

Using digital technologies and applications in midwifery practice in
Belgium: A descriptive cross-sectional study

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ABSTRACT

Introduction: Over the past two decades, there has been a dramatic increase in the use of digital technologies within healthcare and also in midwifery. However, scarce literature exist on the use of digital technologies and applications in midwifery practice particularly in the Belgian setting.

Aim: To map the use of digital technologies and applications by midwives in various settings, encompassing hospitals, primary care, and educational institutions in Belgium.

Methods: A descriptive cross-sectional design was used to collect data via an online questionnaire targeting at midwives working in the Flemish region, Walloon region, or Brussels-Capital region. Midwives were either Dutch-speaking or French-speaking (n = 212). The semi-structured questionnaire addressed three domains: (1) socio-demographics, (2) employment information (3) the use of digital technology, including the level of comfort with technology. Qualtrics[®] program was used for managing data and SPSS v28.0[®] for data analysis using descriptive statistics, Chi² analysis, and independent sample t-test. The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines.

Results: Among respondents, 58% reported the use of digital technologies and applications, with electronic health records (89.6%), electronic prescriptions (65.6%), and remote patient monitoring (51.2%) commonly utilized. Sensor technology (7.2%), mixed care (3.8%), care robots (2.5%), and wearable devices (1.9%) were very rarely used. The target groups for these digital technologies and applications generally encompass all stages of the perinatal period. Midwives felt overall highly confident with these technologies. Younger participants and those with a Master's or PhD degree exhibited greater comfort scores in digital technology use. No significant relationships were observed between socio-demographic characteristics and the adoption of digital technology.

Conclusion: The results highlight the potential for incorporating digital technologies and applications into various midwifery care settings. Addressing barriers and enhancing usability can optimize technology integration, contributing to personalized high-quality care, ultimately improving perinatal health outcomes.

Keywords: Digital technology, Midwifery, Medical informatics, Digital health, Telemedicine

Introduction

The digital transformation of healthcare systems represents a challenging and urgent priority worldwide (Brown Wilson et al., 2020; Vivilaki et al., 2021). The World Health Organization (WHO) Global Strategy Report on Digital Health (2020-2025) outlines the importance of digital health. The primary objective of the WHO report is to support universal health coverage and reach health-related sustainable development goals through the effective use of digital technologies in healthcare (WHO, 2019). Over the past two decades, there has been a striking increase in the use of digital technologies to promote maternal health and support service providers in midwifery practice (Gyselaers et al., 2019; Lanssens et al., 2017).

The internet, mobile technologies (such as software programs or smartphone apps), telecare, remote monitoring equipment, social networking, texting, and wearable devices are examples of digital tools (WHO, 2019; Brown Wilson et al., 2020). The digital field has gained prominence as an area where both traditional and innovative information and communication technologies are employed to address evolving health issues, with a particular impact in the field of midwifery (De Witte et al., 2021). Digital health technologies have the potential to enhance perinatal care by facilitating personalization, reducing administrative burdens, and improving women's experiences during pregnancy and the postpartum period (Bekker et al., 2023; Dowding et al., 2023; Lanssens et al., 2020). Studies have shown that women receiving midwifery care through telehealth experienced insufficient assessments, difficulties in communication, and challenges in building rapport. Midwives shared similar concerns, noting additional issues with technology (Galle et al., 2021; Hearn et al., 2022; Collins et al., 2024). Although technology cannot replace the human touch that midwives provide, digital solutions do enhance midwifery practices (Lanssens et al., 2017; Wakelin et al., 2022).

Midwives increasingly use technology in their practice, notably through electronic health records and remote patient monitoring tools. Electronic health records offer a comprehensive view of a patient's health, facilitating higher quality, coordinated care. Remote patient monitoring, which collects and transmits medical data from patients to healthcare providers, enables timely interventions by detecting early health changes (WHO, 2019). A systematic review highlighted the use of remote monitoring for cardiotocography, blood glucose levels, blood pressure, and prenatal ultrasounds in prenatal care (Gyselaers et al., 2019). Studies have shown that remote monitoring is particularly beneficial for managing gestational hypertensive disorders, offering promising prenatal observation for at-risk women (Lanssens et al., 2017; 2020). Telemonitoring, a subset of remote monitoring, has been found to be as safe as hospital

admission for pregnant women with complications requiring daily surveillance, with significant cost savings and higher patient satisfaction (Bekker et al., 2023). Additionally, mobile apps assist midwives and patients in tracking health metrics, setting appointment reminders, and staying updated with guidelines, further enhancing care delivery in midwifery practice (Gyselaers et al., 2019).

In rural or underserved areas, telemedicine (a broad term encompassing various healthcare services delivered remotely) enable consultations with specialists from a distance, enhancing their ability to provide comprehensive care. This fact also contributes to significant reductions in healthcare costs and improves maternal satisfaction (Lanssens et al., 2017). The scoping review by Lanssens et al. (2017) showed that there is a need for further studies to strengthen the level of evidence in this area and thus gain insight into the added value of these technologies. Integrating digital technology tools and data into midwifery practice can assist in delivering higher-quality obstetric care, achieving better outcomes, increasing job satisfaction, and advancing professionalization (Brown Wilson, 2020). This, in turn, leads to better experiences and improved outcomes for mothers and babies.

However, there are also some key challenges to consider when using technological tools in practice, including privacy and data security, as well as a lack of clear official guidelines and regulations, including reimbursement frameworks (Brown Wilson, 2020; Faucher et al., 2020; Gyselaers et al., 2019; Wakelin et al., 2022). Further, as healthcare becomes increasingly digitalized, there is also a need to support health professionals in developing the capacity to effectively use these digital systems (Wakelin et al., 2022; Bleijenbergh et al., 2023). The lack of technological skills or knowledge in using digital technology has also been identified as a concern by midwives (Dalton et al., 2014; Dowding et al., 2023; Spiby et al., 2019; Wakelin et al., 2023). Consequently, technological, and digital applications bring advantages and disadvantages, both in terms of the quality of services and the organization of healthcare. To provide accessible, evidence-based, and future-oriented services, assessing the current use of digital technologies in midwifery practice and education is necessary (Boury et al., 2022; Konttila et al., 2019; Wakelin et al., 2023).

Therefore, the aim of this study was to provide a comprehensive overview of the utilization of technological and digital applications by midwives, in both their practice in the obstetric field and in the field of education. This study specifically aimed to: (i) evaluate the current use of digital technologies and applications in midwifery practice; (ii) examine the relationship between midwives' use of these technologies and their socio-demographic factors; (iii) identify the digital tools and applications midwives use for different target groups; (iv) assess

midwives' comfort with using digital technologies and applications; and (v) analyze how comfort levels vary based on socio-demographic characteristics.

Methods

Design

This study chose a descriptive cross-sectional design, using an online survey with a semi-structured, self-administered questionnaire. This research followed the recommendations provided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational cross-sectional studies.

Setting

Belgium, a country in Western Europe, is divided into three autonomous communities and regions: the Flemish Region (Dutch-speaking), the Walloon Region (French-speaking), and the Brussels-Capital Region (bilingual) (Vermeulen et al., 2021). In 2019, 10,501 midwives were professionally active in Belgium, 70% (n = 7357) in Flemish, 23% (n = 2400) in Walloon, and 6% (n = 625) in the Brussels-Capital Region. Out of the total of all professionally active midwives, 78% (n = 8243) work in a hospital setting, 9% (n = 990) in primary care, and 12% (n = 1268) combine both (PlanKad Vroedvrouwen, 2019).

Belgian midwives are specialists in the field of physiology and provide their services in both hospital settings (secondary or tertiary healthcare) and primary care. They have the authorization to provide guidance and supervise the care of both expectant mothers and newborns, starting from before conception and throughout the stages of pregnancy, childbirth, and the postnatal period. Furthermore, midwives practicing in Belgium have responsibilities across four key practice areas, including obstetrics, reproductive medicine, gynaecology and neonatology (Lanssens et al., 2022; Vermeulen et al., 2021; 2024). They also have prescription privileges under the law of 13 December 2006 (Federal Government of Health, 2015; Vermeulen and Fobelets, 2022). The criteria for midwives to prescribe medications, as well as the types of medications they are authorized to prescribe during routine pregnancy follow-up, normal childbirth, and care of healthy neonates in primary care, were established by law in 2013 (The Royal Decree of 15 December 2013; Vermeulen et al., 2021). In Belgium, public healthcare is primarily financed through a combination of mandatory health insurance and social security contributions, covering both hospital and primary care. Midwifery services are included in mandatory health insurance, ensuring access for the majority of citizens (Belgian Federal Government, 2024).

In Belgium, midwifery education is offered by twelve higher education institutions in the Flemish Region, providing a three-year bachelor's program, and by nine institutions in the Walloon and Brussels-Capital Regions, offering a four-year bachelor's program (Embo et al., 2016; Vermeulen et al., 2021). After earning a bachelor's degree, midwives must apply for a license to practice, which is required to work in the healthcare field. Additionally, midwives are required to complete Continuous Professional Development (CPD), with a minimum of 75 hours of training every five years to maintain their practice license (Vermeulen et al., 2021; Vermeulen and Fobelets, 2022).

Participants

We aimed to achieve representative participation from midwives working in the three regions mentioned above. To ensure this representativeness, we addressed every hospital, primary care, and educational institution in these regions. Thus, we recruited midwives working at university or non-university hospitals across all professional areas, including maternity care, reproductive medicine, gynaecology, and neonatology. Additionally, we included midwives working in primary care and those involved in research and education, who were either Dutch-speaking or French-speaking.

Data collection tools

We developed a semi-structured, self-administered questionnaire based on literature (De Witte et al., 2021). Questionnaire items were adapted into both Dutch and French statements by two expert researchers (FD and DL) in evidence-based practices and midwifery. The statements underwent external checks to evaluate the content validity of the questionnaire, with a focus on assessing its items for readability, clarity, and comprehensibility. Any identified discrepancies were discussed and adjusted by FD and DL. The questionnaire included a mix of multiple-choice questions with predefined answers, propositions rated on a 10-point Likert scale, and open-ended questions that allowed midwives to share their opinions. The final online questionnaire consisted of three parts that assessed the following: (1) Socio-demographic characteristics (six multiple-choice questions); (2) general employment information (ten questions: three multiple-choice and seven open-ended); (3) use of technology (two multiple-choice questions—one with two options and the other with eleven options related to types of technology—and 11 continuous Likert scale questions). These Likert scale questions were designed to assess participants' comfort levels with various technologies, using a 10-point

Likert scale ranging from "strongly disagree (0)" to "strongly agree (10)." (Supplementary File 1).

Data collection

Data were collected from May 2022 to April 2023 through an online questionnaire using Qualtrics® (Provo, UT, USA), a secure and encrypted survey and research software platform. A convenience sample of midwives working in hospital settings, primary care, and midwifery education was recruited through two different methods in this study. The first method involved reaching out to heads of departments via multiple channels, including email, social media, and the newsletter of the Professional Organization of Midwives (Vlaamse Beroepsorganisatie van Voedvrouwen-VBOV). This approach used consecutive sampling through : 1) Mailing to Flemish, Walloon, and Brussels obstetric services and educational institutions offering midwifery training, 2) Using the newsletter and Facebook page of the VBOV, and 3) Leveraging internal channels of the Belgian Professional Organisation for Midwives (Union professionnelle des sages-femmes belges-UPSfB), and Belgian Midwives Association (BMA). The other recruitment method used was similar to the approach described in Vermeulen et al. (2016). Fourth-semester Bachelor student midwives were tasked with contacting hospitals, primary care facilities or universities in the specified regions to establish connections with potential participants. The students were prepared for this task under the guidance of the first author in the course unit “Evidence-based Midwifery: Empowering the Midwifery Profession” at Erasmus Brussels University of Applied Sciences and Arts. This preparation was intended to offer practical experience in research management, a key objective of their program. Before filling out the online questionnaire, the participants were verbally provided with details about the study and its aims in a standardized manner by the student midwives. The same questions were asked while using two different methods of questionnaire distribution.

Data analysis

Data were analyzed using IBM SPSS Statistics for Windows, Version 28.0® (IBM Corp, Armonk, New York, USA). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to report midwives’ socio-demographic characteristics, current professional setting characteristics, use of digital technologies and applications in midwifery practice, target groups for digital technologies and applications used by midwives in their midwifery practice, and their comfort level with using digital technologies and applications in current practice settings.

The Chi-square test was used to identify relationships between the socio-demographic characteristics of the participants including age, education status, and region and their utilization of digital technology and applications. Independent t-tests were used to explore the differences in participants' comfort levels with each type of technology, based on age, education status, and region. Results with $p < 0.05$ were considered statistically significant.

Ethical considerations

The study was approved by the Social and Ethical Committee at Hasselt University (Date: 18.08.2022; reference: REC/SMEC/2021-22/29). Before participating in the study, all participants were informed about the study's objectives, their expected roles, the voluntary nature of participation, the guarantee of anonymity, and the absence of remuneration. Participants were also provided with an online informed consent form, clearly stating that by completing the questionnaire, they were providing informed consent. The data were securely stored on a locked server at the Erasmus Brussels University of Applied Sciences and Arts, which was accessible only by the researchers.

Results

Participant characteristics

Out of the 250 questionnaires distributed, 218 were in Dutch, and 32 were in French. A total of 212 respondents were included in the study, resulting in an 84.8% participation rate. The study excluded 38 participants due to missing data.

The majority of participants were aged 30-39 years ($n=71$, 33.5%), held a bachelor's degree ($n=165$, 77.8%), were currently employed ($n=182$, 85.8%), worked in the Flemish region ($n=119$, 76.3%), and practised in primary healthcare in combination with a hospital ($n=100$, 47.2%) (Table 1).

Almost all of the midwives ($n=38$, 92.7%) worked in the prenatal care in primary healthcare. Among them, more than one-quarter ($n=13$, 31.7%) held between 5 and 10 years of professional experience, and over than half of them worked part-time ($n=23$, 56.1%). Most midwives worked in the maternity department ($n=65$, 76.5%) and labour ward ($n=38$, 44.7%) in primary healthcare in combination with a hospital, respectively. Among them, more than one-quarter ($n=23$, 27.1%) had less than five years of professional experience, and more than half of them worked part-time ($n=54$, 63.5%). The majority of midwives worked in the maternity department ($n=14$, 37.8%) and maternal intensive care ($n=12$, 32.4%) in hospital.

Among them, more than one-quarter (n=12, 32.4%) had less than five years of professional experience, and more than half of them worked part-time (n=54, 63.5%). In addition, over one-third of midwives (n=11, 37.9%) had less than five years of professional experience in education institution (Table 2).

Current use of digital technologies and applications

Most midwives (n=125, 58.9%) reported having had experience with the use of digital technologies and applications during their current practice settings. Most of the used digital technologies and applications were electronic health records (n=112, 89.6%), electronic prescriptions (n=82, 65.6%), remote patient monitoring (n=64, 51.2%), and consultation/interview by video call (n=38, 30.4%), respectively. The least used digital technologies and applications were sensor technology (n=9, 7.2%), mixed/combined care (n=6, 3.8%), care robot (n=4, 2.5%), and wearable devices (smart watches, etc.) (n=3, 1.9%) (Table 3).

Relationship between the use of digital technologies and applications in practice by Belgian midwives and their socio-demographic variables

No statistically significant relationship was found between age, education status, and region with the overall use of digital technology and applications ($p>0.05$) (Table 3). When examining the use of each specific type of technology, a statistically significant relationship was found only between the participants' education status and the use of electronic health records. Almost all participants with a bachelor's degree (n=95, 96.0%) identified using electronic health records, while this rate was lower for those with a Master's/PhD degree (n=17, 65.4%) ($p<0.001$). There was no statistically significant relationship between age or education status and the use of other types of digital technology, neither between region nor the type of digital technology used ($p>0.05$) (Table 3).

Target groups for digital technologies and applications

Table 4 shows that distribution of digital technologies and applications used by midwives according to target groups in midwifery practice. Electronic health records (n=79, 70.5%; n=63, 56.3%), remote patient monitoring (n=36, 56.3%; n=32, 50.0%), and virtual reality (n=11, 45.8%; n=7, 29.2%) were mostly used for low-risk and high-risk pregnant women. Electronic prescriptions (n=47, 57.3%; n=50, 61.0%), consultation/interview by video call

(n=24, 63.2%; n=16, 42.1%), and tablet apps (n=12, 34.3%; n=13, 37.1%) were mostly used for low-risk pregnant women and women in the postpartum period, respectively. Less frequently used technological devices include sensor technology (n=9); mixed/combined care (n=6); care robot (n=4); smartwatches (n=3); and others not defined (n=5). These were mostly used for low-risk and high-risk pregnant women, and women in postpartum period respectively (n=14, 51.8%; n=12, 44.4%; n=12, 44.4%) (Table 4).

Comfort with digital technologies and applications

The mean comfort scores of midwives with various digital technologies were as follows: electronic health records, 7.78 (SD=1.91); electronic prescriptions, 7.59 (SD=2.08); remote patient monitoring, 7.85 (SD=1.82); consultation/interview by video call, 7.22 (SD=2.14); tablet apps, 7.66 (SD=1.64); virtual reality, 6.14 (SD=2.31) and others 8.33 (SD=1.49) (Table 5).

Differences between the comfort with digital technologies and applications of Belgian midwives and their age, education status, and region

We analyzed midwives' mean comfort levels with various digital technologies in relation to socio-demographic characteristics such as age, education status, and region. When examining comfort with digital technology by age, midwives aged 20-49 reported statistically significantly higher mean scores compared to those aged 50-67 in the use of remote patient monitoring ($p = 0.037$) and tablet apps ($p = 0.038$). However, no statistically significant differences were found between age groups for the use of electronic health records, electronic prescriptions, video call consultations, virtual reality, or other digital technologies ($p > 0.05$).

Regarding education level, midwives with a Master's or PhD degree had statistically significantly higher comfort levels compared to those with a Bachelor's degree specifically in the use of video call consultations ($p = 0.021$). Although not statistically significant, the mean comfort scores for midwives with advanced degrees were also higher for the use of electronic health records, electronic prescriptions, remote patient monitoring, tablet apps, and virtual reality compared to those with a Bachelor's degree ($p > 0.05$).

Midwives in the Brussels-Capital Region reported significantly higher comfort levels with using electronic health records compared to those in the Flemish Region ($p = 0.044$). However, no statistically significant differences were found between the regions in terms of comfort with other types of digital technologies and applications ($p > 0.05$) (Table 5).

Discussion

This descriptive cross-sectional study sought to map the use of digital technologies and applications by midwives in their working settings, including hospitals, primary care, and educational institutions in Belgium. Our results show that approximately three out of five midwives have reported using digital technologies and/or applications. Commonly used tools include electronic health records, electronic prescriptions, and remote patient monitoring. While there was no significant association between socio-demographic characteristics and the use of digital technology, we observed a generally increase confidence levels among midwives, especially among younger participants and those with higher education levels (Master's/PhD degree).

Current use of digital technologies and applications

We found a significant use of digital technologies and applications among the midwives participating in our study, with more than half incorporating various technological tools into their practices. Electronic health records and electronic prescriptions were the most common technologies used by these professionals. These findings are crucial in our study, as it is related to the fact that, a Belgian eHealth action plan was launched several years ago, and one of its action items related to the roll-out of electronic health records in hospitals (Healthy Belgium, 2023).

The report on the level of implementation of electronic health records in general hospitals in Belgium by December 2022 revealed a 100% utilization rate for patient identification (Healthy Belgium, 2023). As of January 1, 2020, electronic prescription became mandatory for health professionals, including midwives, with only a few specific situations as exceptions in Belgium [National Institute for Health and Disability Insurance (RijksInstituut voor Ziekte en InvaliditeitsVerzekering-RIZIV), 2024a]. Furthermore, the telematics premium, which encourages the electronic management of patient files in the context of e-health, contributes to the growing utilization of these digital tools among self-employed midwives in midwifery practices. The premium is a fixed amount of 800 euros, paid annually by the government to midwives who meet certain conditions (RIZIV, 2024b).

Our study found moderately high usage rates for other innovative tools, such as remote monitoring technology and video consultations. These suggest a substantial integration of digitized records and prescription systems and a growing acceptance of remote healthcare delivery and telemedicine practices within the field of midwifery. Notably, our findings revealed a lower usage rate for some specific technologies, including sensor technology, mixed/combined care, care robots, and wearable devices. It is important to point out that,

although certain technologies currently have lower usage rates, their potential impact on improving patient care, efficiency, and health outcomes should not be overlooked.

Our findings, which are in line with previous research, sustaining the ongoing slow or selective adoption of digital healthcare technologies, including midwifery practice. This is despite the consistent increase in efforts towards funding, development, research, and theory-building (Gyselaers et al., 2019; Lanssens et al., 2018; Pérez-Chavolla et al., 2019). These outcomes might also indicate potential barriers or hesitance among healthcare professionals in integrating these technologies into their practices. Factors such as cost, accessibility, lack of training opportunities, and perceived usefulness might influence the slower adoption of these tools (Klamroth-Marganska et al., 2021; Lanssens et al., 2017). These several barriers could be eliminated by focused policy to identify which one to leverage to maximize the results of this modality of care (Kruse et al., 2018).

Relationship between the use of digital technologies in practice by Belgian midwives and their socio-demographic variables

In our study, age, education status, and region were not significantly related to the overall use of digital technology. This indicates that Belgian midwives, regardless of their age, educational background, or region, show a similar tendency to adopt technological innovations in their practice.

Interestingly, we observed that midwives without a Master's or PhD degree reported a higher use of electronic health records. This could be because these individuals are primarily engaged in professional practice rather than in education or research roles. Enhancing digital literacy remains an important factor in boosting confidence and ensuring access to the best evidence for midwifery practice. Lanssens et al. (2021) suggested that midwives with the best knowledge of the evidence-based practice were those holding a Master's degree. This may be because these midwives either retained the understanding of evidence-based practices from their midwifery education or continued to apply the skills they had learned to search for evidence-based practices. Additionally, the reasons for these results warrant further exploration, as they may be influenced by factors such as training opportunities, accessibility, or individual attitudes toward technology integration. Understanding these points is crucial for tailoring interventions and training programs, to address potential generational and educational disparities in the adoption of specific digital tools.

Target groups for digital technologies and applications

Our study revealed high usage rates of electronic health records in both low-risk and high-risk pregnancy follow-ups, as well as during postpartum care. This indicates their crucial role in comprehensive record-keeping and patient management, irrespective of risk profiles. Similarly, remote patient monitoring emerged as a valuable tool for continuous observation in both pregnancy risk categories, including postpartum care and neonatal health. Interestingly, electronic prescriptions, video call consultations, and tablet apps were primarily utilized for low-risk pregnancies and the postpartum period. This suggests their importance in routine care and post-birth recovery, highlighting their potential to address the specific needs of these stages and improve communication between midwives and patients.

The National Institute for Health and Disability Insurance (RIZIV) has set terms and conditions to promote digital technologies, contributing to their increased use in midwifery practices in Belgium (San Miguel et al., 2022). Spiby et al. (2019) proposed that video calling could be a practical method for evaluating women in the early stages of labour, while Lanssens et al. (2018) demonstrated that remote monitoring of prenatal follow-ups for women with gestational hypertensive disorders enables timely interventions. A study by Perez-Chavolla et al. (2019), which included results from six projects across eight countries in Africa, Asia, and the Americas, showed that digital technologies allowed midwives to access information, maintain patient contact, and communicate effectively during the perinatal period, despite implementation challenges. Furthermore, the COVID-19 pandemic has significantly accelerated the digital transformation in healthcare, including midwifery practices (Vivilaki et al., 2021). These findings, consistent with our study, underscore the increasing use of digital tools, including tablet apps, throughout preconception, pregnancy, and postpartum care, and highlight the growing comfort with digital technologies and applications.

Comfort with digital technologies and applications

Our findings indicate that electronic health records, remote patient monitoring, electronic medical prescriptions, tablet applications, and video calls received higher mean scores, suggesting that midwives generally have a greater level of comfort with these core technologies. This positive reception aligns with the widespread adoption of digital technologies noted in our earlier findings and underscores their integration into daily practices. In contrast, midwives exhibited comparatively lower comfort levels with virtual reality. This may reflect a need for targeted training or educational initiatives to enhance proficiency and

confidence in utilizing this tool, particularly given its potential applications in patient education and therapeutic interventions. Interestingly, technologies that are less frequently used, such as sensor technology, mixed/combined care, care robots, and wearable devices, indicate a higher receptiveness among midwives to explore and adopt a broader range of innovative tools beyond traditional technologies. These results are significant because attitudes and experiences influence the willingness and motivation to use digital technology.

Spiby et al. (2019) found that midwives were generally positive about using video calls in obstetric care during early labour, noting that visual cues could improve assessments and build trust. Klamroth-Marganska et al. (2020) reported that nearly two out of five Swiss midwives had a positive view of digital midwifery services. Similarly, Marion et al. (2023) found that the majority of midwives were open to using digital technologies. Konttila et al. (2019) highlighted in a systematic review that while digital technology can enhance patient care, healthcare professionals need to recognize its benefits to fully embrace it. Thus, positive attitudes and experiences with digital technology are crucial, as they significantly impact the willingness and motivation to integrate these tools into daily practice.

Differences between the comfort with digital technologies and applications of Belgian midwives and their age, education status, and region

Our study further identified that younger midwives exhibited higher comfort with digital technology than the older group, including remote patient monitoring and tablet apps. The observed age-related differences may be attributed to the digital upbringing of younger generations and their familiarity with technological advancements. Midwives holding a Master's /PhD displayed higher comfort, particularly in the context of interviewing using video calls, compared to those with a Bachelor's degree. This suggests that midwives with advanced education degrees show an increased comfort with digital technology and a higher readiness to engage in remote consultations using video calls. Additionally, midwives in the Brussels-Capital Region show significantly higher comfort levels with electronic health records, indicating possible regional differences in training, resource availability, or exposure to these systems. Boury et al. (2022) recommend adapting healthcare training to focus on key technologies like artificial intelligence, medical imaging, personalized medicine, telehealth, and robotics. They emphasize the importance of fostering ongoing technological interest and recognizing knowledge gaps for collaboration among healthcare professionals. Vermeulen et al. (2016) suggested integrating technology and applications into midwifery undergraduate and

postgraduate education through inter-professional skills and simulation training as a valuable way to enhance midwives' competencies. An important change in the didactics of healthcare education is much needed to better understand technological healthcare. From this perspective, it is desirable to integrate fundamental technological education, clarifying the basic principles of technology and paying due attention to the language barrier between technological and biomedical profiles, like midwives and nurses.

Moreover, to reduce potential negative impacts of increased digital technologies on women's midwifery care experiences, it is crucial to integrate these tools as supplements to, rather than substitutes for, in-person care. Providing midwives with thorough training in digital skills can improve care quality. Equally important is prioritizing secure, user-centered technology design and maintaining robust data privacy protections. Regular feedback from women should guide the continuous improvement of these tools. Additionally, clear communication about the role of digital technologies in care can help sustain trust and ensure women's individual needs are met effectively (Bekker et al., 2023; Collins et al., 2024; Lanssens et al., 2017).

Study strengths and limitations

This study has several strengths: It is the first study conducted to map the use of digital technologies and applications by midwives in their working settings, including hospitals, primary care, and educational institutions, in Belgium. Due to the high response rate within the sample, our analysis is considered highly representative for the Flemish Region. We worked to reach respondents across diverse work settings by using various recruitment methods, multiple channels, and sending reminders. Although this study used a semi-structured self-administered questionnaire, extensive literature research was conducted to ensure the content validity of the questionnaire. Moreover, the questionnaire was meticulously developed, undergoing thorough checks to assess its content validity. Two independent researchers, experts in evidence-based practices and midwifery, evaluated the items for readability, clarity, and comprehensibility. These results offer valuable insights into the use of digital technologies and midwives' readiness to integrate these tools into their practices.

Nevertheless, several limitations can be also identified. First, we included participants from the three regions of Belgium. However, due to missing values, we observe an unbalance for the Walloon Region. Therefore, our analysis' representativity for this region may be limited. Second, we used a convenience sampling method from the Brussels-Capital Region, Flemish Region, and Walloon Region and findings may not be generalizable to the entire population in

the country. Third, the multiple-choice question on the “target groups for digital technologies and applications used by midwives in their practice” lacked a specific option for "women in labor." This omission may have resulted in underreporting of digital technology use during childbirth in midwifery practice. Fourth, due to the cross-sectional design of the study, causality cannot be inferred from the observed associations. Lastly, a limitation of this study is the relatively small sample size. A larger sample size may be more effective in gaining further insights into the utilization of digital technologies and applications in midwifery practice in Belgium.

Conclusion

Our results highlighted the need for improving usability and addressing barriers to optimize technology integration into high-quality of care, ultimately leading to an improvement in overall perinatal health outcomes in Belgium. We found that more than half of midwives reported using digital technologies and applications. The most commonly used ones were electronic health records, electronic medical prescriptions, monitoring technology, video consultations, tablets, and virtual reality, respectively. The target groups for these digital technologies and applications generally encompass all stages of the perinatal period. While the overall use of technology does not appear to be influenced by age, education level, or region, the specific relationships identified between education and the use of electronic health records warrant further exploration. Furthermore, there was an overall high level of comfort among midwives with these fundamental technologies, but it was not optimized. We recommend several key elements for midwifery practice, including developing competence in digitalization among midwives, ensuring the provision of sufficient organizational resources, equipment, and space for the effective utilization of technology, and offering regular education tailored to the participants' competencies. Further exploration into their practical implications and potential barriers to their widespread adoption is warranted.

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