



SYSTEMATIZATION OF THE CLINICAL EFFECTIVENESS AND USER REQUIREMENTS OF A SMART MATERNITY SUPPORT GARMENT BASED ON SURVEY ANALYSIS

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Abstract: *This study is devoted to the development of a Smart Maternity Support Garment (MSG) designed for the remote monitoring of pregnant women's health. Based on a survey conducted among highly qualified obstetricians and gynecologists in Namangan region, the clinical effectiveness of the system, the optimal period of use, and its technical requirements—including fabric physical properties and sensor integration—were systematically evaluated. The study substantiates the possibility of real-time monitoring of both maternal and fetal conditions as an innovative solution that enables the early detection of pregnancy-related complications and contributes to the prevention of adverse maternal and fetal outcomes.*

Keywords: smart clothing, smart maternity support garment, remote patient monitoring, telemedicine, obstetrics and gynecology, fetal hypoxia, clinical effectiveness, digital healthcare.

Introduction. *Proper management of pregnancy is one of the fundamental prerequisites for the birth of a healthy child. The primary objective of modern obstetric care is not only to ensure a successful delivery but also to detect pregnancy-related disorders at an early stage and implement timely corrective interventions from the first weeks of gestation [1].*

Globally, the markets for **Remote Patient Monitoring (RPM)** and telemedicine have experienced rapid growth over the past five years, particularly following the COVID-19 pandemic. By 2024–2025, these technologies had become an integral component of healthcare strategies in many developed countries [2].

The increasing prevalence of digital healthcare technologies has significantly expanded opportunities for continuous monitoring of pregnant women outside hospital settings. Smart wearable systems equipped with integrated physiological sensors enable healthcare professionals to monitor maternal and fetal health parameters in real time, facilitate early diagnosis of pregnancy complications, and provide timely medical intervention when necessary.

The development of intelligent maternity support garments that combine ergonomic design, functional textile materials, and wearable sensor technologies represents one of the most promising directions in modern biomedical engineering and digital obstetric care. Such systems improve patient comfort while simultaneously enhancing the quality of prenatal monitoring and reducing the risk of maternal and fetal complications.

One of the most important challenges of modern healthcare is the development of effective methods for the continuous **remote monitoring** of maternal and fetal health during pregnancy. In recent years, within the framework of digital healthcare reforms in Uzbekistan, the remote monitoring system for pregnant women has been actively developed. In particular, the **DMED** unified electronic platform has expanded opportunities for online pregnancy monitoring and remote communication between pregnant women and healthcare professionals. Furthermore, the introduction of smart healthcare services, such as the **Online Nurse**, has enabled women living in remote regions to receive qualified medical consultations. These digital healthcare systems reduce paperwork, facilitate real-time monitoring of maternal and fetal health, and enable the early detection of high-risk conditions requiring timely medical intervention [3].

In addition to the DMED platform, the use of **smart maternity support garments (prenatal support devices)** for daily monitoring of pregnant women represents one of the most promising and essential solutions in the era of digital healthcare [4].

The integrated sensors of the smart maternity support garment continuously measure vital physiological parameters, including the **fetal heart rate**, **maternal body temperature**, and **arterial blood pressure**, and automatically transmit these data to the Online Nurse platform, allowing healthcare professionals to continuously monitor the pregnant woman's condition and respond promptly to any abnormalities [5].

Based on the above considerations, the **primary objective of this study** is to systematize the medical and consumer requirements for the development of a **smart maternity support garment** by taking into account the anthropometric and morphological changes in the female body during pregnancy. To achieve this objective, the following research tasks were established:

The following research objectives were established within the framework of this study:

1. **To evaluate the effectiveness of maternity support garments in reducing pain syndromes** in the lower back, shoulders, pelvis, and lower limbs occurring during different stages of pregnancy.

2. **To identify the most appropriate types of maternity support garments**, including universal support belts, corset-type supports, multifunctional garments, and maternity support underwear, as well as to determine their clinical advantages based on recommendations from obstetricians and gynecologists.
3. **To investigate the technical requirements of the Smart Maternity Support Garment (SMSG)**, including fabric composition, color (to ensure invisibility under clothing and provide psychological comfort), and the feasibility of integrating smart functions such as monitoring maternal blood pressure, body temperature, and fetal heart rate.
4. **To determine, based on physicians' recommendations, the safe daily wearing duration of the Smart Maternity Support Garment**, including the recommended wearing time and rest intervals, as well as its positive effects on fetal development, particularly through reducing uterine pressure and maintaining a stable fetal position.

To support the development of an improved **Smart Maternity Support Garment (SMSG)** for pregnant women, a questionnaire survey was conducted among highly qualified obstetricians and gynecologists with many years of professional experience. The survey was carried out at the **NTD Medical Center**, the **First Multidisciplinary Family Polyclinic**, the **Maternity Complex** in Namangan City, **DIDISAH Private Enterprise**, the **Multidisciplinary Family Polyclinic of Pop District**, and the **SANG Village Rural Medical Center (QVP)** in Namangan Region, Uzbekistan [6].

The survey involved highly qualified obstetricians and gynecologists with different levels of professional experience: **21.7%** had up to **5 years** of clinical experience, **26.1%** had **5–10 years** of experience, and **52.2%** had **more than 10 years** of professional experience.

Regarding the use of the **Smart Maternity Support Garment (SMSG)** during pregnancy, **56.5%** of the obstetricians and gynecologists reported that they **routinely recommend** its use, **39.1%** stated that they **recommend it in almost all cases**, while only **4.3%** indicated that they **recommend it only in rare cases** (Figure 1).

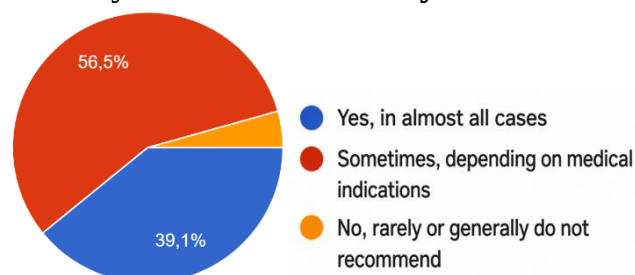


Figure 1. Survey results on physicians' recommendations for the use of the Smart Maternity Support Garment (SMSG).

A survey was conducted among obstetricians and gynecologists to evaluate the **clinical effectiveness** of the **Smart Maternity Support Garment (SMSG)**. The results indicated that **60.0%** of the respondents (14 physicians) considered the SMSG to be an effective device for supporting the anterior abdominal wall in cases of abdominal hernia. Furthermore, **56.5%** (13 physicians) reported that the garment effectively reduces pain in the lower back and sacral region, helps prevent excessive stretching of the abdominal wall, and is particularly recommended for women with multiple pregnancies (e.g., twins).

In addition, **43.5%** of the respondents (10 physicians) emphasized the importance of using the SMSG during the postpartum rehabilitation period, while **21.7%** (5 physicians) stated that it may contribute to reducing the risk of increased uterine tone (**uterine hypertonicity**) during pregnancy (Figure 2).

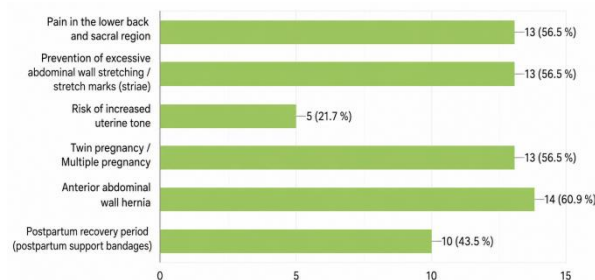


Figure 2. Survey results on the clinical effectiveness of the Smart Maternity Support Garment (SMSG).

During the sociological survey, the clinical contraindications for the use of the **Smart Maternity Support Garment (SMSG)** during pregnancy were systematically identified based on physicians' opinions. The results showed that **73.9%** of the specialists stated that they **would not recommend** the use of the SMSG for pregnant women with **allergic skin reactions**. Meanwhile, **34.8%** of the respondents expressed the opinion that the garment could be used **provided that no general medical contraindications are present**.

Furthermore, **30.4%** of the obstetricians and gynecologists emphasized that the use of the SMSG is **strictly contraindicated** in cases of **abnormal fetal presentation** (transverse or oblique lie) and when there is a **risk of fetal hypoxia** (Figure 3).

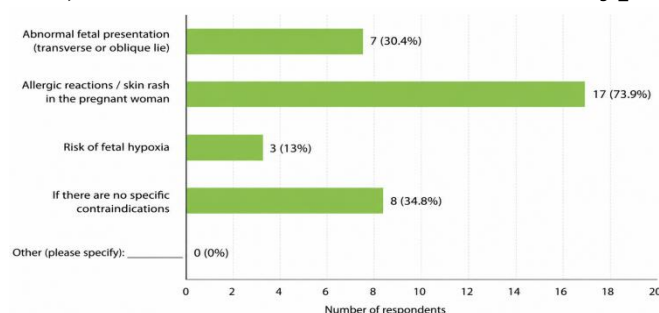


Figure 3. Survey results on the clinical contraindications for the use of the Smart Maternity Support Garment (SMSG).

Regarding the recommended time to begin using the **Smart Maternity Support Garment (SMSG)** during pregnancy, **34.8%** of the physicians recommended initiating its use between **20 and 24 weeks of gestation**, whereas the majority (**43.5%**) advised starting between **28 and 30 weeks of pregnancy** (Figure 4).

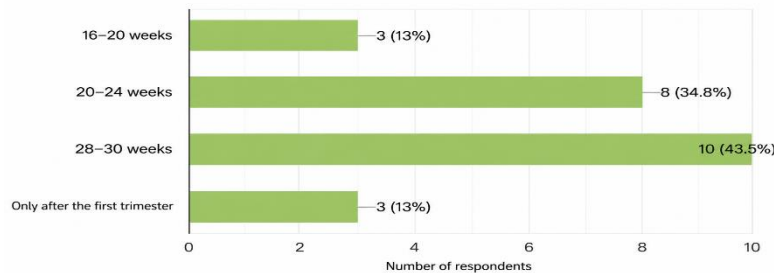


Figure 4. Survey results on the recommended time to begin using the Smart Maternity Support Garment (SMSG).

The results of the survey conducted among obstetricians and gynecologists within the framework of this study made it possible to establish recommendations regarding the **daily use of the Smart Maternity Support Garment (SMSG)** during pregnancy.

A total of **52.2%** of the physicians (12 respondents) recommended **continuous use of the SMSG throughout the day, except during sleep**. Meanwhile, **39.1%** (9 respondents) indicated that the garment should be worn **only during periods of physical activity**, such as walking or prolonged standing. Only **8.7%** (2 respondents) believed that the daily wearing time **should not exceed two hours** (Figure 5).

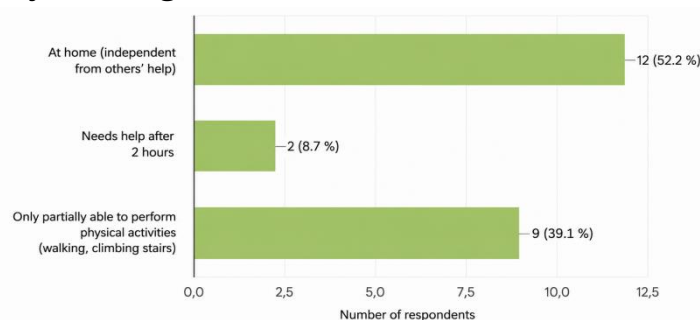


Figure 5. Survey results on the daily wearing regimen of the Smart Maternity Support Garment (SMSG).

With the ongoing transformation of modern healthcare and the rapid expansion of **telemedicine** and **remote patient monitoring**, continuous real-time monitoring of patients without requiring hospitalization has become one of the highest priorities for healthcare professionals. Within the framework of this study, specialists' opinions regarding the proposed **Smart Maternity Support Garment (SMSG)** were also evaluated.

The survey results demonstrated that **65.0%** of the respondents positively evaluated this innovative technology. Meanwhile, **21.7%** emphasized that the implementation of the new technology into clinical practice should be approached with caution, whereas **17.4%** believed that there is currently **no need for additional technological solutions** in prenatal care (Figure 6).

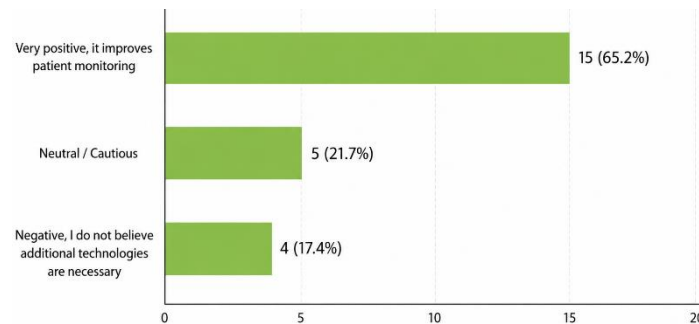


Figure 6. Survey results on specialists' opinions regarding the Smart Maternity Support Garment (SMSG).

During the study, the technological solutions integrated into the Smart Maternity Support Garment (SMSG) and their diagnostic significance were analyzed. According to the survey results, 87.0% of the experts identified the continuous real-time (online) monitoring of the patient's condition as the most important advantage of the system. Furthermore, 43.5% of the respondents emphasized that automated collection and analysis of physiological data could improve diagnostic quality, while 39.1% considered a rapid alert system for physicians and patients during emergency situations to be a critical function of the technology. In addition, 39.1% of the physicians expressed the opinion that the implementation of such smart technologies could increase patients' responsibility for their own health and encourage active participation in prenatal care (Figure 7).

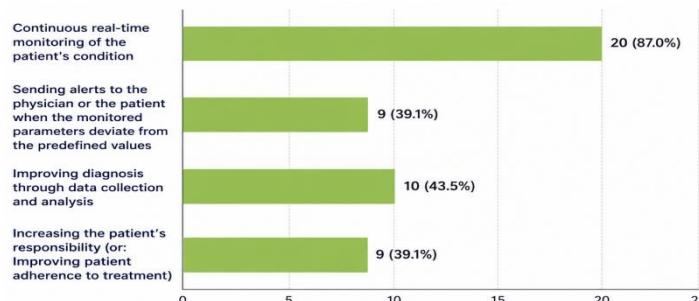


Figure 7. Survey results on technological solutions and their diagnostic significance.

At the end of the survey, the respondents were asked the following open-ended question: "**Please provide your personal recommendations, comments, or**



additional opinions regarding the use of maternity support garments during pregnancy." The physicians highlighted the following key recommendations:

- The garment should be made of **breathable, lightweight fabric** that does not cause excessive perspiration or restrict body movement. In addition, the integrated smart functions should not create any discomfort for the pregnant woman.
- Physicians emphasized the need to increase awareness of the benefits of maternity support garments through "**Women's Schools**" and primary healthcare institutions (polyclinics).
- The proposed **Smart Maternity Support Garment (SMSG)** was described as an **innovative advancement** with considerable potential for preventing numerous pregnancy-related complications.

The survey findings indicate that healthcare professionals generally regard the **Smart Maternity Support Garment (SMSG)** as an innovative solution for modern prenatal care. Nevertheless, they emphasized that its technological development should strictly comply with medical recommendations and ensure appropriate physical characteristics of the fabric, including breathability, adequate elasticity, and the avoidance of excessive compression.

Particular attention was given to the importance of promoting the advantages of the SMSG among **primary healthcare physicians**, as this is expected to facilitate the widespread adoption of remote maternal monitoring systems in the future.

Based on the survey findings and the opinions of experienced obstetricians and gynecologists, it can be concluded that the development of **smart maternity support garments** that consider the anthropometric and morphological changes occurring during pregnancy represents one of the most promising areas at the intersection of **modern healthcare, wearable technologies, and the textile industry**.

The conducted research and expert evaluations further confirmed that this innovative device not only reduces mechanical discomfort and pain in the lumbar and abdominal regions but also enables **continuous real-time remote monitoring** of the pregnant woman's health status. Consequently, the proposed system has the potential to improve prenatal care, facilitate the early detection of pregnancy-related complications, and support timely medical intervention, thereby contributing to better maternal and fetal health outcomes.

References

1. **UNICEF**. (2022). *Digital Health for Every Child: Harnessing the power of digital technologies to support child health*. UNICEF Digital Health Reports. [Manba: [unicef.org](https://www.unicef.org)]

2. **World Health Organization (WHO).** (2023). *Global strategy on digital health 2020-2025*. Geneva: World Health Organization.
3. **Grand View Research.** (2024). *Remote Patient Monitoring System Market Size, Share & Trends Analysis Report By Application (Cancer, Cardiovascular Diseases, Diabetes), By End-use, By Region, And Segment Forecasts, 2024 - 2030*.
4. **O‘zbekiston Respublikasi Prezidentining Farmoni.** (2020). *"Raqamli O‘zbekiston — 2030" strategiyasini tasdiqlash va uni samarali amalga oshirish chora-tadbirlari to‘g‘risida*. PF-6079-son.
5. **Shamsutdinova, D. B.** (2023). *Telemedicine in Obstetrics: Remote Monitoring of High-Risk Pregnancies*. Journal of Digital Medicine and Health Reforms.
6. **Usmanova D., Mahsudov Sh., Vahobova D.** // *"Homilador ayollar bandajlarini takomillashtirishda materiallarning fizik-mexanik, gigiyenik xususiyatlari va funksional imkoniyatlari tadqiqi"* Farg‘ona Davlat texnika universiteti/ *"Ilmiy texnika"* jurnali-Farg‘ona. №1, 2026