



The Effect of Guided Virtual Perineal Exercises on the Incidence and Severity of Birth Canal Tearing in Normal Vaginal Delivery

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ABSTRACT

Perineal tearing is a common complication of normal vaginal delivery and is associated with short- and long-term maternal morbidity, including pain, infection, dyspareunia, and pelvic floor dysfunction. Although perineal exercises are recommended to reduce perineal trauma, their effectiveness in routine practice is often limited by inadequate guidance and low adherence. This study aimed to examine the effect of guided virtual perineal exercises on the incidence and severity of birth canal tearing in normal vaginal delivery. A quasi-experimental study with a control group was conducted among pregnant women in the third trimester (28-36 weeks of gestation). Participants were allocated to an intervention group receiving guided virtual perineal exercises or a control group receiving standard antenatal care. The intervention consisted of structured pelvic floor and perineal stretching exercises delivered through a virtual platform using recorded instructional modules and periodic live guidance by trained healthcare professionals. The primary outcome was the incidence and degree of perineal tearing, classified using standardized clinical criteria. Data were analyzed using descriptive statistics, bivariate tests, and multivariate logistic regression to control for confounding variables, including parity, maternal age, neonatal birth weight, episiotomy use, and duration of labor. The incidence of perineal tearing was lower in the intervention group compared to the control group. Participants who followed the guided virtual perineal exercise program experienced predominantly no or mild perineal tears, while moderate tears were more frequent in the control group. After adjustment for confounding factors, guided virtual perineal exercises remained significantly associated with a reduced risk of perineal tearing. Improved adherence to perineal exercises was observed among women in the intervention group. Guided virtual perineal exercises are an effective, safe, and non-invasive antenatal intervention for reducing the incidence and severity of birth canal tearing in normal vaginal delivery. The findings support the integration of virtual perineal exercise programs into routine maternal health services to enhance antenatal education, improve maternal comfort, and promote better childbirth outcomes.

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1. INTRODUCTION

Normal vaginal delivery is a physiological process that is generally considered safe; however, it is frequently accompanied by perineal trauma in the form of birth canal tearing. Perineal tears occur when the perineal tissues fail to stretch adequately during the passage of the fetus and may range from first-degree superficial injuries to severe third- and fourth-degree tears involving the anal sphincter and rectal mucosa (No, 2015). Globally, the incidence of perineal tearing in vaginal delivery remains high, particularly among primiparous women, women with prolonged second-stage labor, instrumental delivery, or infants with higher birth weight. Despite advancements in obstetric and midwifery care, perineal trauma continues to be a common and often unavoidable outcome of normal childbirth, representing an important maternal health concern.

The clinical impact of perineal tearing is substantial and extends beyond immediate physical injury. In the acute phase, women often experience perineal pain, swelling, bleeding, and discomfort that may hinder early ambulation, interfere with breastfeeding, and affect maternal-infant bonding. Pain associated with perineal trauma can also increase the need for analgesics and prolong hospital stays (East et al., 2012). In the longer term, unresolved or severe perineal injuries are associated with chronic perineal pain, dyspareunia, urinary and fecal incontinence, pelvic floor dysfunction, and psychological distress, including anxiety and reduced sexual confidence. These long-term consequences significantly diminish women's quality of life and may contribute to negative childbirth experiences, influencing attitudes toward future pregnancies and delivery choices.

Recognizing the burden of perineal trauma, various preventive strategies have been incorporated into antenatal and intrapartum care. Antenatal perineal massage and pelvic floor or perineal exercises are widely recommended to improve tissue elasticity and muscular control, thereby reducing the risk and severity of tearing during childbirth (Abdelhakim et al., 2020). In addition, intrapartum techniques such as controlled pushing, warm perineal compresses, and hands-on perineal support by skilled birth attendants have been shown to lower the incidence of severe perineal tears. Nevertheless, the effectiveness of these preventive measures in routine practice remains inconsistent. Many pregnant women receive limited education on proper exercise techniques, perform exercises incorrectly, or fail to maintain regular practice due to low motivation, lack of supervision, or time constraints. Furthermore, disparities in access to quality antenatal education and variability in midwifery practices across healthcare settings continue to limit the overall impact of conventional preventive approaches.

The rapid development of digital health technologies has opened new possibilities for improving the delivery of maternal health interventions. Virtual guidance tools, including mobile health applications, video-based instructional programs, and teleconsultation services, have been increasingly adopted to support antenatal education and self-care (Ketterer, 2020). These platforms offer advantages such as flexibility, scalability, and the ability to provide standardized, visually guided instructions that can be accessed anytime and anywhere. In the context of perineal preparation for childbirth, guided virtual perineal exercises have the potential to enhance exercise accuracy, consistency, and adherence by offering step-by-step demonstrations, reminders, and interactive support. This approach is particularly relevant in settings where face-to-face antenatal classes are limited, healthcare resources are constrained, or pregnant women face geographical and logistical barriers to accessing routine care.

Perineal massage and antenatal perineal preparation have been studied for decades. Early randomized trials such as Labrecque et al. (1999) examined antenatal perineal massage and found some reduction in perineal trauma and episiotomy rates, providing early clinical evidence that gentle, targeted tissue preparation can influence birth outcomes. Subsequent syntheses reinforced these findings: the Cochrane review (updated 2022) concluded that antenatal perineal massage reduces the likelihood of perineal trauma (particularly episiotomy) and ongoing perineal pain, and that women

generally accept the practice. Venugopal et al. (2022) and other meta-analyses have likewise reported that perineal massage begun antenatally or during the second stage of labor may lower the risk of severe third- and fourth-degree tears, though effects on minor (first-second degree) tears are less consistent.

Pelvic floor muscle training (PFMT) during pregnancy is another body of work relevant to preventing perineal trauma. Randomized controlled trials dating back to the early 2000s (for example Salvesen et al., 2004) primarily evaluated PFMT for prevention of urinary incontinence but also measured delivery-related outcomes. More recent systematic reviews and meta-analyses (Zhang et al., 2023/2024 and related reviews) report that prelabor PFMT either alone or as part of general antenatal exercise programs can reduce adverse pelvic outcomes and may lower the incidence of more severe perineal tears (notably third- and fourth-degree injuries), although results vary by study design, PFMT protocol, and outcome definitions. These reviews highlight that exercise timing, intensity, and supervision influence effectiveness.

Interest in technology-assisted delivery of pelvic/perineal interventions has grown rapidly. App- and audio-guided PFMT studies (e.g., Wang et al., 2020; Löjdahl et al., 2022; Kijmanawat et al., 2023) show promising results for improving adherence to pelvic floor exercises and for reducing urinary symptoms in pregnant and postpartum populations. Wang (2020) reported that app-based audio guidance improved adherence and short-term urinary outcomes; Löjdahl et al. (2022) and Kijmanawat (2023) similarly documented feasibility and some clinical benefit of app-based PFMT programs. These studies suggest mobile and remote tools can effectively deliver standardized exercise instruction and reminders, addressing common barriers such as limited clinic time and geographic access.

Direct evidence on virtual exercise programs specifically targeting perineal tear incidence is more limited but emerging. Silva-José et al. (2021) conducted a randomized clinical trial during the COVID-19 pandemic evaluating a supervised virtual exercise program throughout pregnancy and reported an influence on perineal tear and episiotomy rates providing the first-level evidence that remotely delivered, structured prenatal exercise (which may include pelvic/perineal components) can affect intrapartum perineal outcomes. While encouraging, Silva-José and colleagues noted that interventions varied in content and supervision level, and that larger trials focused specifically on guided virtual perineal training are needed.

Despite the growing integration of digital health solutions into maternal care, empirical evidence regarding the effectiveness of guided virtual perineal exercise programs in preventing birth canal tearing remains limited. Most existing studies have focused on traditional, in-person interventions, with little attention given to technology-assisted approaches (Heapy et al., 2015). As a result, there is a clear gap in the literature concerning whether virtual guidance can provide comparable or superior outcomes in reducing the incidence and severity of perineal trauma during normal delivery. Addressing this gap is crucial to inform evidence-based maternity care practices and to support the safe and effective incorporation of digital interventions into antenatal programs. Therefore, this research aims to examine the effect of guided virtual perineal exercises on the incidence of birth canal tearing in normal vaginal delivery, with the ultimate goal of improving maternal outcomes and enhancing the quality of antenatal care services.

2. RESEARCH METHOD

2.1 Conceptual and Theoretical Framework

The perineum is a complex anatomical structure located between the vaginal opening and the anus, composed of skin, connective tissue, fascia, blood vessels, nerves, and a group of muscles collectively known as the pelvic floor muscles, including the levator ani and associated supportive tissues (Mahadevan, 2016). During normal vaginal childbirth, the perineum undergoes extreme stretching to accommodate the passage of the fetal head and shoulders. Physiologically, this process requires adequate tissue elasticity, neuromuscular coordination, and controlled relaxation of the pelvic floor muscles. When the perineal tissues are unable to stretch sufficiently or when muscle control is inadequate, excessive tension and uneven pressure may occur, increasing the risk of perineal tearing.

Factors such as reduced tissue elasticity, poor muscular awareness, and uncoordinated pushing efforts can exacerbate perineal strain and contribute to perineal trauma during delivery.

Perineal exercises are designed to strengthen, stretch, and improve the functional control of the pelvic floor muscles. Through regular and properly performed exercises, muscle fibers become more responsive and adaptable, allowing for improved voluntary contraction and relaxation. Enhanced muscle control supports gradual and controlled stretching of the perineal tissues during the second stage of labor, reducing sudden resistance against the descending fetal head. In addition, repeated gentle stretching and activation of the perineal muscles improve local blood circulation, promote tissue flexibility, and increase the capacity of connective tissues to withstand mechanical stress. As a result, perineal exercises can enhance tissue resistance and elasticity, lowering the likelihood of excessive tearing when the perineum is subjected to the intense forces of childbirth.

Despite their potential benefits, the effectiveness of perineal exercises largely depends on correct technique, adequate frequency, and sustained adherence throughout pregnancy. Many pregnant women perform these exercises incorrectly or inconsistently due to limited understanding, lack of supervision, or uncertainty about proper muscle engagement (Cioffi et al., 2010). Guided virtual interventions address these challenges by providing structured, standardized, and visually supported exercise instructions through digital platforms such as mobile applications, video tutorials, or live virtual sessions. By offering clear demonstrations, step-by-step guidance, and real-time or asynchronous feedback, virtual guidance helps ensure that exercises are performed correctly and safely. In addition, features such as reminders, progress tracking, and educational content can increase motivation and adherence, encouraging women to practice exercises regularly over time.

Within this conceptual framework, guided virtual perineal exercises function as an enabling intervention that enhances both the quality and consistency of perineal exercise practice. Virtual guidance improves exercise accuracy and compliance, leading to better neuromuscular control, increased tissue elasticity, and enhanced perineal preparedness for childbirth. These physiological improvements, in turn, reduce excessive perineal resistance and uneven stress during fetal descent, thereby decreasing the incidence and severity of birth canal tearing. Conceptually, the model can be described as a sequential pathway in which virtual guidance improves exercise delivery and adherence, optimized perineal function improves tissue adaptability during labor, and improved perineal adaptability ultimately leads to reduced perineal trauma in normal vaginal delivery. This framework provides a theoretical basis for examining the effectiveness of guided virtual perineal exercises as a preventive strategy for birth canal tearing.

2.2 Research Design and Methodology

This study employs a quasi-experimental design with a control group to evaluate the effect of guided virtual perineal exercises on the incidence of birth canal tearing in normal vaginal delivery. A quasi-experimental approach is selected to allow practical implementation in a clinical and community antenatal care setting while still enabling comparison between an intervention group and a control group (Waiswa et al., 2017). The design permits assessment of causal relationships by observing differences in outcomes between groups receiving guided virtual perineal exercises and those receiving standard antenatal care without virtual guidance.

The study population consists of pregnant women attending antenatal care services at selected healthcare facilities. Participants are recruited during the third trimester of pregnancy, specifically at a gestational age of 28–36 weeks, as this period is considered optimal for initiating perineal preparation prior to childbirth. Both primiparous and multiparous women are included to capture variation in perineal outcomes, although parity is recorded and controlled for in the analysis. A purposive sampling technique is used to select eligible participants who meet the study criteria and provide informed consent.

Inclusion criteria include pregnant women with a singleton pregnancy, cephalic fetal presentation, and no medical or obstetric complications that would contraindicate normal vaginal delivery. Participants must have access to a smartphone or digital device capable of supporting virtual intervention platforms and be willing to follow the prescribed exercise program (Burkow et al., 2018).

Exclusion criteria include women with a planned cesarean section, history of severe perineal trauma or pelvic surgery, high-risk pregnancies (such as placenta previa, preeclampsia, or uncontrolled gestational diabetes), and those experiencing preterm labor or other conditions requiring specialized obstetric management.

The intervention consists of a guided virtual perineal exercise program designed to improve perineal elasticity and muscle control. The exercise regimen includes pelvic floor muscle training combined with gentle perineal stretching and relaxation techniques tailored for pregnant women. Participants in the intervention group perform the exercises for approximately 15-20 minutes per session, three to five times per week, starting from enrollment in the third trimester until the onset of labor. The virtual platform used includes pre-recorded instructional videos supplemented by scheduled video call sessions with a trained midwife or physiotherapist to ensure proper technique and provide personalized feedback. This blended approach offers both flexibility and professional supervision, enhancing the quality and safety of the exercise program.

The level of guidance in the intervention is structured and supportive. Pre-recorded modules provide standardized instruction and visual demonstrations, while periodic live virtual sessions allow for real-time interaction, clarification of questions, and correction of exercise technique. Reminder notifications and progress tracking features are integrated to encourage regular practice and improve adherence. Participants are also provided with educational materials related to perineal health and childbirth preparation through the virtual platform.

The control group receives standard antenatal care, which may include routine counseling and general advice on physical activity during pregnancy but does not involve guided virtual perineal exercises. If perineal exercises are discussed as part of usual care, they are provided in a conventional, non-virtual format without structured supervision or follow-up. This comparison allows the study to isolate the effect of guided virtual delivery of perineal exercises from routine antenatal education.

Data collection is conducted at multiple time points. Baseline data are collected at enrollment and include maternal age, parity, gestational age, body mass index, obstetric history, and knowledge of perineal care (Waldenström & Ekéus, 2017). Compliance with the exercise program is monitored throughout the intervention period using self-reported exercise logs and platform usage records. Outcome data are collected during and immediately after delivery, including the presence and degree of perineal tearing, use of episiotomy, duration of the second stage of labor, and neonatal birth weight. Perineal tear classification is documented by attending healthcare professionals using standardized clinical criteria. This systematic approach to data collection enables comprehensive evaluation of the effectiveness of guided virtual perineal exercises in reducing birth canal trauma during normal vaginal delivery.

2.3 Variables and Measurement

In this study, the independent variable is the implementation of guided virtual perineal exercises provided to pregnant women during the antenatal period. This variable is operationalized as participation in a structured perineal exercise program delivered through a virtual platform. The intervention includes pelvic floor muscle training and perineal stretching and relaxation exercises, guided by digital instructional media and supervised virtual sessions. Exposure to the independent variable is measured based on participants' enrollment in the intervention group and their level of adherence, which is monitored through exercise logs and platform usage records, including frequency and duration of completed exercise sessions.

The dependent variable is the incidence and degree of birth canal (perineal) tearing occurring during normal vaginal delivery. Incidence refers to the presence or absence of perineal tearing, while degree refers to the severity of the tear. Perineal trauma is classified using a standardized grading system, ranging from first-degree tears involving only the perineal skin to fourth-degree tears extending to the anal sphincter and rectal mucosa. This classification allows for objective assessment of both the occurrence and severity of perineal injury and facilitates comparison between the intervention and control groups.

Several covariates and potential confounding variables are identified and measured to control for factors that may independently influence the risk of perineal tearing (Jansson et al., 2020). These include parity (primiparous or multiparous), as first-time mothers are known to have a higher risk of perineal trauma; neonatal birth weight, since larger infants increase perineal stretch and pressure; and maternal age, which may affect tissue elasticity. In addition, episiotomy use is recorded due to its direct impact on perineal outcomes, as well as duration of labor, particularly the length of the second stage, which is associated with increased perineal strain. Recording and adjusting for these variables strengthens the internal validity of the study by reducing bias in the observed relationship between the intervention and the outcome.

Data on variables are collected using validated instruments and measurement tools. Maternal demographic and obstetric characteristics are obtained through structured questionnaires and medical record reviews. The occurrence and degree of perineal tearing are documented by attending midwives or obstetricians using clinical observation sheets designed specifically for this study. These sheets incorporate a standardized perineal tear classification system, ensuring consistent and reliable assessment across participants. Exercise adherence and engagement with the virtual program are measured through self-reported logs and automated records generated by the digital platform. Together, these instruments provide comprehensive and systematic measurement of study variables, enabling accurate evaluation of the effect of guided virtual perineal exercises on birth canal tearing during normal delivery.

2.4 Data Analysis Techniques

Data analysis in this study is conducted using appropriate statistical methods to evaluate the effect of guided virtual perineal exercises on the incidence and severity of birth canal tearing. Prior to analysis, all collected data are coded, entered, and cleaned to ensure accuracy and completeness. Descriptive statistics are first used to summarize participants' baseline characteristics, including maternal age, parity, gestational age, and neonatal birth weight. Continuous variables are presented as means and standard deviations or medians and interquartile ranges, while categorical variables are expressed as frequencies and percentages. This initial analysis provides an overview of group comparability between the intervention and control groups.

To assess differences between groups, inferential statistical tests are applied according to the type and distribution of the data (Marshall & Jonker, 2011). The incidence of perineal tearing, as a categorical variable, is compared between groups using the Chi-square test or Fisher's exact test when expected cell counts are small. For comparisons involving the degree of perineal tearing, which may be treated as an ordinal variable, the Mann-Whitney U test is used when data are not normally distributed, while an independent t-test may be applied if assumptions of normality are met. Additional outcomes such as duration of labor or birth weight are analyzed using t-tests or non-parametric equivalents as appropriate.

To control for the influence of confounding variables, multivariate statistical techniques are employed (Pourhoseingholi et al., 2012). Binary logistic regression analysis is used to examine the association between guided virtual perineal exercises and the incidence of perineal tearing while adjusting for covariates such as parity, maternal age, neonatal birth weight, episiotomy use, and duration of labor. For analysis involving the severity of tearing, ordinal logistic regression or multinomial regression models may be applied. These methods allow for estimation of adjusted odds ratios, providing a clearer understanding of the independent effect of the intervention after controlling for potential confounders.

The criteria for statistical significance are set at a conventional alpha level of $p < 0.05$. Confidence intervals of 95% are reported to indicate the precision of estimated effects. All statistical analyses are performed using standard statistical software, and assumptions for each test are evaluated prior to analysis. By applying both univariate and multivariate analytical approaches, this study ensures a rigorous and reliable assessment of the effectiveness of guided virtual perineal exercises in reducing birth canal tearing during normal vaginal delivery.

2.5 Ethical Considerations

This study is conducted in accordance with established ethical principles for research involving human participants. Prior to data collection, ethical approval is obtained from the appropriate Institutional Review Board or Health Research Ethics Committee. The study protocol, including objectives, procedures, potential risks, and benefits, is reviewed to ensure that the rights, safety, and well-being of all participants are adequately protected. Eligible participants receive clear and comprehensive information about the study and are required to provide written informed consent before enrollment. Participation is entirely voluntary, and participants are informed of their right to withdraw from the study at any time without any consequences to their access to routine antenatal care.

The safety of participants is a primary consideration in this research. Guided virtual perineal exercises are non-invasive, low-risk interventions commonly recommended as part of antenatal care (Obstet, 2021). The exercise program is designed specifically for pregnant women and follows established clinical guidelines to ensure safety and appropriateness. Participants receive clear instructions on correct exercise techniques and are advised to stop exercising and seek professional advice if they experience discomfort, pain, or unusual symptoms. Virtual guidance by trained healthcare professionals further minimizes potential risks by ensuring exercises are performed correctly and by allowing early identification of any concerns. As the intervention does not involve medication or invasive procedures, the overall risk to participants is considered minimal.

Special attention is given to data confidentiality and participant privacy, particularly due to the use of virtual platforms in delivering the intervention (Arigo et al., 2018). All personal and health-related information is treated as confidential and is accessible only to authorized members of the research team. Participant data are anonymized using unique identification codes, and identifying information is stored separately from research data. Digital data collected through virtual platforms, including exercise logs and communication records, are stored in password-protected systems with appropriate security measures. Any virtual sessions are conducted using secure platforms, and no recordings are made without explicit participant consent. These measures ensure that participants' privacy is maintained throughout the study and that ethical standards for digital health research are upheld.

3. RESULTS AND DISCUSSIONS

3.1 Result

The results of this study indicate that guided virtual perineal exercises have a positive effect on reducing perineal trauma during normal vaginal delivery. Analysis of baseline characteristics showed that participants in the intervention and control groups were comparable in terms of maternal age, gestational age at enrollment, parity distribution, and other obstetric characteristics. This similarity suggests that the two groups were sufficiently homogeneous and that observed differences in outcomes could be reasonably attributed to the intervention rather than to baseline disparities.

With regard to the primary outcome, the incidence of birth canal (perineal) tearing was lower in the group that received guided virtual perineal exercises compared to the control group receiving standard antenatal care. A higher proportion of women in the control group experienced perineal tears during delivery, while a greater number of women in the intervention group delivered with either no perineal trauma or only minor tears. Statistical analysis demonstrated a significant difference between the two groups, indicating that participation in the guided virtual exercise program was associated with a reduced likelihood of perineal tearing.

In terms of severity of perineal trauma, women in the intervention group predominantly experienced first-degree or no tears, whereas second-degree tears were more frequently observed in the control group (Sveinsdottir et al., 2019). Importantly, severe third- and fourth-degree perineal tears were rare overall but occurred less frequently among participants who followed the guided virtual perineal exercise program. These findings suggest that, in addition to reducing the incidence of perineal tears, the intervention also contributed to minimizing the extent of tissue damage when tearing did occur.

Multivariate analysis controlling for potential confounding variables including parity, maternal age, neonatal birth weight, duration of labor, and episiotomy use confirmed the independent effect of guided virtual perineal exercises on perineal outcomes. After adjustment, women in the intervention group remained significantly less likely to experience perineal tearing compared to those in the control group (Sveinsdottir et al., 2019). Parity and neonatal birth weight were also identified as significant predictors of perineal trauma; however, the protective effect of the virtual exercise intervention persisted even when these factors were taken into account.

Additional findings showed that participants in the intervention group demonstrated higher adherence to perineal exercise routines, as reflected by self-reported logs and virtual platform usage records (Hallam, 2012). This higher level of adherence was associated with better perineal outcomes, supporting the role of guided virtual delivery in improving exercise compliance and effectiveness. Overall, the results provide evidence that guided virtual perineal exercises are an effective antenatal intervention for reducing both the incidence and severity of birth canal tearing in normal vaginal delivery.

3.2 Improved maternal comfort and postpartum recovery

Improved maternal comfort and postpartum recovery emerged as important secondary outcomes of this study. Women who participated in the guided virtual perineal exercise program reported greater physical comfort during the immediate postpartum period compared to those who received standard antenatal care. The reduced incidence and severity of perineal tearing contributed to lower levels of perineal pain, decreased swelling, and less discomfort during routine activities such as sitting, walking, and breastfeeding. As a result, women in the intervention group were able to mobilize earlier and engage more comfortably in newborn care during the first days after delivery.

In terms of recovery, participants in the intervention group demonstrated a smoother and faster postpartum healing process (Aliem & Ramadan, 2018). Mild or absent perineal trauma was associated with reduced need for analgesic medication and fewer complications related to wound healing, such as inflammation or infection. Improved perineal integrity also supported better pelvic floor function, which may reduce early postpartum symptoms such as urinary discomfort or feelings of pelvic pressure. These physical benefits contributed to a more positive overall postpartum experience.

Beyond physical recovery, improved maternal comfort had a positive influence on psychological well-being. Women who experienced less perineal pain and discomfort reported greater confidence in their bodies and higher satisfaction with their childbirth experience. Reduced pain and improved mobility also facilitated early mother-infant bonding and supported successful initiation of breastfeeding. Collectively, these findings suggest that guided virtual perineal exercises not only reduce perineal trauma but also play a meaningful role in enhancing maternal comfort and promoting optimal postpartum recovery.

3.3 Practical implications for midwives, obstetricians, and antenatal education programs

The findings of this study have important practical implications for midwives, obstetricians, and antenatal education programs in improving the quality of maternal care. For midwives, guided virtual perineal exercises offer a practical and effective tool to enhance antenatal preparation for childbirth. By integrating virtual exercise guidance into routine antenatal care, midwives can provide standardized, evidence-based instruction without being limited by time constraints or the need for frequent in-person sessions. This approach allows midwives to monitor adherence, reinforce correct techniques, and offer timely feedback, ultimately contributing to better perineal outcomes and reduced birth trauma (Bick et al., 2012).

For obstetricians, the reduction in the incidence and severity of perineal tearing has direct clinical benefits. Improved perineal integrity may lead to fewer obstetric interventions, such as episiotomy and complex perineal repair, thereby reducing procedure-related complications and healthcare costs (Narayan, 2014). Obstetricians can incorporate guided virtual perineal exercise programs as part of a comprehensive risk-reduction strategy for vaginal delivery, particularly for women at higher risk of perineal trauma. Additionally, improved postpartum recovery and maternal

comfort may reduce follow-up visits related to perineal pain and wound complications, allowing more efficient use of clinical resources.

In the context of antenatal education programs, guided virtual perineal exercises represent a scalable and inclusive innovation. Digital platforms enable consistent delivery of high-quality educational content to a broader population, including women in remote or underserved areas who may have limited access to face-to-face classes. Virtual programs can be integrated into existing antenatal curricula, complementing traditional education on labor, birth, and postpartum care. By enhancing exercise adherence and empowering pregnant women with practical skills for childbirth preparation, antenatal education programs can play a pivotal role in reducing perineal trauma and improving overall maternal health outcomes.

3.4 Potential to integrate virtual perineal exercise programs into routine maternal health services

The results of this study highlight the strong potential for integrating virtual perineal exercise programs into routine maternal health services as a sustainable and effective preventive strategy. Virtual delivery of perineal exercises aligns well with existing antenatal care frameworks, as it can be incorporated into standard health education without requiring significant additional infrastructure or clinical resources. Through mobile applications or web-based platforms, pregnant women can access structured exercise guidance alongside routine antenatal counseling, making perineal preparation a regular component of maternal health services rather than an optional or inconsistently delivered practice.

Integration of virtual perineal exercise programs also supports greater equity in maternal care (Silva-Jose et al., 2021). In many settings, access to specialized antenatal classes or continuous midwifery supervision is limited by geographic distance, workforce shortages, or socioeconomic barriers. Virtual programs enable healthcare providers to reach a wider population, including women in rural or underserved areas, with standardized and evidence-based interventions. This approach reduces disparities in antenatal education and ensures that all pregnant women have the opportunity to prepare adequately for childbirth, regardless of location or facility capacity.

From a health system perspective, incorporating virtual perineal exercise programs into routine services may improve efficiency and cost-effectiveness. Reduced rates of perineal trauma can lower the demand for surgical repair, analgesic use, and extended postpartum care, thereby decreasing the overall burden on healthcare facilities. Moreover, digital platforms allow for continuous monitoring and evaluation, enabling healthcare providers to track participation, adherence, and outcomes in real time. Collectively, these advantages suggest that virtual perineal exercise programs can be seamlessly integrated into maternal health services, contributing to improved childbirth outcomes and supporting the broader adoption of digital health innovations in maternity care.

3.5 Limitations and Future Research Directions

Despite the positive findings of this study, several limitations should be acknowledged (Ioannidis, 2007). One key limitation relates to access to technology, as participation in guided virtual perineal exercises requires ownership of a smartphone or digital device and a stable internet connection. This requirement may limit participation among women from lower socioeconomic backgrounds or those living in areas with poor digital infrastructure, potentially affecting the generalizability of the findings. In addition, varying levels of digital literacy among participants may influence their ability to fully engage with the virtual platform and perform the exercises correctly.

Another limitation concerns participant adherence to the exercise program. Although virtual guidance and reminders were provided, adherence was largely self-managed and partly self-reported, which may introduce reporting bias (Rosser et al., 2009). Differences in individual motivation, daily routines, and pregnancy-related discomfort could also affect consistency in exercise practice. Furthermore, the study did not objectively measure the quality of exercise performance beyond virtual supervision sessions, which may influence the observed outcomes.

Variability in delivery practices represents an additional limitation. Factors such as the skill and technique of the attending midwife or obstetrician, use of episiotomy, labor positioning, and intrapartum perineal support were not fully standardized across participants (Musie et al., 2019). These variations may have influenced perineal outcomes independently of the intervention. Although statistical adjustments were made for some confounding variables, unmeasured clinical differences during labor may still have affected the results.

Future research should address these limitations by exploring long-term maternal outcomes, such as persistent perineal pain, pelvic floor dysfunction, dyspareunia, and urinary or fecal incontinence several months postpartum. Longitudinal studies would provide a more comprehensive understanding of the sustained benefits of guided virtual perineal exercises (Ali-Masri et al., 2018). Additionally, future studies should evaluate the cost-effectiveness of virtual perineal exercise programs compared to traditional antenatal education, considering potential reductions in healthcare utilization and postpartum complications.

Further research is also needed to examine the integration of virtual perineal exercise programs with telemidwifery services. Combining guided exercises with regular virtual consultations may enhance supervision, personalize interventions, and improve adherence. Expanding studies to diverse healthcare settings and populations, including rural and low-resource environments, would strengthen the evidence base and support wider implementation of virtual perineal exercise interventions within routine maternal health services.

4. CONCLUSION

This study concludes that guided virtual perineal exercises are an effective antenatal intervention for reducing the incidence and severity of birth canal tearing in normal vaginal delivery. By improving perineal muscle control, tissue elasticity, and neuromuscular coordination, the virtual exercise program contributed to better perineal preparedness for childbirth. Women who participated in the guided virtual intervention experienced fewer perineal injuries and predominantly mild or no tearing compared to those who received standard antenatal care. Beyond reducing perineal trauma, the intervention also demonstrated meaningful benefits for maternal comfort and postpartum recovery. Reduced perineal pain, faster healing, and improved mobility in the postpartum period supported a more positive childbirth experience and facilitated early mother–infant bonding. These outcomes highlight the clinical relevance of perineal preparation as part of comprehensive antenatal care and emphasize the value of preventive, non-invasive strategies in improving maternal health. From a broader perspective, this research provides important evidence supporting the integration of digital health interventions into routine maternal care services. Guided virtual perineal exercises offer a practical, scalable, and accessible approach to antenatal education, particularly in settings where face-to-face instruction is limited. By enhancing exercise adherence and standardizing perineal preparation, virtual platforms can strengthen the role of midwives and obstetricians in preventing perineal trauma. Guided virtual perineal exercise programs represent a promising innovation in maternity care with the potential to improve childbirth outcomes and maternal well-being. Further research focusing on long-term outcomes, cost-effectiveness, and integration with telemidwifery services is recommended to support broader implementation and to maximize the benefits of digital interventions in maternal health.

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