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MULTISOURCE SOCIAL SUPPORT AND PRIMARY-SECONDARY PREECLAMPSIA PREVENTION BEHAVIORS AMONG PREGNANT WOMEN WITH PREECLAMPSIA

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ABSTRACT
Preeclampsia is a leading cause of maternal mortality in Indonesia, with a prevalence in East Java reaching 24.4%. Low awareness among pregnant women remains a major barrier; therefore, social support is needed to reinforce healthy behaviors. This study aimed to analyze the effects of support from family, friends, and healthcare workers on preeclampsia prevention in Sumenep Regency. This quantitative, cross-sectional study involved a population of 474 pregnant women with preeclampsia across 28 community health centers (Puskesmas). A total of 217 respondents were selected using stratified random sampling. Data were collected using a validated questionnaire and analyzed using multiple linear regression. Most respondents reported good family support (59.4%), moderate support from friends (58.1%), and good support from healthcare workers (70%). In terms of behavior, 57.1% of respondents were highly compliant with antenatal care, while stress management remained at a moderate level (48.3%). Regression analysis showed that support from family, friends, and healthcare workers significantly influenced ANC adherence, nutrition, physical activity, and medication use ($P < 0.05$). However, for stress management, support from healthcare workers was not statistically significant (P 0.290). Social support is a vital determinant in the prevention of preeclampsia. Strengthening synergy between family and friends is particularly important for psychological support. Healthcare workers should optimize their role by transforming services from providing clinical education to offering empathetic emotional counseling. In addition, developing community-based mentoring programs (such as pregnancy classes that involve husbands) is strongly recommended to improve stress management and comprehensively reduce preeclampsia morbidity.

KEYWORDS: Preeclampsia; Pregnancy; Prevention; Social Support

INTRODUCTION

Preeclampsia is a syndrome that occurs in pregnant women during pregnancy, labor, and the postpartum period. It is characterized by elevated blood pressure, edema, and proteinuria, appearing from 20 weeks of gestation up to 7 days postpartum. Preeclampsia can lead to postpartum problems, including endothelial dysfunction in multiple organs, which increases the risk of metabolic diseases and other complications (1). According to the World Health Organization, the incidence of preeclampsia in developing countries is approximately seven times higher than in developed countries. In developed regions, the prevalence ranges from 1.3% to 6%, whereas in developing countries it ranges from 1.8% to 18%. Preeclampsia contributes to approximately 70,000 maternal deaths worldwide each year and is also associated with about 500,000 infant deaths annually.

Based on data from the MPDN (Maternal Perinatal Death Notification) system the Ministry of Health's maternal mortality reporting system Indonesia recorded 4,005 maternal deaths in 2022, increasing to 4,129 in 2023. In January 2023, the maternal mortality ratio was approximately 305 per 100,000 live births, placing Indonesia second among ASEAN countries for the highest maternal mortality rate. The direct causes of maternal mortality in Indonesia include hemorrhage, preeclampsia, and infection. In East Java, preeclampsia (24.4%) was the leading cause of maternal death after hemorrhage (21.24%). Furthermore, East Java ranked second nationally for maternal mortality in 2022, following West Java (2). Despite extensive research, the precise etiology of preeclampsia remains unclear.

However, numerous studies suggest that the development of preeclampsia is influenced by multiple maternal risk factors, including advanced maternal age (>35 years), a history of hypertension (either chronic hypertension or hypertension in previous pregnancies), and high parity, particularly among women who have given birth more than three times (3). In addition, exposure to cigarette smoke (passive smoking) for 4–7 days per week and ≥2 hours per day can increase the risk of preeclampsia by 1.27 times compared with less frequent exposure and <1 hour per day (4). Various efforts have been implemented to reduce the incidence of preeclampsia, but the rate remains high due to many obstacles and failures related to the pregnant women with preeclampsia themselves.

One major contributing factor is the limited knowledge and awareness among pregnant women regarding early detection and recognition of preeclampsia symptoms. This lack of awareness often results in delayed self-care and late utilization of healthcare services, which may negatively affect both maternal and fetal outcomes (5). Previous studies have shown that social support emotional, informational, and practical (tangible) support, including spiritual supportfrom husbands or family members is associated with better mental health in pregnant women and lower levels of stress. Social support may also be linked to biological stress pathways, such as inflammatory responses and physiological stress markers (e.g., cortisol), which are theoretically relevant to pregnancy complications, including hypertensive disorders and preeclampsia (6).

Moreover, substantial evidence indicates that strong family support and well-established social networks during pregnancy play a critical role in reducing psychological distress and stress levels among pregnant women. These protective effects are associated with improved maternal and fetal well-being and may contribute significantly to the prevention of pregnancy-related complications, including preeclampsia (7). Furthermore, psychosocial interventions that integrate support from healthcare professionals starting in early pregnancy have been reported to be effective in improving the psychological wellbeing and experiences of pregnant women at high risk of preeclampsia. Several participants noted that the involvement of healthcare providers including professional guidance and emotional counseling helped them strengthen their coping skills and manage pregnancy-related risks more effectively (8).
Based on the background outlined above, this study aims to provide a more comprehensive understanding of the role of social support in preventing preeclampsia among pregnant women. Specifically, the study will examine the influence of family support, peer support, and support from healthcare professionals on preeclampsia prevention efforts, including through improvements in pregnant women's knowledge, awareness, and self-care behaviors. The findings are expected to serve as a foundation for developing health promotion and preventive interventions that optimally involve the pregnant woman's social environment, thereby reducing the risk of preeclampsia and improving maternal and fetal health outcomes.

METHOD

This study employs a clear and systematic approach to ensure the reliability and validity of the findings. Below are the components of the methodology:

Study Design

This study employed a cross-sectional design. Data for the independent and dependent variables were collected simultaneously at a single point in time. The study was conducted in Sumenep Regency and carried out from October to December 2025.

Population and Sample

The population comprised all pregnant women with preeclampsia who did not have chronic diseases across 28 public health centers (Puskesmas) in Sumenep, totaling 474 women. This study used probability sampling with a stratified random sampling technique. Samples were selected from the 28 Puskesmas to ensure that the sample size met the requirements for representativeness. The final sample consisted of 217 pregnant women with preeclampsia.

Data Collection

At this stage, a preliminary study was conducted, research permits were obtained, and research instruments were developed. The instruments included a questionnaire on demographic data and respondent characteristics. Data were collected by distributing questionnaires that had been tested for validity and reliability.

Measurement and Data Processing

The questionnaire measured family support, peer support, and support from healthcare providers, as well as preeclampsia prevention. Primary preeclampsia prevention was assessed by adherence to the scheduled ANC (antenatal care) visits. Secondary prevention included nutrition, physical activity, stress management, and medication use. Data were analyzed using regression tests.

Ethical approval

This study was granted ethical approval by the Health Research Ethics Committee of Universitas STRADA Indonesia, as indicated by certificate number 1023439/EC/KEPK/I/10/2025, issued on 13 October 2025. All respondents were informed about the purpose of the study and voluntarily signed an informed consent form.

RESULTS

Demographics of Respondents

Table 1 presents the distribution of respondents according to age, gestational age, education level, and body mass index (BMI). Most respondents were aged 20–35 years (70.5%), followed by those aged >35 years (24.9%), while only a small proportion were aged <20 years (4.6%). In terms of gestational age, approximately half of the respondents were in the third trimester (50.7%), followed by the second trimester (39.2%) and the first trimester (10.1%).
Regarding education level, the largest proportion of respondents had elementary school (primary school) education (36.4%), followed by senior high school (24.9%) and junior high school education (20.3%). Only a minority had no formal education (5.1%) or higher education (13.4%). Based on BMI classification, the majority of respondents were categorized as Obesity Class II (57.6%), followed by Obesity Class I (30.0%). Very few respondents were classified as overweight (6.5%), normal weight (3.7%), or underweight (2.3%).

Table 1. Distribution of Respondents by Age, Gestational Age, Education Level, and BMI Category (n = 217)

Variable	Category	Frequency (n)	Percentage (%)
Age	< 20 years	10	4.6
	20–35 years	153	70.5
	> 35 years	54	24.9
Gestational age	First trimester	22	10.1

	Second trimester	85	39.2
	Third trimester	110	50.7
Education level	No formal education	11	5.1
	Elementary school (primary school)	79	36.4
	Junior high school	44	20.3
	Senior high school	54	24.9
	Higher education (college/university)	29	13.4
BMI category	Underweight	5	2.3
	Normal	8	3.7
	Overweight	14	6.5
	Obesity Class I	65	30.0
	Obesity Class II	125	57.6

Family Support, Peer/Friend Support, and Healthcare Worker Support.

Table 2 illustrates the distribution of respondents according to levels of family support, peer/friend support, and healthcare worker support. Most respondents reported good family support (59.4%), while 38.2% reported moderate support and only a small proportion reported low family support (2.3%). In terms of peer or friend support, the majority of respondents reported moderate support (58.1%), followed by low support (25.8%), whereas only 16.1% reported good peer support. Regarding healthcare worker support, the largest proportion of respondents perceived good support (70.0%), with 29.0% reporting moderate support and less than 1% reporting low support (0.9%). Overall, healthcare worker support was the most positively perceived source of support among the respondents.

Table 2. Distribution of Respondents Based on Family, Peer, and Healthcare Worker Support (n = 217)

Support Source	Category	Frequency (n)	Percentage (%)
Family Support	Low	5	2.3
	Moderate	83	38.2
	Good	129	59.4
	Total	**217**	**100**
Peer Support	Low	56	25.8
	Moderate	126	58.1
	Good	35	16.1
	Total	**217**	**100**
Healthcare Worker Support	Low	2	0.9
	Moderate	63	29.0
	Good	152	70.0
	Total	**217**	**100**

Compliance with ANC Visits

Table 3. Distribution of Respondents Based on ANC Compliance (n = 217)

No.	Category	Frequency (n)	Percentage (%)
1	Non-compliant	2	0.9
2	Moderately compliant	91	41.9
3	Highly compliant	124	57.1
	Total	**217**	**100**

Based on Table 3 the frequency distribution of respondents according to ANC compliance shows that the majority of respondents were highly compliant, with 124 respondents (57.1%). Meanwhile, 91 respondents (41.9%) were moderately compliant, and only 2 respondents (0.9%) were non-compliant.

Nutrition

Table 4. Distribution of Respondents by Nutrition Status (n = 217)

No.	Category	Frequency (n)	Percentage (%)
1	Poor	0	0.0
2	Adequate	126	58.1
3	Good	91	41.9
Total		**217**	**100.0**

Table 4 shows the distribution of respondents according to nutritional status.

Most respondents had adequate nutritional status (58.1%), while the remaining respondents were categorized as having good nutritional status (41.9%). No respondents were classified as having poor nutrition.

Physical Activity

Table 5. Distribution of Respondents by Physical Activity Level (n=217)

No.	Category	Frequency (n)	Percentage (%)
1	Low	0	0.0
2	Moderate	124	57.1
3	Good	93	42.9
Total		**217**	**100.0**

Table 5 illustrates the distribution of respondents by physical activity level.

More than half of the respondents reported a moderate level of physical activity (57.1%), while the rest had a good level of physical activity (42.9%). No respondents were categorized as having low physical activity.

Stress Management

Table 6. Distribution of Respondents by Stress Management Level (n=217)

No.	Category	Frequency	Percentage (%)
1	Very Low	8	3.7
2	Low	99	45.6
3	Moderate	107	48.3
4	High	3	1.4
Total		**217**	**100.0**

Based on Table 6, the frequency distribution of respondents by stress management level shows that nearly half of the respondents demonstrated moderate stress management (48.3%), followed by those with low stress management (45.6%). A small proportion of respondents reported very low (3.7%) or high (1.4%) stress management levels.

Medication Consumption

Table 7. Distribution of Respondents by Medication Consumption Level (n=217)

No.	Category	Frequency	Percentage (%)
1	Low	1	0.5
2	Moderate	124	57.1
3	High	92	42.4
Total		**217**	**100.0**

Table 7 shows the distribution of respondents according to medication consumption levels. Most respondents were classified as having moderate medication consumption (57.1%), while 42.4% reported high medication consumption. Only a minimal proportion of respondents had low medication consumption (0.5%).

The Effect of Independent Variables on ANC Compliance

Table 8. Results of Multiple Linear Regression Analysis of Independent Variables on ANC Compliance.

Variable	P-value
Family Support	0.002
Peer/Friend Support	0.038
Support from Health Workers	0.007

Table 8 shows that the multiple linear regression analysis found a significant effect of family support on ANC compliance, with a p-value of 0.002 (< 0.05). Therefore, family support has a statistically significant influence on ANC compliance. Similarly, peer/friend support also had a significant effect on ANC compliance, with a p-value of 0.038 (< 0.05). Thus, peer/friend support significantly influences ANC compliance. In addition, support from health workers showed a significant effect on ANC compliance, with a p-value of 0.007 (< 0.05). This indicates that support from health workers has a statistically significant influence on ANC compliance.

Influence of Independent Variables on Nutritional Adequacy

Table 9. Results of Multiple Linear Regression Analysis of Independent Variables on Nutritional Adequacy

Variable	p-value
Family Support	0.019

Peer/Friend Support	0.000
Healthcare Provider Support	0.008

Based on Table 9, the multiple linear regression analysis shows that family support (p = 0.019), peer/friend support (p = 0.000), and healthcare provider support (p = 0.008) have a significant effect on nutritional adequacy (p < 0.05). These findings are consistent with recent scientific evidence indicating that dietary quality during pregnancy is associated with maternal outcomes, including the risk of hypertensive disorders.

Influence of Independent Variables on Physical Activity

Table 10. Results of Multiple Linear Regression Analysis of Independent Variables on Physical Activity

Variable	**p-value**
Family Support	0.010
Peer/Friend Support	0.001
Healthcare Provider Support	0.011

Based on Table 10, the multiple linear regression analysis shows that family support has a significant effect on physical activity (p = 0.010, < 0.05). Peer/friend support also has a significant effect on physical activity (p = 0.001, < 0.05). Likewise, healthcare provider support has a significant effect on physical activity (p = 0.011, < 0.05). These findings indicate that increased physical activity is not solely determined by individual intention, but is also strongly influenced by the closest social environment. Such social support helps reduce barriers such as limited time, low motivation, and concerns about performing movements incorrectly, while also strengthening consistency in maintaining the behavior.

Influence of Independent Variables on Stress Management

Table 11. Results of Multiple Linear Regression Analysis of Independent Variables on Stress Management

Variable	**p-value**
Family Support	0.002
Peer/Friend Support	0.030
Healthcare Provider Support	0.290

Based on Table 11, the multiple linear regression analysis shows that family support has a significant effect on stress management (p = 0.002, < 0.05). Peer/friend support also has a significant effect on stress management (p = 0.030, < 0.05). In contrast, healthcare provider support does not have a significant effect on stress management (p = 0.290, > 0.05). These findings emphasize that the family is the primary support system in stress management.

Influence of Independent Variables on Medication Adherence

Table 12. Results of Multiple Linear Regression Analysis of Independent Variables on Medication Adherence

Variable	**p-value**
Family Support	0.014
Peer/Friend Support	0.000
Healthcare Provider Support	0.016

Based on Table 12, the multiple linear regression analysis shows that family support has a significant effect on medication consumption/adherence (p = 0.014, < 0.05). Peer/friend support also has a significant effect on medication consumption/adherence (p = 0.000, < 0.05). Likewise, healthcare provider support has a significant effect on medication consumption/adherence (p = 0.016, < 0.05). These findings are relevant because the management of hypertensive disorders in pregnancy (including preeclampsia) requires adherence to prescribed therapy and close monitoring to prevent rapid deterioration.

DISCUSSION

The results of this study confirm that support from family, friends, and healthcare providers is a crucial determinant in the prevention of preeclampsia in Sumenep Regency. Statistically, these three sources of support significantly improve pregnant women's adherence to clinical protocols, such as antenatal care (ANC), nutrition, physical activity, and medication use. These findings align with health behavior theories that emphasize the role of the social environment as a reinforcing factor that validates and strengthens health-related actions. Consistent with this perspective, a previous study also noted that strong social support can help translate intentions into concrete actions in disease prevention practices.

These findings reinforce that ANC compliance is influenced not only by individual factors, but also by social support (from family and friends) and support from the health-care system (health workers). This pattern is consistent with previous studies showing that support during pregnancy commonly takes the form of emotional support, instrumental support (practical/financial assistance), and informational support, with the main sources coming from husbands/family and women's networks/peers. Such support helps pregnant women reduce stress and improves their ability to cope with

pregnancy, which logically contributes to more regular use of ANC services. Specifically, the significant effect of family support in this study confirms that the family particularly the partner often serves as the key decision-maker and provider of resources that determine access to ANC (e.g., transportation, costs, accompaniment, and appointment reminders). Family support also provides emotional reassurance that can reduce anxiety and increase motivation to attend ANC visits. This is consistent with findings from Uganda showing that partner-related factors (such as the partner's employment status) are among the considerations associated with adherence to the recommended 8+ ANC contacts, highlighting the role of household and partner dynamics in service compliance (9).

Meanwhile, the significant effect of friend support can be explained through mechanisms of peer influence and peer support: peers help reinforce positive norms, share practical experiences and information, and provide emotional encouragement. Evidence from the implementation of group antenatal care suggests that a group-based ANC model increases opportunities for education and peer support, and in practice some participants are able to attend most or even all meetings (including a series of up to eight sessions). This illustrates how peer support may strengthen engagement and retention in ANC visits (10).

The significant effect of support from health workers highlights that ANC compliance is not determined solely by the availability of services, but is strongly shaped by the quality of the provider–client relationship and the care experience (including communication, counseling, feeling respected, and continuity of care). A prior study emphasizes that continuity of care and a strong partnership between clinicians and women are central to ANC engagement; when relationships and care experiences are positive, women are better able to overcome other barriers and are more motivated to attend regularly. This finding is also consistent with qualitative studies conducted in the era of the eight-contact policy, which underline that perceptions of service quality and encouragement/support within the health-care system contribute to ANC attendance (11). Collectively, these results indicate the need for integrated strategies that involve families, strengthen peer support mechanisms (such as pregnancy classes or group ANC), and enhance communication quality and continuity of care delivered by health workers.

In relation to nutrition, healthy dietary patterns such as the Mediterranean diet and the DASH diet have been reported to reduce the risk of hypertension during pregnancy through improved blood pressure regulation, reduced inflammation, and enhanced endothelial function (12). When pregnant women at risk of preeclampsia receive adequate social support, they are more likely to adhere to dietary recommendations, including appropriate food choices, portion control, meal frequency, and supplementation.

Theoretically, support from family and friends can be expressed in several forms: (1) instrumental support, such as helping with grocery shopping or meal preparation and reminding mothers about meal schedules and supplement intake; (2) emotional support, which helps reduce stress and psychological fatigue; and (3) informational support, which involves sharing knowledge and practices related to healthy eating patterns. Findings from other studies also emphasize that pregnant women perceive social support as a combination of emotional assistance, practical help from family or friends, and relevant health information [7]. In addition, family support particularly from parents or parents in law has been reported to be associated with nutrition-related health behaviors among pregnant women, such as adherence to iron and folic acid supplementation. Conceptually, this support can serve as a behavioral bridge that encourages more optimal nutritional adequacy, especially in high risk pregnancies (13,14).

Regarding physical activity, family support often provides the foundational resources and emotional encouragement needed to initiate and sustain exercise routines, while peer support promotes adherence through companionship and shared activities. This pattern is consistent with empirical evidence demonstrating that social support is strongly associated with participation in physical activity and serves as an important predictor in both longitudinal studies and systematic reviews (15).

The significant influence of healthcare provider support indicates that education alone may not be sufficient; what is needed is credible, safe, and structured guidance for example, explanations regarding appropriate intensity and duration, as well as adjustments based on individual conditions. This approach may enhance self-efficacy and improve adherence to physical activity. Research findings also suggest that physical activity interventions delivered or initiated by healthcare providers in primary care settings can increase moderate-to-vigorous physical activity levels (16). Therefore, these findings underscore the importance of a holistic support-system approach: physical activity promotion programs should simultaneously involve family (instrumental support), peers (companionship support), and healthcare providers (informational support).

In terms of stress management, consistent emotional support from family members can enhance feelings of safety and self-control, enabling individuals to appraise stressful situations more effectively and choose adaptive coping strategies. From the perspective of the transactional stress and coping theory, the availability of interpersonal resources helps individuals perceive stressors as more manageable and strengthens both problem-focused and emotion-focused coping (17). Stress responses are also biologically mediated through activation of the HPA axis (hypothalamic–pituitary–adrenal axis) and cortisol release; therefore, adequate social support may help reduce the psychophysiological burden of stress by regulating these stress responses (18).

Peers also play an important role in coping mechanisms, particularly by providing emotional support and opportunities for venting/ventilation (expressing one's feelings) as a form of emotion-focused coping. However, empirical evidence suggests that the effects of venting are not always consistent; its effectiveness may depend on the level of perceived emotional support (19). Venting may also be associated with a reduction in internalizing symptoms when perceived emotional support is low, but it may be associated with increased symptoms when support is very high. This suggests that the quality, context, and responsiveness of the social environment determine whether venting becomes adaptive or maladaptive (20).

The non-significant effect of healthcare provider support may be because it is often perceived as more formal and

primarily oriented toward clinical problem-solving. In the context of stress management, which is emotional and private in nature, individuals tend to rely more on support from their intimate social circle (family and peers), who are present more frequently, more personal, and more responsive to everyday psychological needs. This is consistent with the buffering hypothesis framework, which emphasizes that the most protective support is support that is well-matched and responsive to the demands of the stressor being faced (17).

The effect size observed for healthcare provider support suggests a communication gap or psychological distance between respondents and healthcare personnel. The researchers believe this may occur because stress management is closely related to comfort in sharing private matters, and respondents may feel more listened to by those closest to them. Meanwhile, family support appears to be the most dominant factor, as the family is often the first environment to detect changes in an individual's mood. The researchers recommend that healthcare providers adopt a more humanistic, psychologically informed approach or involve family members in mental health interventions so that the impact of provider support can be felt more strongly (11,17).

Even among high-risk groups, prevention of preterm preeclampsia may be achieved through low-dose aspirin initiated before 16 weeks of gestation, and calcium supplementation may be considered in populations with low dietary calcium intake (21). On the other hand, the literature indicates that medication adherence during pregnancy is often still suboptimal and is influenced by mothers' concerns about fetal safety and negative beliefs about medications, which are associated with lower adherence. Therefore, family support and social networks can serve as protective factors that help women maintain consistent medication routines (22).

Beyond family support, peer support contributes through behavioral role modeling, normalization of experiences, and motivational reinforcement that sustains regular medication use. Meanwhile, healthcare provider support functions as a key determinant that anchors treatment decisions, because many adherence barriers stem from doubts about benefits, fears of side effects, and uncertainty or misinformation. This is consistent with qualitative reviews of low-dose aspirin adherence for preeclampsia prevention, which highlight the importance of ongoing support to initiate and maintain therapy (23).

Moreover, recent state-of-the-science reviews emphasize that healthcare provider interventions are more effective when they are multi-strategy, personalized, and sustained over time, rather than limited to a one-time educational session (24). This is further supported by the need for psychosocial support among women at risk of preeclampsia, which conceptually strengthens the argument that social support from family, friends, and healthcare providers makes a tangible contribution to health behaviors, including adherence and accuracy in medication use (8).

Healthcare provider support shows a dominant influence on procedural and medical aspects of maternal care. The relatively high adherence to antenatal care (ANC) (57.1%) and medication use reflects the success of healthcare staff at community health centers (Puskesmas) in delivering clinical information. This finding is consistent with previous studies indicating that the credibility of healthcare providers is a primary driver of patient adherence in medical management. Based on these results, it can be inferred that pregnant women in Sumenep have a high level of trust in formal medical instructions, which represents an important asset in reducing the risk of physical morbidity associated with preeclampsia (21).

One of the most notable findings of this study is the absence of a significant association between healthcare provider support and maternal stress management ($p = 0.290$). In contrast, stress management was significantly influenced only by family and peers. This suggests a gap in antenatal services, which have tended to focus on physical and physiological aspects while overlooking psychological needs. Unlike studies in urban settings showing that medical interventions can reduce anxiety, in the Sumenep population emotional comfort appears to be derived more from informal bonds (19,20). A plausible hypothesis is that interactions between healthcare providers and patients in this region remain largely transactional and clinically focused, limiting their capacity to address emotional needs related to stress reduction (25).

The imbalance between clinical and psychological influences highlights the need for a more comprehensive approach to preeclampsia prevention. Given that stress management is strongly shaped by the closest social environment, preventive interventions should extend beyond pregnant women alone and actively involve husbands and family members as primary sources of emotional support. In addition, healthcare providers need to integrate emotional counseling techniques into every routine antenatal visit. Synergy between medical authority and family-based emotional support is key to fostering comprehensive preventive behaviors and, ultimately, to substantially reducing maternal mortality due to preeclampsia (17,21).

Strengths of the Study

The primary strength of this study lies in its comprehensive approach to examining preeclampsia prevention by integrating multiple dimensions of social support, namely family support, peer support, and healthcare provider support. Unlike studies that focus solely on clinical risk factors, this research adopts a behavioral and psychosocial framework that acknowledges the complex interaction between medical care and social environments. The use of validated indicators such as antenatal care (ANC) compliance, nutritional behavior, physical activity, stress management, and medication adherence provides a multidimensional assessment of preventive behaviors. Furthermore, the relatively large sample size enhances the statistical power and reliability of the findings. The inclusion of multiple behavioral outcomes allows for a nuanced understanding of which preventive domains are most strongly influenced by different sources of support. This holistic design strengthens the study's internal validity and relevance for public health interventions.

Another key strength is the contextual relevance of the study setting in Sumenep Regency, an area with a high burden of maternal mortality and preeclampsia risk. By focusing on a real-world community setting rather than a controlled clinical environment, the findings reflect actual conditions faced by pregnant women in resource-limited contexts. The use of standardized statistical analyses ensures methodological rigor, while the stratification of social support sources

allows for comparative interpretation of their respective roles. Importantly, the study identifies a critical gap in stress management support, which might otherwise be overlooked in purely biomedical studies. This evidence-based insight provides practical value for healthcare planners and policymakers. Overall, the study contributes novel empirical evidence by bridging clinical prevention and psychosocial determinants of maternal health.

Limitations of the Study

Despite its strengths, this study has several limitations that should be acknowledged. First, the cross-sectional design limits the ability to establish causal relationships between social support and preeclampsia preventive behaviors. Although significant associations were observed, temporal sequencing between exposure and outcome cannot be definitively determined. Second, the reliance on self-reported data for several behavioral variables may introduce recall bias or social desirability bias, potentially leading to overestimation of adherence behaviors. Third, stress management was assessed using subjective measures, which may not fully capture physiological stress responses relevant to preeclampsia. These factors may affect the precision of the findings.

Another limitation is that the study did not incorporate biological or clinical biomarkers, such as blood pressure trends, inflammatory markers, or cortisol levels, which could have strengthened the interpretation of stress-related outcomes. In addition, healthcare provider support was measured broadly and did not differentiate between types of interactions, such as emotional counseling versus routine clinical advice. Cultural factors specific to Sumenep Regency may also limit the generalizability of the findings to other regions with different social norms and healthcare systems. Furthermore, peer support was assessed without distinguishing between structured support groups and informal social networks, which may have varying impacts on health behaviors. These limitations suggest that the findings should be interpreted cautiously and contextualized within the study setting.

Future Directions

Future research should consider employing longitudinal or prospective cohort designs to better elucidate causal pathways between social support and preeclampsia prevention outcomes. Tracking pregnant women from early gestation through delivery would allow researchers to assess changes in behavior, stress levels, and clinical indicators over time. Incorporating objective biomarkers, such as blood pressure trajectories, cortisol levels, and inflammatory markers, could strengthen the biological plausibility of psychosocial influences on preeclampsia risk. In addition, mixed-methods approaches combining quantitative analysis with qualitative interviews may provide deeper insights into how different forms of social support are perceived and utilized by pregnant women. Such approaches would enrich understanding beyond numerical associations alone.

Further studies should also explore the development and evaluation of integrated intervention models that combine medical care with structured psychosocial support. In particular, training healthcare providers in basic emotional counseling and stress-management communication may address the identified gap in psychological support. Family-based and partner-inclusive interventions should be systematically tested to determine their effectiveness in improving stress management and adherence to preventive behaviors. Expanding research to diverse geographical and cultural settings would enhance the external validity of future findings. Ultimately, these directions may contribute to the formulation of comprehensive maternal health policies that address both clinical and social determinants of preeclampsia prevention.

CONCLUSION

Family support, peer/friend support, and healthcare provider support play crucial roles and have a significant influence on various aspects of maternal health, ranging from adherence to antenatal care (ANC) to nutritional adequacy, physical activity, and medication adherence. However, in the area of stress management, healthcare provider support does not show a significant effect, indicating that emotional interventions may be more effective when they come from the closest social circle.

Author's Contributions Statement

A and YP—conceptualized the manuscript; carried out data analysis; drafted the manuscript. A and RYA—carried out the methodology; edited the manuscript. SW, YP, and RYA—supervised the project, provided critical revisions of intellectual content, and oversaw project administration. All authors subsequently revised the drafts. All authors read and approved the final manuscript.

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