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OBESITY AS A PREDICTOR OF PREECLAMPSIA IN HIGH-RISK PREGNANCIES: A LITERATURE REVIEW

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Abstrak

Obesitas pada ibu hamil merupakan faktor risiko utama yang berkontribusi terhadap meningkatnya kejadian preeklampsia, sebuah komplikasi kehamilan serius yang menjadi penyebab signifikan morbiditas dan mortalitas maternal. Bertujuan untuk menelaah hubungan antara obesitas dan kejadian preeklampsia pada ibu hamil, khususnya dalam konteks kehamilan risiko tinggi. Studi ini merupakan tinjauan sistematis berdasarkan pedoman PRISMA. Artikel dicari melalui database PubMed, ScienceDirect, Scopus, dan Google Scholar. Delapan artikel yang memenuhi kriteria inklusi dianalisis secara naratif. Hasil penelitian ini adalah dari delapan studi yang ditelaah, ditemukan bahwa obesitas berkontribusi signifikan terhadap kejadian preeklampsia, dengan prevalensi hingga 37,5%. Faktor risiko lainnya yang dominan meliputi usia ibu berisiko (<20 tahun atau >35 tahun), hipertensi, jumlah kehamilan (gravida tinggi), kondisi sosial budaya, dan kehamilan kembar. Studi menunjukkan bahwa obesitas sebelum kehamilan meningkatkan risiko preeklampsia secara proporsional terhadap kelas obesitas, dengan risiko tertinggi pada IMT ≥40. Kesimpulan adalah Obesitas merupakan faktor risiko yang dapat dimodifikasi dan memiliki peran penting dalam kejadian preeklampsia pada kehamilan risiko tinggi. Temuan ini menegaskan pentingnya intervensi dini dan upaya pencegahan yang terfokus pada pengendalian berat badan ibu hamil.

Kata kunci: Preeklampsia, Obesitas, Kehamilan Risiko Tinggi, Mortalitas Ibu

Abstract

Obesity in pregnant women is a major risk factor contributing to the increased incidence of preeclampsia, a serious pregnancy complication that significantly contributes to maternal morbidity and mortality. This study aims to examine the relationship between obesity and the incidence of preeclampsia in pregnant women, particularly in the context of high-risk pregnancies. It is a systematic review conducted in accordance with PRISMA guidelines. Articles were retrieved from the PubMed, ScienceDirect, Scopus, and Google Scholar databases. Eight articles meeting the inclusion criteria were analyzed narratively. The findings indicate that obesity significantly contributes to the incidence of preeclampsia, with a reported prevalence of up to 37.5%. Other predominant risk factors include maternal age extremes (<20 years or >35 years), hypertension, high parity, sociocultural conditions, and multiple pregnancies. The reviewed studies show that pre-pregnancy obesity increases the risk of preeclampsia proportionally to the class of obesity, with the highest risk observed at a BMI ≥40. In conclusion, obesity is a modifiable risk factor that plays a significant role in the occurrence of preeclampsia in high-risk pregnancies. These findings underscore the importance of early interventions and preventive efforts focused on maternal weight management.

Keywords: Preeclampsia, Obesity, High-Risk Pregnancy, Maternal Mortality

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INTRODUCTION

Obesity is classified into three levels of severity, with higher levels associated with increased health risks. It can be influenced by both genetic and behavioral factors (Betty et al., 2020). Behavioral factors include dietary patterns, physical activity levels, medication use, as well as various social aspects such as food accessibility, educational attainment, and food marketing strategies (Zhang et al., 2024).

In pregnant women, obesity increases the likelihood of various adverse complications for both the mother and the fetus (Bayuana et al., 2023). For the mother, risks during pregnancy include gestational diabetes, preeclampsia, postpartum hemorrhage, and sleep apnea. Meanwhile, the fetus is more susceptible to miscarriage, preterm birth, macrosomia, congenital anomalies, and even neonatal death (Hafsa Mohamed Mohamud & Istianah Surury, 2022).

Preeclampsia is one of the pregnancy complications that significantly contributes to maternal morbidity and mortality, particularly in low- and middle-income countries (Dachlan, 2019). It is estimated to cause the deaths of approximately 50,000 to 60,000 pregnant women each year and is recognized as one of the leading factors contributing to preterm birth (Fitriani, 2016; Moncayo Párraga et al., 2022). This condition is a systemic syndrome that occurs during pregnancy, originating from the placenta due to suboptimal cytotrophoblast invasion (Renita Sanyasi, 2021). This inadequate placental development subsequently triggers widespread maternal endothelial dysfunction. All clinical manifestations of preeclampsia are associated with glomerular endotheliosis, increased vascular permeability, and a systemic inflammatory response that ultimately leads to organ damage or hypoperfusion (Karmia & Serudji, 2022).

In pregnant women with preeclampsia, various pathophysiological changes occur that affect multiple organs or organ systems, which subsequently manifest as clinical symptoms. These changes are believed to be caused by vasospasm, endothelial dysfunction, and ischemia. The diagnosis of preeclampsia is generally established based on elevated blood pressure and the presence of protein in the urine (proteinuria) (Fatimah et al., 2022; Rolnik et al., 2022).

Preeclampsia is estimated to occur in approximately 5% of all pregnancies. If left untreated, preeclampsia can progress to eclampsia, a life-threatening condition that poses serious risks to both mother and fetus. In developing countries, the incidence of eclampsia is reported to range from 0.3% to 0.7%, whereas in developed countries, the rate is significantly lower, around 0.05% to 0.1% (Zainiyah et al., 2023). According to data from the Indonesian Ministry of Health in 2024, approximately 50,000 maternal deaths were attributed to preeclampsia and eclampsia. The incidence of preeclampsia and severe preeclampsia is reported to range from 1 in 1,000 to 1 in 1,700 pregnancies (Handayani & Nurjanah, 2021).

The 2019 guidelines from the National Institute for Health and Care Excellence (NICE) state that a woman is considered at high risk of developing preeclampsia if she has a history of hypertension in a previous pregnancy or has underlying medical conditions such as chronic kidney disease, autoimmune disorders, diabetes, or chronic hypertension (Bermúdez Salas, 2018; Raio et al., 2015).

Moderate risk is assigned to women with certain factors such as being nulliparous, aged ≥40 years, having a body mass index (BMI) ≥35 kg/m², a family history of preeclampsia, multiple pregnancies, or an interpregnancy interval of more than 10 years (Dewenter et al., 2015; Pratiwi, 2020). These risk factors are also reflected in the largest meta-analysis to date on clinical risk factors for preeclampsia conducted by Bartsch et al., which involved over 25 million pregnancies across 92 studies. The presence of one high-risk factor or two or more moderate-risk factors forms the basis for the recommendation to use aspirin as prophylaxis, which has been shown to effectively reduce the risk of preeclampsia when administered before 16 weeks of gestation (Bartsch et al., 2021).

Excessive weight gain during pregnancy can pose various risks for both the mother and the fetus. Maternal obesity contributes to an increased likelihood of developing gestational diabetes, delivering a large-for-gestational-age baby (macrosomia), preterm birth, pregnancy-induced hypertension, difficulty losing weight postpartum, the need for cesarean delivery, and a higher risk of preeclampsia (Hanif et al., 2021; Rastegari et al., 2019).

Considering the high prevalence of obesity and the serious impact of preeclampsia on maternal and fetal health, it is essential to further examine the relationship between obesity and the incidence of preeclampsia, particularly among pregnant women classified as high risk (Fatimah et al., 2022; Raio et al., 2015). This literature review aims to provide a deeper understanding of the association between obesity and preeclampsia, as well as its implications for preventive efforts and early interventions in the management of high-risk pregnancies.

METHOD

This systematic review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to maintain transparency and rigor throughout the processes of article identification, selection, and data synthesis. The literature search was carried out using several scientific databases,

including PubMed, Scopus, ScienceDirect, and Google Scholar. The keywords used included: "preeclampsia prevention," "pregnant women," "preventive behavior," "risk factors," "maternal mortality," and "obesity." The inclusion criteria were limited to articles published between 2020 and 2025, written in either English or Indonesian, and available in full-text format.

Study Selection and Data Extraction Process

All articles retrieved from the initial search were compiled and checked for duplicates. Two independent researchers reviewed the titles and abstracts, and subsequently conducted a full-text evaluation of articles that fulfilled the initial inclusion criteria. Discrepancies in assessment were resolved through discussion or consultation with a third reviewer. This process was conducted to ensure that only relevant articles meeting methodological standards were included in the final analysis.

Data from each selected study were systematically extracted into a matrix that included information on the author, year of publication, study design, location and target population, type of intervention, and key findings. A narrative synthesis was conducted by comparing the effectiveness of interventions based on the context and population characteristics. Risk of bias was assessed using appropriate tools depending on the study design, such as the CASP or JBI checklist, to ensure the integrity of the resulting synthesis.

Inclusion and Exclusion Criteria

The inclusion criteria for this literature review consist of original research articles, including cohort studies, case-control studies, as well as systematic reviews or meta-analyses that examine the relationship between obesity and the incidence of preeclampsia in pregnant women, particularly within high-risk pregnancy groups. Eligible studies must involve populations of high-risk pregnant women, such as those aged ≥35 years, with a history of preeclampsia, multiple pregnancies, chronic hypertension, diabetes, or kidney disease. Only articles published within the last ten years (2020–2025) were included to ensure relevance to current developments. Furthermore, only full-text articles written in either Indonesian or English were considered for analysis.

The exclusion criteria included non-research articles such as editorials, opinion pieces, commentaries, letters to the editor, and single case reports. Studies that were not relevant to the focus of this review—such as those that did not examine obesity as a risk factor for preeclampsia or were not conducted in high-risk pregnancy populations—were also excluded. Duplicate articles, as well as studies with weak or inadequate methodology (e.g., those with a high risk of bias or incomplete data), were eliminated during the final selection process.

Initial Research Data and Screening Process

The initial data collected from medical records research between 2020 and 2025 comprised 476 studies, including 261 unpublished research results (non-open access journals) and 215 published articles (open access journals). The data were then filtered by including only studies published in peer-reviewed journals, resulting in 56 journals that met the criteria of data recency and relevance to the research topic. From this screening process, a final selection of 8 journal articles from various research locations was identified and used as the study sample.

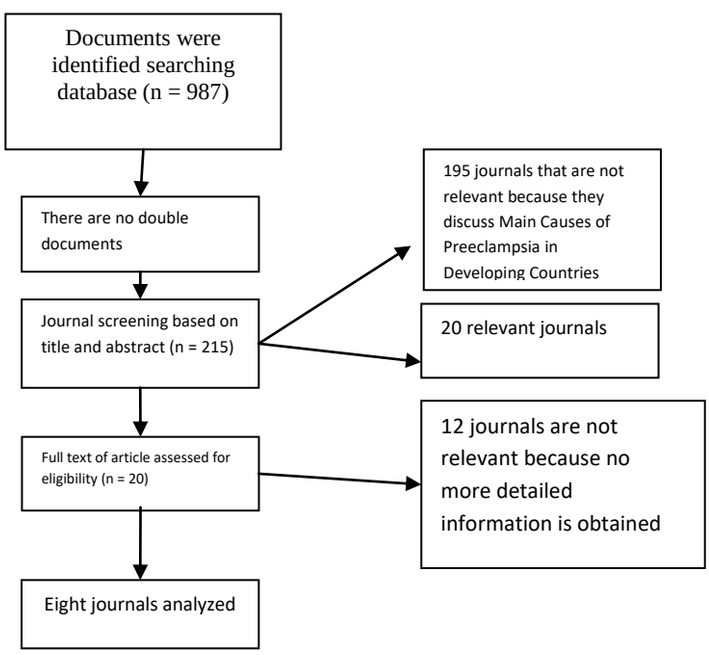

Figure 1. Literature Search Results

RESULT AND DISCUSSION

A total of 8 articles, all of which were original research studies, were included in this review. The literature search was conducted using the PubMed, ScienceDirect, Google Scholar, and Scopus database. The findings from the reviewed journals are summarized as follows:

Tabel 1. Summary of research related to maternal preventive strategies against preeclampsia

No	Author	Location	Sample	Study	Results
1	Santa Betty, Indasah, Yenny Puspitasari(Sinurat et al., 2019)	Sultan Imaniddin Hospital Pangkalan Bun, Indonesia	148 pregnant women in the third trimester	cross sectional sampling approach	a. The history of hypertension (X1) yielded a p-value of 0.000, which is less than 0.05, indicating a significant influence on the incidence of preeclampsia (Y), thus H1 is accepted. Twin pregnancy (X2) showed a p-value of 0.999, which is greater than 0.05, indicating no significant influence on the incidence of preeclampsia, thus H1 is rejected. Obesity (X3) yielded a p-value of 0.000, which is less than 0.05, indicating a significant influence on the incidence of preeclampsia, thus H1 is accepted. b. The most dominant factor influencing the incidence of preeclampsia at Sultan Imanuddin Hospital, Pangkalan Bun, is the variable of a history of hypertension.
2	Zahra Rastegari, Mohammad H. Yarmohammadian, Fatemeh Mohammadi and Shahnaz Kohan(Rastegari et al., 2019)	Iran	all the women with preeclampsia, obstetricians, midwives, and maternal health policy makers	Mix Methode Analysis	a. Timely and comprehensive monitoring of high-risk pregnant women. This study also has the potential to improve the quality of healthcare services and promote equity in healthcare delivery. b. The development of home care programs for pregnant women, especially those at high risk, should take into account the sociocultural context of Iran to ensure that interventions are more effective and sustainable.
3	Hemi Fitriani(Fitriani et al., 2021)	Indonesia	The study included 24 participants in the preeclampsia group and 24 in the non-preeclampsia group	Case Control Study	a. The univariate analysis showed that preeclampsia most frequently occurred among pregnant women of high-risk age, accounting for 58.3% of cases. b. Pregnant women of high-risk age were seven times more likely to develop

					preeclampsia compared to those of non-risk age.
4	Dwi Rukma Santi, Dewi Retno Suminar, Shrimarti Rukmini Devy, and Mahmudah(Santi et al., 2023)	Tuban Regency, Indonesia	225 respondents	a cross sectional study approach	a. The findings indicated that sociodemographic factors influenced the behavior of recognizing preeclampsia (PE) warning signs indirectly, through perceptions of susceptibility and severity, as well as perceived barriers. b. Health belief components—such as perceived susceptibility and severity, perceived threat, perceived benefits, perceived barriers, and self-efficacy—were found to have a direct impact on behaviors related to the detection of PE warning signs. c. Cues to action influenced the detection behaviors of PE warning signs through both direct and indirect pathways.
5.	Omar M Young(Young et al., 2016)	Amerika	165,811 respondents	a retrospective cohort study	Women who experienced preeclampsia before 37 weeks of gestation (n = 784) were more likely to be obese compared to those who developed preeclampsia after 37 weeks (33.1% vs. 25.3%, P = 0.0001). Compared to women with normal weight who did not develop preeclampsia, the risk of preterm preeclampsia increased proportionally with the class of pre-pregnancy obesity, with the highest risk observed in women with a BMI ≥ 40 kg/m² (RR 5.23; 95% CI: 3.86–7.09; P < 0.001).
6.	Mergy Gayatri, Nurul Fathiyyah, Jesica Mulyadi, Diadjeng Setya Wardani, I Wayan Agung Indrawan (Gayatri et al., 2022)	Indonesia	Forty-three mortality cases from preeclampsia were acquired using total sampling	Case-control study	a. Maternal deaths due to preeclampsia in Jember district were linked to factors such as anemia and low household income. b. To lower the mortality rate from preeclampsia, preventive measures targeting anemia during pregnancy are essential.
7	Enoch Odame Anto, Wina Ivy Ofori BoaduI, Ezekiel Ansah, Augustine Tawiah, Joseph Frimpong,	Ghana	total of 1,259 pregnant women	prospective cross-sectional study	a. Preeclampsia was frequently observed among women aged 20–29 years, particularly those with a basic level of education, engaged in informal

	Valentine Christian Kodzo Tsatsu Tamakloe(Anto et al., 2023)				employment, and with a history of multiple pregnancies and births. b. Pregnant women who were primigravida, had a previous caesarean section, and experienced fetal growth restriction were identified as having the highest risk for developing preeclampsia.
8.	Eka Cerelia, Ivon Diah Wittiarika, Muhammad Ilham Aldika Akbar	Surabaya, Indonesia	A total of 82 participants were included	Cross sectional	a. A significant overall association was found between gestational age and the occurrence of preeclampsia/eclampsia, as well as between gestational age and several maternal factors, including age, birth spacing, number of pregnancies (gravida), multiple gestations, history of diabetes mellitus, body mass index (BMI), history of hypertension, and prior preeclampsia. b. Gravida, body mass index, and hypertension were each found to have a considerable individual (partial) influence on the development of preeclampsia

Based on the review of eight research articles related to preventive strategies for preeclampsia in pregnant women, several key risk factors were found to be significantly associated with the occurrence of preeclampsia (Araya et al., 2016; Ayupova & Babajanova, 2008). These risk factors include hypertension, obesity, high-risk maternal age (<20 years and >35 years), sociocultural conditions, gravida (number of pregnancies), and multiple pregnancy (Fatimah et al., 2022; Muminova et al., 2016).

The causes of preeclampsia in pregnant women were examined through a literature review and qualitative research involving samples of journal articles and other relevant literature. In general, researchers conducting studies on preeclampsia risk have identified five key indicators

Table 2: Frequency Distribution of Main Causes of Preeclampsia

No.	Variable	Distribution	
		Total	**percentage (%)**
1.	**Hypertension factor** An increase in blood pressure during pregnancy, occurring at any stage from early to late gestation	2	25%
2.	**Obesity** (Excess body weight)	3	37.5%
3.	**High-Risk Age** (High-risk age defined as younger than 20 years or older than 35 years)	4	50%
4.	**Socio-Cultural Factors** (Influence of inherited or traditional beliefs)	2	25%
5.	**Gravida** (Women who have	4	50%

	been pregnant more than five times, including miscarriages or live births)		
6.	**Multiple Pregnancy** (A condition in which a woman carries more than one fetus in a single pregnancy)	2	25%

High risk maternal age emerged as the most dominant contributing factor, appearing in 50% of the studies reviewed. This indicates that pregnant women under the age of 20 or over 35 are at a higher risk of developing preeclampsia, as reported by Fitriani et al. and Eka Cerelia et al. Both very young and advanced maternal age are associated with hormonal imbalances and elevated blood pressure, which ultimately increase the likelihood of pregnancy complications (Ekawati & Nurhalimah, 2022; Fitriani, 2016).

Obesity is another significant factor, accounting for 50% of the reviewed studies. It is known to increase the risk of hypertension and metabolic disorders during pregnancy. Meanwhile, high gravida reflects an accumulation of risks from repeated pregnancies, particularly when accompanied by a history of miscarriage or previous high-risk pregnancies (Kuswandari, 2022; Sudarman et al., 2021).

The findings of this literature review indicate that pre-pregnancy obesity is one of the most significant risk factors for the development of preeclampsia, partic(Bisson et al., 2023; Fox et al., 2019)ularly in high-risk pregnancies (Betty et al., 2020; Chuang et al., 2024). Several studies have reported that an increase in body mass index (BMI) is proportional to the heightened risk of preeclampsia, both at term and preterm gestational ages. This is most likely related to the physiological and metabolic alterations associated with obesity, such as insulin resistance, chronic systemic inflammation, endothelial dysfunction, and oxidative stress. These conditions contribute to impaired placental implantation and poor uteroplacental perfusion pathophysiological factors strongly linked to the development of preeclampsia (Moslemizade et al., 2011; Young et al., 2016).

In addition, obesity has been correlated with increased levels of leptin and decreased levels of anti-inflammatory cytokines such as IL-33 during the first trimester of pregnancy (Trier et al., 2024). This imbalance contributes to impaired angiogenesis and abnormal spiral artery remodeling, which are recognized as key mechanisms in the pathogenesis of preeclampsia (Holz et al., 2019; Johnson & Louis, 2022). These findings are supported by studies showing that pregnant women with obesity tend to have higher uterine artery pulsatility indices, indicating increased vascular resistance and inadequate blood flow to the placenta.

Furthermore, obesity is often associated with other comorbidities such as gestational diabetes and chronic hypertension, which synergistically increase the risk of pregnancy complications, including preeclampsia. This highlights the importance of a multidimensional approach in managing obese pregnant women, emphasizing early screening, weight control, and strict management of blood glucose and blood pressure throughout the antenatal period.

Although the majority of studies support a positive association between obesity and preeclampsia, limitations in study design such as variations in the definition of preeclampsia, obesity classification, and uncontrolled confounding factors may affect the validity of the findings (Poniedziałek-Czajkowska et al., 2023; Young et al., 2016). Therefore, large-scale prospective studies with rigorous control of variables are needed to strengthen causal evidence and identify the most effective interventions for preventing preeclampsia in high-risk obese populations.

Hypertension as a direct factor plays a crucial role in the development of preeclampsia, contributing to approximately 25% of total cases according to various studies analyzed. Clinically, preeclampsia manifests as elevated blood pressure during pregnancy accompanied by target organ damage—such as renal impairment (proteinuria), hepatic dysfunction (elevated liver enzymes), and other systemic complications. This condition reinforces the argument that hypertension is not merely a comorbidity but serves as a major determinant underlying the pathophysiology of preeclampsia (Amini Moghadam et al., 2021; Vaamonde & Álvarez-Món, 2020).

A study conducted by Santa Betty et al. demonstrated that a history of hypertension whether chronic or gestational in previous pregnancies has a dominant influence on the occurrence of preeclampsia in subsequent pregnancies (Betty et al., 2020). This is attributed to persistent chronic vascular changes and sustained endothelial dysfunction, which subsequently trigger increased systemic vascular resistance and impaired placental perfusion. These findings align with existing theories that preeclampsia is the end result of inadequate uteroplacental perfusion caused by ailed vascular adaptation in women with a predisposition to hypertension (Bisson et al., 2023; Fox et al., 2019) .

Furthermore, hypertension during pregnancy often does not occur in isolation, but is commonly accompanied by other metabolic conditions such as obesity, gestational diabetes, or dyslipidemia, which synergistically exacerbate maternal vascular dysfunction. Therefore, early screening and close monitoring of blood pressure in pregnant women especially those with a history of hypertension or classified as high risk is essential (Fernández Macedo et al., 2023). Early interventions, including lifestyle modification and optimal blood pressure control, have been proven effective in reducing the risk of progression to severe preeclampsia (Pribadi, 2021).

Sociocultural factors also contributed to 25% of the identified risk elements, as highlighted in a study by Rastegari et al. in Iran, which emphasized the need for culturally tailored interventions in the development of care programs for high-risk pregnant women (Rastegari et al., 2019). This underscores the importance of culturally sensitive approaches in enhancing the effectiveness of health promotion and medical interventions. Twin pregnancies, which inherently carry higher physiological risks, were also identified in two studies contributing another 25%. This condition places additional strain on the maternal cardiovascular system, potentially accelerating the onset of preeclampsia symptoms (Erez et al., 2022).

Overall, the reviewed literature indicates that obesity is not only a risk factor but also an important predictor for the development of preeclampsia. Therefore, promotive and preventive efforts through nutritional education and weight management before and during pregnancy should be an integral part of maternal healthcare services, especially for high-risk groups (Jeyabalan, 2013). Furthermore, preeclampsia prevention efforts cannot be separated from the management of hypertension before and during pregnancy. Further research is highly necessary to evaluate the effectiveness of risk-based hypertension interventions and to identify predictive biomarkers that can assist in the early detection of preeclampsia in populations with a history of hypertension.

CONCLUSION

Preeclampsia in pregnant women is a serious condition that can lead to severe complications for both the mother and the fetus, particularly in high-risk pregnancies. Based on the analysis of eight studies, it was found that maternal age at risk (<20 years or >35 years), obesity, hypertension, multiple pregnancies, sociocultural factors, and the number of pregnancies (gravida) are the factors most frequently associated with the occurrence of preeclampsia.

Obesity emerges as one of the most prominent risk factors, particularly due to its association with increased blood pressure, metabolic disturbances, and its impact on implantation and placental perfusion. An elevated pre-pregnancy Body Mass Index (BMI) has been consistently reported to correlate positively with an increased risk of preeclampsia, in both term and preterm pregnancies. The underlying pathophysiology involves insulin resistance, chronic inflammation, endothelial dysfunction, and oxidative stress.

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