNFPA. (2022b). *United Nations Population Fund Commitment*.

[34] United Nations. (2022). *World Family Planning 2022: Meeting the changing needs for family planning: Contraceptive use by age and method*. United Nations.

[35] Westoff, C. F. (2006). *New Estimates of Unmet Need and the Demand for Family Planning*.

[36] WHO. (2012). *WHO recommendations: Optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting*. World Health Organization. https://apps.who.int/iris/handle/10665/77764

[37] Yesuf, K. A., Birhanu, A. Y., & Nigatu, A. M. (2020). Spatial Distribution and Factors Associated with Unmet Need for Family Planning Among Married Women Aged Between 15-49 Years: Spatial and Multilevel Analysis of EDHS 2016. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3669133