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*Original Research*

# The Importance of Prenatal Diagnosis for the Early Detection of Fetal Abnormalities in Rural Areas, Indonesia: A Mixed-Method Study

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**Abstract**

**Background**: Prenatal diagnosis in rural areas is a global challenge especially for maternal reproductive health. The challenges of implementing prenatal diagnosis in rural areas include: low public awareness and knowledge, minimal access to health care facilities, low economic factors. Yogyakarta represents Indonesia as a province with the same proportion of urban and rural areas. Apart from that, there is still a culture that influences the knowledge and behavior the health care community. The incidence of congenital abnormalities is increasing in rural areas due to delays in early detection during pregnancy. By using a mixed-method approach, this study aims to provide insight into the importance of prenatal diagnosis for pregnant women in rural areas. **Methods**: This research is a mixed-method study with 100 webinar participants of community service, 6 health care workers, and 6 pregnant women. Demographic data and knowledge about prenatal diagnosis are presented through quantitative methods. The qualitative data presented through in-depth interviews explored the perspectives of health care workers and pregnant women regarding experiences, obstacles, and support in carrying out prenatal diagnosis. Thematic analysis was used in this study. **Results**: The importance of knowledge in the early detection of fetal abnormalities and children's growth development has a significance value of 0.000 each ($p$-value $< 0.05$). In contrast, the hospital services expectation has 0.243. Qualitative reports indicated that the achievement of prenatal diagnosis services requires awareness of pregnant women and support from health care workers as direct providers of counseling and services. Pregnant women in this study realized the importance of prenatal diagnosis to detect early pregnancy abnormalities. **Conclusions**: Prenatal diagnosis in rural areas is an effort to increase early detection of fetal abnormalities and improve child development. The implementation of prenatal diagnosis in rural areas is supported by the active role of health workers and non-health workers. Several obstacles to the implementation of prenatal diagnosis in rural areas are the lack of knowledge of pregnant women, fear of poor examination results, distance from the pregnant woman's house to the health care facilities, uneven availability of ultrasound equipment, and high costs of ultrasound examinations. The government can increase access of prenatal diagnosis in rural areas, through free ultrasound subsidies and the implementation of pregnant women's classes in each village.

**Keywords:** early detection; prenatal diagnosis; pregnancy; rural area; reproduction health

## 1. Introduction

Prenatal diagnosis consists of screenings to determine the risk of fetal abnormalities and complications in pregnant women. It is done to prevent maternal and child morbidity and mortality [1]. Congenital malformations are structural and functional abnormalities in newborns that cause death in infancy and childhood [2,3]. In 2015, there were 2.68 million infant deaths worldwide, of which congenital abnormalities caused 11.3% [4]. In Indonesia, 1.4% of infants born aged 0–6 days and 18.1% of infants aged 7–28 days were born with congenital defects [5]. Additionally, the prevalence of congenital abnormalities in Indonesia is around 59.3 per 1000 live births. Also, there were also 295,000 cases of congenital abnormalities for every five million babies born per year [6]. The types of congenital disorders that generally occur in Indonesia include blindness, speech impairment, hearing impairment, quadriplegia, cleft lip, and Down Syndrome [7].

Congenital abnormalities are caused by a variety of factors that can be divided into genetic factors and non-genetic factors, such as radiation, use of drugs, and other teratogenic substances [2,8,9]. These abnormalities can consist of only one specific or multiple congenital abnormalities [2,7,10]. Delays in treating congenital abnormalities contribute to infant mortality. Low socioeconomic status, particularly in rural areas, contributes to low micronutrient intake in early pregnancy and a lack of public awareness about prenatal diagnosis [11]. Yogyakarta represents

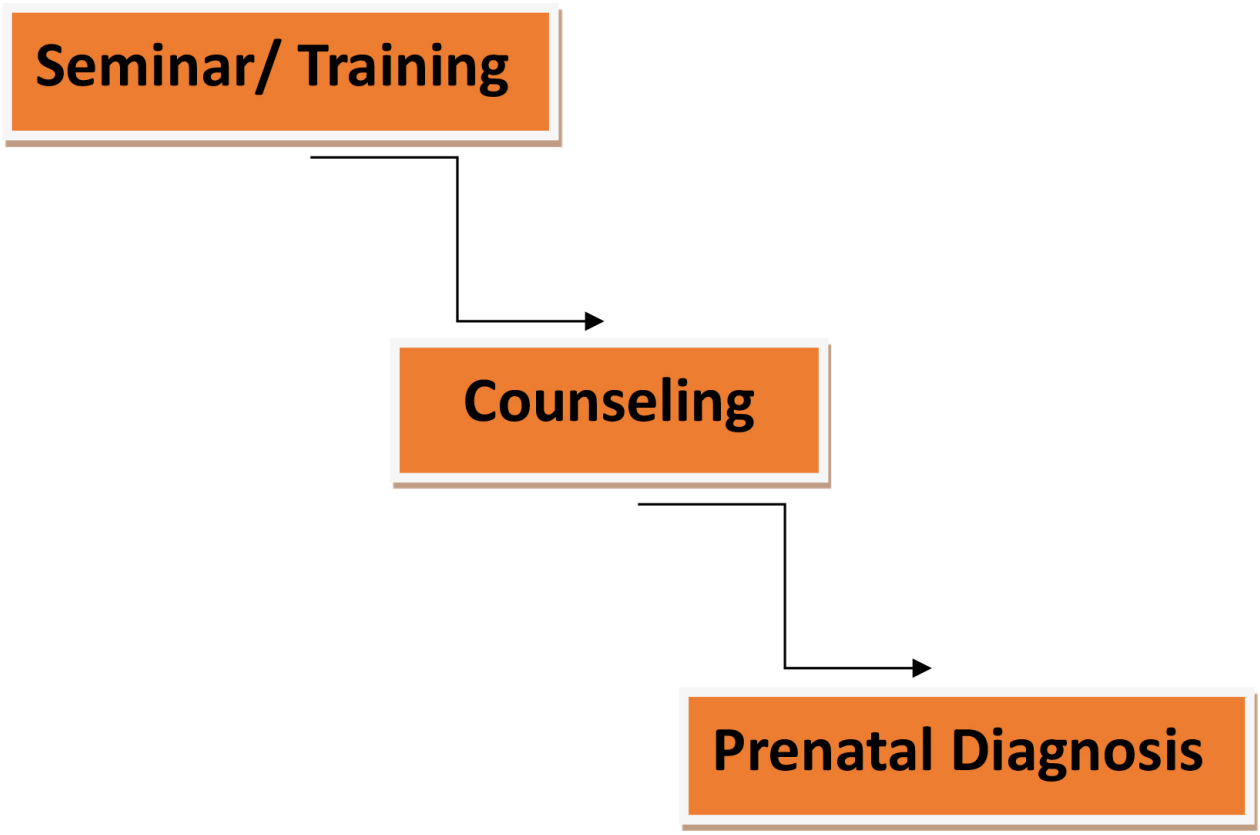


**Fig. 1. Flow of study.**

Indonesia as a province with the same proportion of urban and rural areas. Apart from that, there is still a culture that influences people's health behavior [5]. Rural health disparities have attracted increasing national attention, especially regarding the issue of health screening. Numerous cases of late referral in rural areas have an impact on maternal and infant mortality [12].

Prenatal diagnosis can guide families on prognosis, planning of adequate obstetric follow-up, intrauterine management for selected cases, and referral for cases of complex congenital heart disease [2]. Currently, advances in medical technology have also aided in detecting congenital abnormalities during fetal life [7]. Nevertheless, to decrease infant mortality, innovative efforts are needed to improve the quality of services provided by health care workers along with pregnant women's knowledge about care during pregnancy [13]. Pregnant women who are knowledgeable about the benefits of early detection of fetal abnormalities will form a positive attitude towards prenatal diagnosis, which would lead them to conduct antenatal care examinations as early as possible with health care workers [14]. This study aims to provide insight into the importance of prenatal diagnosis for pregnant women in rural areas using a mixed-method approach.

## 2. Materials and Methods

Fig. 1 shows the process of implementing prenatal diagnosis in rural area. The first is a seminar/training activity for health workers to improve their ability to detect early pregnancy. The second is a counseling process between health workers and pregnant women to obtain informed consent for prenatal diagnosis. The last is prenatal diagnosis through ultrasound examination.

This mixed method study involved 100 patients (pregnant women) and non-patients of the Gynecology Clinic at Pembinaan Kesejahteraan Umat (PKU) Muhammadiyah Gamping Hospital, Yogyakarta. In addition, they included pregnant women (n = 6) and health care workers from public health centers (n = 6). Patients came from rural areas in Sleman and Kulon Progo Regencies. These regencies are located near the diagnostic center location of PKU Muhammadiyah Gamping hospital and the hospital receives the most referrals for prenatal screening from these two regions. They were identified from the medical records of PKU Muhammadiyah Gamping Hospital, Yogyakarta, from 2020 to 2022. Sleman and Kulon Progo Regencies are district coverage area of PKU Muhammadiyah Gamping Hospital in Badan Penyelenggara Jaminan Sosial (BPJS) health services.

**Table 1. Criteria of respondents.**

| Inclusion criteria | Exclusion criteria |
|---|---|
| Patients at PKU Muhammadiyah Gamping Hospital, Yogyakarta | |
| Being recorded in the medical record for having been a patient since 2020–2022 | Being patients at PKU Muhammadiyah Gamping Yogyakarta Hospital before 2020 and after 2022 |
| Living in the rural areas of Sleman and Kulon Progo | Living in the urban areas of Sleman and Kulon Progo |
| Having a telephone number that can be contacted | The telephone number cannot be contacted |
| Willing to voluntarily become a respondent | Only willing to participate in the webinar but are not willing to fill out a questionnaire |

PKU, Pembinaan Kesejahteraan Umat.

*2.1 Quantitative Methods*

2.1.1 Sampling Method

The sampling used was purposive sampling by adjusting the inclusion and exclusion criteria that had been set (See Table 1).

2.1.2 Data Collection

An open invitation was distributed through social media platforms such as Instagram, WhatsApp, and instant messaging, to attract participants to participate in the community service activity. Pengabdian Kesehatan Masyarakat (PKM) was held online through Zoom meetings on June 17, 2022, for 90 minutes from 09:00 to 10:30 western Indonesian time. The online seminar consisted of activities, including presentations by professional speakers and an interactive question-and-answer (Q&A) session with the audience. All respondents were allowed to ask the speakers questions after the presentation session using the chat feature and the raise hand feature in the Zoom cloud meeting application. The PKM was conducted online to adapt to the pandemic, where it was impossible to conduct activities in person [12,13]. Therefore, the Zoom meetings application remains the best option for holding an online seminar that could increase the knowledge aspect of seminar participants. The questionnaire was distributed through Google forms and was filled out by the respondents to determine the extent of their knowledge of the importance of prenatal diagnosis.

2.1.3 Instruments

The community service team developed 20 questions or statements, with two correct and incorrect answer choices for each question. The questionnaire consisted of 3 indicators: knowledge of the importance of early detection of fetal abnormalities, child growth and development, and expectations of hospital services. To check the validity of the questionnaire, the questions were re-examined by the speakers who were members of the service team and were adjusted to the outcomes expected to be mastered by the participants after attending the online seminar.

2.1.4 Data Analysis

Pearson correlation analysis from SPSS 25.0 (IBM Corp., Chicago, IL, USA) was used by researchers to determine the relationship between variables and the importance of prenatal diagnosis in rural areas.

*2.2 Qualitative Methods*

2.2.1 Sampling Method

Participants were pregnant women and health workers in Kulon Progo District who were recorded as living in rural areas. Sampling was carried out until data saturation was achieved (n pregnant women = 6) and (n health workers = 6). Participants did not know each other to maintain the credibility of the data.

2.2.2 Data Collection

In-depth interviews were conducted online via Zoom for 30–40 minutes for each participant. The interviews were conducted by SW and LF. Before conducting in-depth interviews, informed consent was obtained from the participants. Participants were given the opportunity to answer freely.

2.2.3 Instruments

The interview guide was created through an agreement between researchers by adjusting the research objectives. The interview guide was created with open questions so that it gives participants the opportunity to answer freely. Questions in the interview guide relate to the experiences of pregnant women, support and obstacles in implementing prenatal diagnosis in rural areas.

2.2.4 Data Analysis

Qualitative data analysis was carried out thematically. The results of the in-depth interview recordings were transcribed, then theme mapping was carried out. The themes explored in this study included experiences, obstacles, and support in prenatal diagnosis services. Before qualitative data analysis, the data were confirmed with participants as a form of transcript validation.

This study involved human respondents and was reviewed and approved by Muhammadiyah Yogyakarta University Number 013/EC-KEPK FKIK UMY/V/2022.

**Table 2. Distribution of patient origin from rural villages at Kulon Progo and Sleman district.**

| Origin | Frequency (n) | Percentage (%) |
|---|---|---|
| Kulon Progo | | |
| Samigaluh | 5 | 5.0 |
| Girimulyo | 9 | 9.0 |
| Lendah | 13 | 13.0 |
| Kokap | 9 | 9.0 |
| Sleman | | |
| Pakem | 15 | 15.0 |
| Seyegan | 18 | 18.0 |
| Turi | 10 | 10.0 |
| Wedomartani | 9 | 9.0 |
| Kalitirto | 6 | 6.0 |
| Purwomartani | 6 | 6.0 |
| Total | 100 | 100.0 |

## 3. Results

### *3.1 Quantitative Result*

Table 2 shows the distribution of patients' origin in the rural areas of Kulon Progo and Sleman Regency. Participants were rural patients from Sleman Regency (64%) and Kulon Progo Regency (36%).

Table 3 shows that most respondents were 21–30 years old (47%). In terms of education, most of the respondents had an undergraduate education (58%) and an income of Indonesian Rupiah 2,000,000–3,000,000 (33%), and the majority of the respondents were non-patients at PKU Muhammadiyah Gamping Hospital (76%). 1 United States Dollar (USD) equals 15,654.85 Indonesian Rupiah.

Among the respondents, most (9%) had been a patient for 1–5 years, and only 1 was a patient for the 11–15 years and 16–20 years categories. Most of the respondents (84%) were not pregnant and he majority of respondents (59%) had experienced an ultrasound.

Table 4 demonstrates that most respondents had a high level of knowledge on 2 indicators, including knowledge about early detection 91 (91%) and knowledge about child development 55 (55%). Meanwhile, at least 1 (1%) and 4 (4%) of the respondents had a low level of knowledge. Most respondents have a high level of knowledge in early detection and child development. Meanwhile, most respondents have a middle level of knowledge regarding expectations of hospital services. On indicators of expectations of hospital services, most respondents had a middle level of knowledges 94 (94%).

Table 5 exhibits the results of Pearson correlation analysis. Early detection of fetal abnormalities and child development indicators had a $p$-value of 0.000 each or a $p$-value $< 0.05$. It indicates that these 2 indicators correlated with knowledge of the importance of prenatal diagnosis. Meanwhile, the expectation of hospital services indicator had a $p$-value of 0.243 or a $p$-value $> 0.05$. It suggests that the expectations of hospital service indicators do not correlate with knowledge about the importance of prenatal diagnosis. The coefficient-r of variables are importance of early detection of fetal abnormalities (0.932), child development (0.634), and expectations of hospital services (0.118).

**Table 3. Characteristics of webinar respondents.**

| Characteristics | Frequency (n) | Percentage (%) |
|---|---|---|
| Age | | |
| ≤20 years | 4 | 4.0 |
| 21–30 years | 47 | 47.0 |
| 31–40 years | 30 | 30.0 |
| 41–50 years | 11 | 11.0 |
| 51–60 years | 6 | 6.0 |
| >60 years | 2 | 2.0 |
| Total | 100 | 100.0 |
| Education | | |
| Senior high school | 27 | 27.0 |
| Bachelor | 58 | 58.0 |
| Master | 14 | 14.0 |
| Doctoral | 1 | 1.0 |
| Total | 100 | 100.0 |
| Income (USD) | | |
| <64.43 | 19 | 19.0 |
| 64.43–128.86 | 18 | 18.0 |
| 128.86–193.29 | 33 | 33.0 |
| >193.29 | 30 | 30.0 |
| Total | 100 | 100.0 |
| Patient status | | |
| New patient | 6 | 6.0 |
| Old patient | 18 | 18.0 |
| Non-patient | 76 | 76.0 |
| Total | 100 | 100.0 |
| Duration of being patient | | |
| <1 year | 4 | 4.0 |
| 1–5 years | 9 | 9.0 |
| 6–10 years | 3 | 3.0 |
| 11–15 years | 1 | 1.0 |
| 16–20 years | 1 | 1.0 |
| Total | 18 | 18.0 |
| Present condition | | |
| Pregnant | 16 | 16.0 |
| Not pregnant | 84 | 84.0 |
| Total | 100 | 100.0 |
| Complaints during pregnancy | | |
| Any complaints | 6 | 6.0 |
| No complaints | 10 | 10.0 |
| Total | 16 | 16.0 |
| Ultrasound history | | |
| Already had an ultrasound | 59 | 59.0 |
| Never had an ultrasound | 41 | 41.0 |
| Total | 100 | 100.0 |

USD, United States Dollar.

**Table 4. Respondent's level of knowledge on webinar indicators.**

| Knowledge level | Indicators | | |
|---|---|---|---|
| | Knowledge about early detection | Knowledge about child development | Expectations of hospital services |
| Low | 1 (1%) | 4 (4%) | 1 (1%) |
| Middle | 8 (8%) | 41 (41%) | 94 (94%) |
| High | 91 (91%) | 55 (55%) | 5 (5%) |

**Table 5. Indicators and knowledge about the importance of prenatal diagnosis.**

| Indicators | Knowledge of the importance of prenatal diagnosis | | | |
|---|---|---|---|---|
| | | *p*-value | Correlation coefficients | n |
| | Early detection of fetal abnormalities | 0.000 | 0.932 | 100 |
| | Child development | 0.000 | 0.634 | 100 |
| | Expectations of hospital services | 0.243 | 0.118 | 100 |

*3.2 Qualitative Results*

3.2.1 Participants Characteristics

The participants included health care workers (n = 6) and pregnant women (n = 6). The health care workers were senior midwives at public health centers who have worked over 10 years. Pregnant women in the third trimester were also involved as the main subjects for implementing prenatal diagnosis services. The average age of the pregnant women involved was approximately 30 years.

3.2.2 Theme

The themes raised in this research are experiences, obstacles, and support in prenatal diagnosis services in rural areas.

a. The experience of prenatal diagnosis.

Most in-depth interview participants reported that they knew about prenatal diagnosis services after receiving counseling from health care workers at the public health center. On average, pregnant women stated that the services they received were laboratory checks, and several participants had ultrasound services. Health care workers also explained that the prenatal diagnosis program is mandatory for all pregnant women, irrespective of their risk status. Integrated antenatal care in Indonesia provides pregnant women with the opportunity to receive accurate health information [13]. Pregnant women in primary health care facilities receive quality early detection of pregnancy. This is supported by professional health workers and complete health facilities [15].

*"Yes, initially because the midwife told me to check, then I was given information first before checking. Only then did I understand the importance of prenatal diagnosis for early detection of pregnancy..."* (Pregnant Woman-1)

*"The midwife initially suggested checking labs such as hemoglobin (Hb), protein, blood glucose, checking for human immunodeficiency virus (HIV) and syphilis. At first, I was afraid, but the midwife assured me that this test was mandatory from the government. Apart from that, it is also important for early detection of the fetus..."* (Pregnant Woman-5)

"*The team of health workers, of course, provide services according to procedures... Because this program has become mandatory, so every time a pregnant woman, whether normal or at risk, we still ask for a prenatal diagnosis...*" (Health Worker-3)

*"Basically, every time a pregnant woman is pregnant, we always recommend a complete examination, such as laboratory checks and blood pressure checks. Also, other pregnancy checks that comply with standard operational procedures... This early detection helps health workers perform appropriate follow-up according to the patient's condition...When a referral is needed, we are very ready..."* (Health Worker-6)

b. Obstacles of prenatal diagnosis.

In-depth interviewed participants stated that the obstacles encountered, especially for pregnant women, included a lack of education in the community regarding the importance of prenatal diagnosis and the distance from access to healthcare facilities [14]. Meanwhile, health care workers experience obstacles in promoting ultrasound. These obstacles are often found in rural areas [13,14]. They consider that prenatal diagnosis is not something important to be done to all pregnant women. Only a few high-risk pregnant women are considered mandatory to undergo prenatal diagnosis [14].

*"At first I was really scared... Because this was my first pregnancy so I did not have the experience of carrying out the test that the midwife suggested at that time... Apart from that, I was also worried about the results of this pregnancy test, especially when the results were bad..."* (Pregnant Woman-3)

*"My house is quite far from the public health center... So I need my husband to take me for an examination... So at that time, I had to wait for my husband's holiday so he could take me for an examination..."* (Pregnant Woman-2)

*"Yes, it seems difficult to carry out ultrasound services here... Because not all public health centers have ultrasound equipment, so we have to encourage patients to do the screening outside the public health center... Because*

*this program is free, all pregnant women should get the service without exception... However, due to the lack of education in the community regarding prenatal diagnosis, pregnant women do not have sufficient knowledge...”* (Health Worker-1)

*“The lab check service and other services are free, but the ultrasound service. Sometimes this creates obstacles for us to advise patients to have an ultrasound as soon as possible...”* (Health Worker-4)

c. The support of prenatal diagnosis.

Support for the implementation of prenatal diagnosis requires the role of health workers, families and the wider community [6,13]. The existence of a positive attitude from the wider community allows pregnant women to get information related prenatal diagnosis [8,16]. In addition, the government provides complete facilities and infrastructure to appropriate of all pregnant women, especially in rural areas [14]. Another way to increase support is through maternity waiting homes to facilitate access for pregnant women to receive safe delivery services [15].

*“My husband and family always provided support for my pregnancy. Apart from that, I was helped by cadres in the village who were very quick to provide health information... As well as obstetricians and midwives who helped me to get quality health services...”* (Pregnant Woman-1)

*“Yes, of course, my husband always provides help and support for my current pregnancy... Such as helping to calm me down when I am worried about the results of the examination... Reminding me to have routine pregnancy control... Health workers also help provide early pregnancy detection services which are beneficial for me...”* (Pregnant Woman-4)

*“We are supported by the government in terms of updating information regarding prenatal diagnosis... Previously we have received seminars or training for screening services for pregnant women...”* (Health Worker-3)

*“We participated in training such as pregnancy screening from the government...Usually, the district health office always provides us with updated information...”* (Health Worker-1)

## 4. Discussion

Prenatal diagnosis aims to detect abnormalities in the fetus [1,17]. Pregnant women with low knowledge about prenatal diagnosis will not be able to take rapid and appropriate actions regarding potential fetal problems [14]. Therefore, maternal health efforts should be conducted during the pregnancy and followed by child health efforts. Efforts to maintain the child’s health are made when the fetus is still in the womb, when they are born, after birth, and until the age of eighteen years old [16]. Prenatal diagnosis is considered an effort to reduce neonatal morbidity and mortality [17]. Therefore, this online seminar was conducted to bring awareness to the importance of prenatal diagnosis for the early detection of fetal abnormalities.

In rural areas, health is influenced by many factors. Rural communities experience a higher prevalence of chronic conditions than their urban counterparts [18]. Rural communities also experience higher rates of mortality and disability than urban communities. Limited access to health promotion, disease prevention programs, and healthcare services contribute to these health challenges [19]. It affects low awareness of prenatal diagnosis for various reasons, including long distances to hospitals, the economic cost, and employment [18,20].

Prenatal diagnosis aims to detect 3 types of congenital disabilities caused by structural defects, genetic syndromes, and chromosomal disorders [21]. These 3 types of congenital disabilities can be detected through the use of prenatal ultrasound examination [5,22]. The history of performing ultrasound services was reviewed in this study. The history of ultrasound showed the participants’ awareness of conducting prenatal diagnoses. Ultrasound is important during pregnancy to monitor the growth and development of the fetus. It is performed as an early detection of abnormalities in the fetus [3,7]. According to the World Association of Perinatal Medicine (WAPM) and Perinatal Medicine Foundation (PMF) study groups, ultrasound examinations should be performed in the first trimester to identify fetal structures at risk for abnormalities. It aims to optimize the referral process and establish the detection of fetal structural abnormalities in the first trimester [23].

An ultrasound examination and genetic counseling should follow prenatal diagnosis to determine any anomaly cases [24]. During prenatal evaluation, a detailed ultrasound assessment of the entire spine is performed with the identification of fetal position and morphology [25]. The follow-up recommendation other than ultrasound is to perform amniocentesis, blood tests, and magnetic resonance imaging (MRI) [3,21,26]. In addition to having a history of ultrasound and conducting early detection, pregnant women are advised to consult a pediatrician before giving birth. It is important to support parents’ readiness to nurture children’s growth and development from an early age [27]. Preparation for childbirth needs to be considered, especially in choosing a safe delivery method and a hospital that can provide these services [28]. The knowledge level about early detection and child development of the respondents in this study was in the high category. It occurred because most respondents had a good socio-economic status supporting high knowledge. Participants’ awareness in conducting health service visits is influenced by socioeconomic status [29]. Socioeconomic status is one factor that affects the health status of the community or family [30]. The economic level of a family will greatly influence the sustainability of family members, both from the level of education and health [29,31].

Knowledge about the importance of early detection of fetal abnormalities and child development correlates with the importance of prenatal diagnosis. Therefore, all pa-

tients seeking prenatal diagnosis should receive counseling regarding the health care's risks, benefits, and limitations [3]. Support from health care workers will affect the mindset and behavior of pregnant women; mothers who obtain support from health care workers will behave positively by making efforts to determine whether they have a high-risk pregnancy [1,3]. The expectations for hospital services indicator did not correlate with knowledge about the importance of prenatal diagnosis. It may be because most respondents have a level of knowledge in the middle category, without a positive attitude in conducting prenatal diagnosis. Participants still thought that they only visited the hospital when they had health problems. Furthermore, a positive attitude from the community needs to be built to increase awareness of early pregnancy detection [1,32]. Medical diagnosis during the antenatal period significantly influences the further prognosis of the developing fetus and newborn [33].

Building awareness of prenatal diagnosis in rural areas begins with a positive attitude so that patients are willing to come to the hospital and have appropriate expectations of the services at the hospital [34,35]. A previous study revealed that the consistent provision of prenatal care is an important quality indicator for pregnant women. Health care that provides positive experiences by prioritizing loving treatment can overcome negative emotional experiences during prenatal diagnosis [36]. Another supporting finding is that routine healthcare encounters during the prenatal period can potentially improve children's health trajectories [37]. Generally, expectations for hospital services only appear after the patient undergoes an examination at the hospital, experiences complaints, or feels any concerns regarding fetal growth and maternal health conditions.

Efforts to increase capacity-building skills for ultrasound for fetal screening for general practitioners in rural primary care (Puskesmas) should be considered. Based on a study in rural Pakistan, it is necessary to increase ultrasound capabilities in primary facilities by empowering human resources as an initial screening effort, as well as other approaches such as developing maternity waiting homes [38]. Other developments, such as telemedicine based on congenital screening, need to be utilized. Telemedicine opportunities allows the benefits of helping to monitor health and long-range consultations. However, the current challenges are in the severe category in rural areas, as well as resources that have not been available to use telemedicine [39]. In addition to increasing capacity building, it is necessary to consider the ease of access for referrals and utilization of primary care, which will be a key success factor for the effective and efficient use of available health infrastructure and achieving maternal health coverage [15]. The collaborative role of the government and non-government sectors is needed to develop telemedicine and increase capacity building for congenital screening in pregnancy in rural areas. This is an important effort to improve the reproductive health status of mothers.

## 5. Conclusions

Prenatal diagnosis in rural areas is considered an effort to increase early detection of fetal abnormalities and child development. The implementation of prenatal diagnosis in rural areas is supported by the active role of health workers, especially obstetricians and midwives through education to pregnant women. Several obstacles to the implementation of prenatal diagnosis in rural areas are the lack of knowledge of pregnant women, fear of poor examination results, distance from the pregnant woman's house to the health care facilities, uneven availability of ultrasound equipment, and high costs of ultrasound examinations. In addition, the role of the government, cadres and husbands is also considered important for pregnant women to carry out prenatal diagnosis. The government can increase access of prenatal diagnosis in rural areas, through free ultrasound subsidies and the implementation of pregnant women's classes in each village.

The limitation of this study can be seen that we only used respondents who attended the webinar, and their knowledge was assessed through a pre-experimental test. Further research is suggested that will involve more respondents, is conducted in various hospitals, and assess respondents' pre- and post-experimental knowledge levels over a defined period.

## Abbreviations

PKM (Pengabdian Kesehatan Masyarakat), The community service; SMS, Short message service; WAPM, World Association of Perinatal Medicine; PMF, Perinatal Medicine Foundation; Puskesmas (Pusat Kesehatan Masyarakat), Public Health Center; BPJS (Badan Penyelenggara Jaminan Sosial), Social Insurance Administration Organization.

## Availability of Data and Materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

## Author Contributions

SW: concept, data provision, data analysis, data and result interpretation, writing and discussion, funding acquisition. LF: data and result interpretation, writing, and discussion. RND: data collection, data and result interpretation, FHS: data collection, data and result interpretation. DN: concept, discussion. FB: concept, discussion. All authors contributed to the article and approved the submitted version. All authors contributed to editorial changes in the manuscript. All authors read and approved the fi-

nal manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

## Ethics Approval and Consent to Participate

This study was granted ethical approval from the health research ethics committee of Universitas Muhammadiyah Yogyakarta with No. 013/EC-KEPK FKIK UMY/V/2022 to investigate the importance of prenatal diagnosis for pregnant women in rural areas. This study's participants voluntarily participated and signed a written consent form before participating in the in-depth interview activities. Informed consent was obtained from all participants. All data collection was performed per relevant guidelines and regulations (Declaration of Helsinki). In addition, the participants received incentives related to this activity.


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## Conflict of Interest

The authors declare no conflict of interest.

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