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Undergraduate midwifery students' perceived readiness to conduct fetal surveillance at a University in the Western Cape

A mini thesis submitted in partial fulfilment of the requirements for the degree of master's in nursing (Education) at the School of Nursing, Faculty of Health and Community Sciences

By

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DECLARATION

I declare that **"Undergraduate midwifery students' perceived readiness to conduct fetal surveillance at a University in Western Cape"** is my own work. Hence, this work has not been submitted for any degree or examination in any other university. All the sources used or quoted in this study are clearly indicated and acknowledged by complete references.

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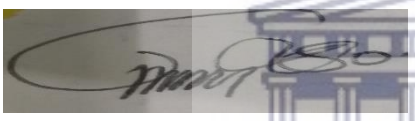
SIGNATURE:  DATE: 28 November 2021

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UNIVERSITY of the
WESTERN CAPE

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TABLE OF CONTENTS

UNIVERSITY of the WESTERN CAPE

http://etd.uwc.ac.za/

UNIVERSITY of the
WESTERN CAPE

http://etd.uwc.ac.za/

UNIVERSITY of the WESTERN CAPE

http://etd.uwc.ac.za/

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WESTERN CAPE

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http://etd.uwc.ac.za/

LIST OF ABBREVIATIONS

CTG	Cardiotocograph
FHR	Fetal heart rate
FS	Fetal surveillance
HIE	Hypoxic-ischemic encephalopathy
MOU	Midwife obstetric units
NMR	Neonatal mortality rate
SANC	South African Nursing Council
SON	School of Nursing

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DEFINITION OF TERMS

Fetal surveillance: A broad term that refers to performing a variety of non-invasive procedures such as abdominal palpations and use of electronic devices to monitor fetal heart rate, and invasive procedures such as vaginal examination and correctly recording and interpreting the data resulting from these procedures (Tedesco, Wallace, Chang, & Beaves, 2020)) .

Perception: Defined as the conscious recognition and interpretation of sensory stimuli through unconscious associations, especially memory, which serves as a basis for understanding, learning, and knowing, or for the motivation of a particular action or reaction. Perception in this study means the midwives' awareness of their levels of competency about fetal surveillance (Hasan, & Bao, 2020).

Hypoxic-ischemic encephalopathy: A type of brain dysfunction that occurs when the brain doesn't receive enough oxygen or blood flow for some time. Hypoxic means 'not enough oxygen' while ischemic is 'not enough blood flow' and encephalopathy is a brain disorder (Vannucci, & Perlman, 1997)

Readiness: This is the state of preparedness of midwifery students to conduct fetal surveillance after acquiring training in doing so. Readiness is based on students' knowledge, confidence, skills, and ability to plan and carry out all fetal surveillance procedures that can determine the fetal well-being (Mirza, Manankil-Rankin, Prentice, Hagerman, & Draenos, 2019).

Cardiotocograph: An electronic device made up of a monitor, a toco, and a cardiac probe. It is mostly used in the third trimester of pregnancy to monitor fetal heart rate

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and uterine contractions. The device records the contractions, fetal movements, and fetal heartbeat on a paper graph called a CTG paper, from which interpretation about the well-being of the fetus can be made (James, Maduna, & Morton, 2019).

Feotal surveillance competence Refers to the knowledge, skills, and or capacity by which the midwifery students in this study conduct fetal surveillance (Hodges, Konicki, Talley, Bordelon, Holland, & Galin, 2019).

Competence: In the context of this study, competence refers to the high level of skills, knowledge, and expertise that the midwifery students need to acquire and develop to perform electronic fetal monitoring, by implementing and accurately interpreting cardiotocographs according to a defined standard (Hodges et al., 2019).

Fetal surveillance knowledge: As used in this study, refers to facts, information and skills that the midwifery students acquires, through theoretical classes and practical sessions on fetal surveillance or through clinical experience and education. This include a good background in the anatomy of the female reproductive system, the birth process and management of maternal hypo saturation (Hodges et al., 2019).

UNIVERSITY of the
WESTERN CAPE

http://etd.uwc.ac.za/

LIST OF TABLES

UNIVERSITY of the
WESTERN CAPE

http://etd.uwc.ac.za/

LIST OF FIGURES

UNIVERSITY of the
WESTERN CAPE

http://etd.uwc.ac.za/

ABSTRACT

Background: Fetal surveillance (FS) helps midwives to predict the well-being of the fetus during labour and its relationship with uterine contractions as labour progresses. Incorrect use of surveillance apparatus and wrong interpretation of data from electronic fetal heart rate monitoring have been identified as contributing factors to delayed interventions that might have prevented the development of hypoxic-ischemic encephalopathy, which is the fifth largest cause of death of children under five globally.

Aim: This study aims to determine the level of perceived readiness of 3rd year undergraduate midwifery students to conduct fetal surveillance on women in labour at a university in the Western Cape.

Methodology: This research adopted a quantitative approach with a descriptive survey design to describe the readiness of 3rd undergraduate midwifery students at a university in the Western Cape to conduct fetal surveillance. A self-administered questionnaire to assess the level of perceived knowledge and competence was used to collect the data. An all-inclusive sampling technique was used to recruit participants for this study from the study population (N=197). Of the total, only 137 questionnaires were returned, yielding a response rate of 69.5%. The data were analysed using GraphPad Prism version 6.02 software, and findings were presented by descriptive statistics and tests for association.

Findings: Although respondents know about the use of the cardiotocograph (CTG) and partograph in fetal surveillance, the majority reported that they were either incompetent or required supervision to interpret the CTG data accurately. Almost 70% of the midwifery students had insufficient fetal surveillance knowledge. Also, the midwifery module, duration of clinical placement in the low- or high-risk maternity obstetrics units, and overall midwifery

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WESTERN CAPE

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clinical experience are significantly ($p<0.05$) related to the CTG monitoring and data interpretation skills of respondents since respondents who spent more time in the mentioned areas reported that they were either proficient or needed supervision. However, the data did not reveal a clear consensus among respondents on the adequacy of the training programme in preparing them to perform fetal surveillance better.

Conclusion and recommendations: Overall, findings suggest a knowledge deficit in fetal surveillance among midwifery students at the university, which may have negative effects on their readiness to conduct fetal surveillance. Therefore, measures should be put in place to improve the university's midwifery fetal surveillance educational curriculum, to attain a good balance between theory and clinical practice. Also, the training of midwifery students in conducting fetal surveillance, especially on improving their fetal surveillance knowledge and CTG data interpretation capacity, should be improved to achieve more favourable neonatal and maternal outcomes in South Africa. Hence, increasing the duration in clinical training facilities and allowing students to practice more with cardiotocograph can be considered as an approach to improve on the acquisition of skills and knowledge for undergraduate midwifery students to improve on their ability to perform fetal surveillance.

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KEYWORDS

Cardiotocograph

Electronic fetal monitoring

Fetal surveillance

Knowledge

Midwifery students

Partograph

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter begins with a description of the background and orientation of the study. Then, the key operational words are defined, followed by the problem statement that the study seeks to address and the significance of the study. The chapter ends with a clear outline of the specific aims and objectives as well as the pertinent research questions of this study.

1.2 Background

The first four weeks in a new-born's life is considered very critical, as they represent the period when the child is at the highest risk of dying. An estimated 2.4 million new-borns died within this period in 2019 (World Health Organization, 2020). This number may be even higher in low-middle-income countries compared to their high-income counterparts, due to the significant under-reporting in the former (Kayode et al., 2017) and the disparities existing in neonatal outcomes between these two categories of countries (Hedstrom et al., 2019). Intrapartum-related deaths are the second-leading contributor to global neonatal deaths and account for about 1.2 million stillbirths annually (Jagau et al., 2017). The intrapartum complication of hypoxic-ischaemic encephalopathy (HIE), which occurs when there is a loss in oxygen flow to the brain, is a major cause of death in neonates. The incidence of HIE is estimated to be up to 10 – 20 cases per 1000 in low-middle-income countries compared to 1.5 cases per 1000 live births in high-income countries (Greco et al., 2020). The conventional treatment of neonatal HIE is therapeutic hypothermia; however, this has been less effective, as not more than half of those treated achieved an improvement in their condition (Greco et

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al., 2020). Hence, prevention may be a better strategy in this instance. Neonatal deaths may be prevented or reduced to the barest minimum by deploying effective neonatal-specific and neonatal-sensitive interventions (Hedstrom et al., 2019), including a meticulous fetal surveillance programme.

The description of the fetal heartbeat by Jacques Alexandre Lejumeau de Kargaradec in 1819, with subsequent recognition of its importance in 1821 (Carrera, 2003) and the acquisition of the first fetal electrocardiogram by Cremer in 1906 (Cremer, 1906; Su et al., 2019), marked the beginning of intrapartum cardiotocographic monitoring. This was combined with clinical techniques for accurately identifying the fetal location (presentation, position, etc.), as well as amniotic volumetry and fetal biochemical monitoring in the period between 1955 and 1960, to essentially birth the concept of fetal surveillance, a cause championed by Caldeyro-Barcia and Saling (Dueñas-Garcia & Diaz-Sotomayor, 2011; Epstein et al., 2016; Mandile, 2017). Before this discovery, very little was known about fetal medicine and maternal care. Moreover, the introduction of ultrasonography into obstetric practice by Ian Donald in 1965 (Erjavic, 2018) marked a critical developmental milestone in the development of fetal surveillance techniques (Campbell et al., 2011). Subsequent years witnessed the discovery of new techniques, procedures and diagnostic possibilities (such as invasive techniques, fetal haemodynamic study and fetal cardiotocography) with great improvements in fetal morbidity and mortality (Pels et al., 2019).

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WESTERN CAPE

Fetal surveillance (FS) encompasses the use of different non-invasive and invasive procedures to monitor the fetus's health during gestation and labour for signs of hypoxia, and to intervene promptly to prevent the sequelae of asphyxia (Leslie & Arulkumaran, 2011;

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Liston et al., 2018). Usually, the fetal heart rate (FHR) is closely observed over a duration during FS. This is usually achieved by two methods: continuous electronic fetal monitoring with electronic devices, e.g. cardiotocograph (CTG), and non-electronic intermittent fetal monitoring (auscultation) (Arnold & Gawrys, 2020). Intrapartum fetal monitoring presents the possibility of prompt and effective intervention when required and circumvents unnecessary interventions like caesarean section (CS) by displaying confirmation of a favourable fetal condition (Garcia-Canadilla et al., 2020; Smith et al., 2019). FS requires intricate techniques which are often considered to be sophisticated and complex in operation, and to require significant financial resources (Housseine et al., 2018) . For instance, fetal echocardiography (a procedure that uses sound waves to create images of the fetal heart) demands a measure of expertise from sonographers (Garcia-Canadilla et al., 2020). Additionally, consensus-based guidelines have been developed for FS, based on evidence of varying significance from studies on fetal monitoring essentially conducted in high-income countries, which may not be readily applicable to low-middle-income countries due to context-specific factors (Alfirevic et al., 2017; Kruk et al., 2016; Maaløe et al., 2018; Pitchforth et al., 2010). Thus, in many low-resource settings, economical and simpler methods such as intermittent auscultation by Pinard stethoscope or hand-held Doppler, are the only accessible methods (Hofmeyr et al., 2009). Although the emergence of the various FS devices coupled with meticulous FS guidelines has led to significant reductions in the incidence of HIE in most high-income countries, the same cannot be said for low-middle-income countries thus highlighting the essential role of the FS training being offered to midwives and midwifery students in these countries (Pehrson et al., 2011). For example, the neonatal mortality rates (NMRs) from moderate HIE and severe HIE in South Africa are 7.1% and 62.5% respectively in 2011, despite the availability of FS apparatus in most tertiary hospitals in the country (Bruckmann & Velaphi,

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2015). Also, the NMR for sub-Saharan Africa in 2018 was 28 deaths per 1000 live births; specifically, 10.7 and 19.6 deaths per 1000 live births in South Africa and Kenya respectively (Masaba & Mmusi-Phetoe, 2020). These rates are significantly higher than the average 2–3 deaths per 1000 live births which occur in higher-income countries such as Australia and New Zealand, Europe and Northern America (United Nations International Children's Emergency Fund et al., 2019).

The disparity in neonatal outcomes may be connected to the level of expertise of midwives and the quality of training received by midwifery students, especially in conducting an effective FS. In South Africa, for example, a study conducted in a Gauteng hospital revealed that midwives had insufficient knowledge and understanding of the partograph – an essential tool in FS – reflecting the absence of quality training (Maphasha et al., 2017). Similarly, midwives in KwaZulu-Natal public hospitals were also reported to have only limited knowledge of the use of the cardiotocograph (CTG) (James et al., 2019). An earlier report had proposed that newly graduated nurses may need further practical training to augment the theoretical knowledge acquired in school (Blomberg et al., 2014). Nursing midwifery students face many challenges in translating theory into practice, and this may be related to the teaching approach and methods employed in school or lack of practice time during training (Senti & Seekoe, 2014). Also, the clinical component of nursing is mostly taught in hospital settings which may not be as conducive for effective learning as the school setting (Ecclestone & Hayes, 2019). Additionally, ecological analysis indicates an inverse relationship between both neonatal and maternal mortality, and efficiency of skilled birth attendants, emergency obstetric care, and neonatal intensive care (Nove et al., 2021; Tekelab et al., 2019). Consequently, countries with the highest rates of neonatal mortality (NMR>45) (World Health

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WESTERN CAPE

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Organization (WHO), 2020) have the lowest rates of skilled attendance (median 46% vs 100% in countries with NMR<5), caesarean deliveries (3% vs 17%) (Yaya et al., 2018), and physician density (11/100,000 of the population vs 131/100,000) (Aziz et al., 2020; Goldenberg et al., 2018; Hoyler et al., 2014; Merriel et al., 2018; Saluja et al., 2020). The density of skilled personnel is several-fold lower in areas with the highest mortality, and in many low-resource settings these are the only personnel legally permitted to provide obstetric care (Okpechi et al., 2021; Truche et al., 2021). Evidence suggests that two-thirds of neonatal deaths could be prevented if all pregnant mothers and newborns had access to cost-effective and direct interventions as well as care from skilled healthcare providers during pregnancy and childbirth (Cuadros et al., 2020; Tekelab et al., 2019).

Midwifery is a global profession. Foetuses, new-born infants, and their mothers share similar needs across the world, and midwives make a vital contribution to their survival, health and well-being (Callister, 2021). Although this is yet to be accepted as a nationwide model, in the Western Cape midwifery is an autonomous profession, with the establishment of midwife obstetric units (MOUs) managed by registered midwives in Cape Town (Campbell et al., 2011; Martin, 2018). Hence, the title 'midwife' is a protected title; midwifery students must apply to the South African Nursing Council (SANC) to be registered as a learner midwife, and only midwives who have reached and maintain the required standards set by SANC as the professional regulator are recognised (Dolamo, 2018).

Although a paucity of population-level data regarding the quality of obstetric care (Gage et al., 2019) such as FHR monitoring and use of the partograph (Palo et al., 2019) exists in low-income countries, it is apparent from both high-income and middle-income countries

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http://etd.uwc.ac.za/

(Hofmeyr et al., 2009) that many intrapartum-related neonatal deaths are due to avoidable factors. Therefore, there is an urgent need to instil continuous evaluation of the nursing training methods, particularly on FS guidelines, to facilitate achieving and maintaining a low NMR. The confidence, competence, and skills of midwifery students in conducting FS upon completion of nursing school need constant assessment.

The ethical principle of the fetus as a patient, which gained prominence based on developments in fetal diagnosis and management strategies to optimise fetal outcome (Schmitz & Henn, 2021), plays a central theoretical and clinical role in maternal-fetal medicine (Chervenak & McCullough, 2018). Hence, improving neonatal health, one of the unfinished agendas of the Millennium Development Goals, remains a high priority in the era of Sustainable Development Goals (United Nations International Children's Emergency Fund et al., 2019). The Global Strategy for Women's, Children's, and Adolescents' Health (2016–2030) also highlights the importance of access to essential interventions and an effective health workforce (Tekelab et al., 2019). Strengthening the capacity of midwives to deliver fetal surveillance expertise would contribute to this global agenda. Professional support from the midwife has been described as providing appropriate perinatal care, and fetal surveillance in ensuring fetal well-being to optimise fetal and maternal outcomes (Brown et al., 2017). In high-income countries midwife-led continuity of care has been associated with positive outcomes, including fewer preterm births, fewer fetal losses at any gestational age, and high rates of positive experiences reported by women (Sandall et al., 2016). Strengthening the capacity of midwives to deliver high-quality maternal and new-born healthcare is a priority for the United Nations Population Fund (UNFPA) (WHO, 2018).

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1.3 Orientation to the study

The University of the Western Cape, South Africa through its School of Nursing (SON) offers the midwifery module during the third year of study for nursing midwifery students. This module is designed to train the students to be primary healthcare providers to women during pregnancy, delivery, and postnatal care. The midwifery module has a clinical component, during which students are placed in MOUs in hospitals, to be exposed to various midwifery procedures and equally to take part in maternal care, delivery, and postnatal care. The students are expected to have deep insight into the theoretical component of the midwifery module, and to integrate this with the clinical component to facilitate learning at the clinical placement sites (SANC, 2005). In this regard, the theoretical component of the midwifery module which is taught in class is an essential building block for success.

The Nursing Council's curriculum highlights the competencies that midwives and midwifery students are required to have to be able to practise safely. Firstly, the Nursing Act (Act No. 33 of 2005) defines a midwife as a person who is qualified and competent to independently practise midwifery in a manner and to the level prescribed, and who is capable of assuming responsibility and accountability for such practice (SANC, 2005). In doing so, this person must have acquired the necessary training to prepare them in the cognitive, affective, and psychomotor domain for the successful practise of midwifery. The curriculum for midwifery requires a midwifery student to be able to monitor, diagnose and initiate interventions in case of abnormalities during pregnancy and/or delivery, and to perform deliveries under supervision. Considering this, students must be to perform effective FS, especially in terms of ability to use the FS electronic and non-electronic devices. The midwifery module therefore requires continual revision and updating, in line with the modern day-to-day changes in FS

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practice. How the students respond to and assimilate the module in clinical practice should be regularly assessed to ensure that the objective of the module is efficiently realised.

1.4 Problem statement

It is believed that robust FS during gestation and labour reduces the mortality rates in neonates, due to timely diagnosis of any intrapartum complications with possible interventions. The higher NMR in low-middle-income countries compared to their high-income counterparts can be linked to the level of expertise to conduct an effective FS of the midwives in the former – a situation possibly linked to the nature of the nursing school midwifery module and its assimilation in clinical practice by students. Also, the lack of adequate postgraduate training of midwives to administer FS may play a huge role in the elevated risk of neonatal mortality in low-middle-income countries. A case study of South Africa, for example, revealed that midwives have insufficient skills to accurately interpret the partograph or in the use of the CTG (Yazbek, & Jomeen, 2019). Although the South African nursing legislation (Act No. 33 of 2005) and the SANC stipulate that graduating midwifery students must be competent in conducting deliveries and FS as they venture into the practice, the reality from day-to-day experiences indicates that FS remains challenging to execute in the practice of midwifery. The researcher's personal experience as graduate from the university where this study was conducted and as a practicing midwife in South Africa validates the statement that more training is necessary post-graduation to become competent in conducting FS. Therefore, since very little empirical information regarding the knowledge of midwifery students at university regarding FS has been documented, this study on the level of perceived knowledge and competence of midwifery students in conducting FS during labour has become imperative.

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1.5 Significance of the study

The findings of this research will provide information that is relevant to the management of nursing training institutions and the Department of Health to strengthen curricula or make changes focused on enhancing the training of midwifery students in conducting FS. The findings of the study will also help those involved in training midwifery students to focus on the knowledge and competence of these students regarding conducting effective FS, as they are the future workforce to reduce the maternal and neonatal mortality rate. This may eventually result in more favourable neonatal outcomes in South Africa.

1.6 Aims and objectives

This study aims to determine the level of perceived knowledge and competence of undergraduate midwifery students in conducting FS during labour at a university in the Western Cape.

UNIVERSITY of the
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The specific objectives are:

- To determine the level of perceived knowledge of midwifery students in using the CTG.
- To determine the level of perceived competence of midwifery students in recording and interpreting the partograph.
- To assess the adequacy of the training programme of the midwifery module in preparing students for conducting FS in practice.

1.7 Research questions

The research questions addressed in this study are as follows:

- What is the level of perceived knowledge of midwifery students in conducting FS?

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- What is the level of perceived competence of midwifery students in the use of a cardiotocograph for FS?
- How adequate is the midwifery module in imparting knowledge on recording and interpreting the partograph for FS during labour?

1.8 Conclusion

In this chapter the background and orientation of the study were introduced. The problem which the study seeks to address as well as the aims and objectives were clearly outlined. The significance of study and how the aim will be achieved were also stated. Therefore the chapter states in some details a synopsis of the preceding chapters in the study and will be preceded by a detailed review of the relevant literature that supports this study.

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CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter the recent scientific literature on key concepts relating to neonatal and maternal health, fetal surveillance (FS) and the training of midwives and midwifery students is reviewed.

2.2 Fetal surveillance

It is estimated that more than 2 million stillbirths occur annually worldwide, with the vast majority happening in low-middle-income regions and during labour (Housseine et al., 2018). To reverse this trend, novel strategies focused on achieving effective and highly sensitive FS are urgently warranted. FS refers to a variety of non-invasive tests that may be administered during pregnancy to evaluate whether or not a growing baby is doing well *in utero* (Liston et al., 2018). Over the years, the knowledge on FS has evolved from considering a gestating mother as one patient in the 1950s, to acknowledging the pair as two separate patients with specific and unique needs and care requirements (Carrera, 2003). Although the first account of direct fetal auscultation and uterine contraction was documented in 1821, the introduction of ultrasound devices for FS only came about in the 1970s, and other sophisticated electronic devices have since been developed to improve FS (Grytten, Skau, Sørensen, & Eskild, 2018). The invention of the cardiotocograph (CTG) especially has changed the practice of FS, by detailing the relations between FHR and uterine contractions (Carrera, 2003). Today, FS is integral to a good pregnancy outcome; hence, all healthcare professionals involved in the care of pregnant women in labour are expected to be adequately trained in and should possess a comprehensive knowledge on the pathophysiology of FHR changes in labour (Viswanatha et

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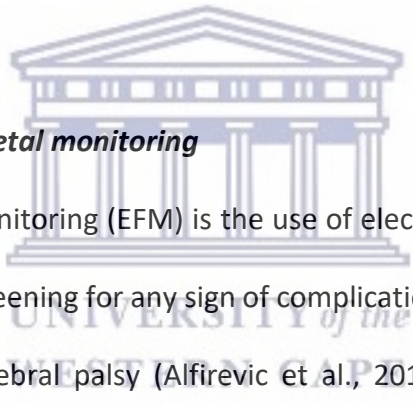
al., 2017). Midwives in South Africa are obliged to become experts in performing FS with relative ease and accuracy, as spelled out in the scope of practice for midwives (SANC, 2005).

There are two main methods of FS in midwifery practice, namely continuous electronic fetal monitoring and intermittent fetal monitoring. The choice of a particular method to be deployed is mostly informed by the type of support required to ensure the mother's and baby's health before and during delivery in a case-by-case manner, as determined by the obstetrician (Housseine et al., 2018). This is also dependent on the level of risk in the pregnancy; those classified as at high risk may require a more intensive FS with the use of electronic devices, while low-risk pregnancies may need only need intermittent auscultation.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2.2.1 Continuous electronic fetal monitoring

Continuous electronic fetal monitoring (EFM) is the use of electronic devices to monitor the FHR and fetal well-being by screening for any sign of complications, such as hypoxic-ischemic encephalopathy (HIE) and cerebral palsy (Alfirevic et al., 2017; Arnold & Gawrys, 2020). Continuous EFM has become the most used method of performing FS, and the need for a uniform guideline regarding the terms, characteristics and data interpretation of EFM that can be globally accepted has been emphasised (Mohan et al., 2021). Although originally developed to give early warning of potential fetal complications, for possible medical intervention to prevent fatality, widespread use of EFM has led to inadvertent increases in unnecessary medical interventions that have lasting maternal complications such as poor wound healing and scarring at sites of caesarean section (Alfirevic et al., 2017; Patey et al., 2017). When intrapartum FS is continuous, it reduces the risk of medical interventions, such as emergency caesarean section or neonatal resuscitation, and many delivery complications

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can be avoided (Patey et al., 2017). For instance, complications that could arise from meconium aspiration syndrome, a potentially dangerous medical event during birth where the baby aspirates meconium (the first faeces) and amniotic fluid, can be minimised or avoided through constant fetal monitoring to identify fetal distress for rapid intervention (Christopher, 2020). Low-income countries with limited resources for fetal monitoring and delivery room care have been indicated to bear a major burden of morbidity due to meconium aspiration syndrome (Goel & Nangia, 2017).

To perform and interpret EFM correctly, practitioners of EFM must possess critical knowledge of this technique confidently and skilfully. An interventional study (Daglar et al., 2020) aimed at training midwifery students of the faculty of Health Sciences, Cumhuriyet University, Turkey, on EFM within the course scope, demonstrated a statistically significant ($p<0.05$) difference between the pre- and post-EFM course scores (Daglar et al., 2020). There was a clear indication that the participants' post-course EFM knowledge and trace interpretation skills were better than their pre-course EFM knowledge and trace interpretation skills, with a success rate of 80% (Daglar et al., 2020). Another study (Gourounti et al., 2020) aimed at developing and assessing the psychometric properties of the Electronic Fetal Monitoring Knowledge Scale (EFMKS), a self-report and short instrument measuring knowledge concerning EFM methods, with 128 professionals (midwives and doctors) as participants. The findings of the study recommended an annual multi-professional CTG training for all intrapartum staff, particularly the midwives and doctors with shorter clinical experience in the labour ward, since approximately one-third of the participants had poor knowledge of EFM (Gourounti et al., 2020).

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Many EFM devices are now generally available for FS, but the emphasis in this study will be on the cardiotocograph (CTG), as it is the device of choice of many midwives and midwifery students. The CTG (Figure 1) utilises an ultrasound transducer and tocodynamometer to monitor continuous changes in FHR and uterine contractions (Patey et al., 2017). The device is placed on the abdomen of the pregnant woman, and it records the data generated on a CTG paper. These data can then be recorded on a partograph, which when interpreted gives valuable insights into the well-being of the fetus. It has been established that the use of a CTG during labour led to a decrease in neonatal seizures, but data on other complications (e.g., hypoxic ischaemic encephalopathy and neonatal mortality) indicated no changes following CTG use (Alfirevic et al., 2017).

Figure 1: A typical cardiotocograph (Bistos Koeria®, Gyeonggi-do, South Korea)

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The WHO partograph is a composite graphical record of key data during labour, entered against time on a single sheet of paper, to prevent prolonged labour and other birth complications (Metawia et al., 2020). Measurements such as the FHR, cervical dilatation, maternal blood pressure, strength and number of uterine contractions, descent and position of the fetus in the pelvic or birth canal, doses of analgesia, etc., are plotted against time, as shown in Figure 2 (Lavender & Bernitz, 2020). The partograph also contains alert and action lines that indicate the possible interventions that can be made if birth is delayed. While there is consensus on the general protocol for the CTG and partograph, interpretation of the data that are generated is a subject of debate among practitioners. Inconsistency of such interpretations account for about 70% of all legal claims regarding the intrapartum care of neonates with brain injury in South Africa (Walker et al., 2001).

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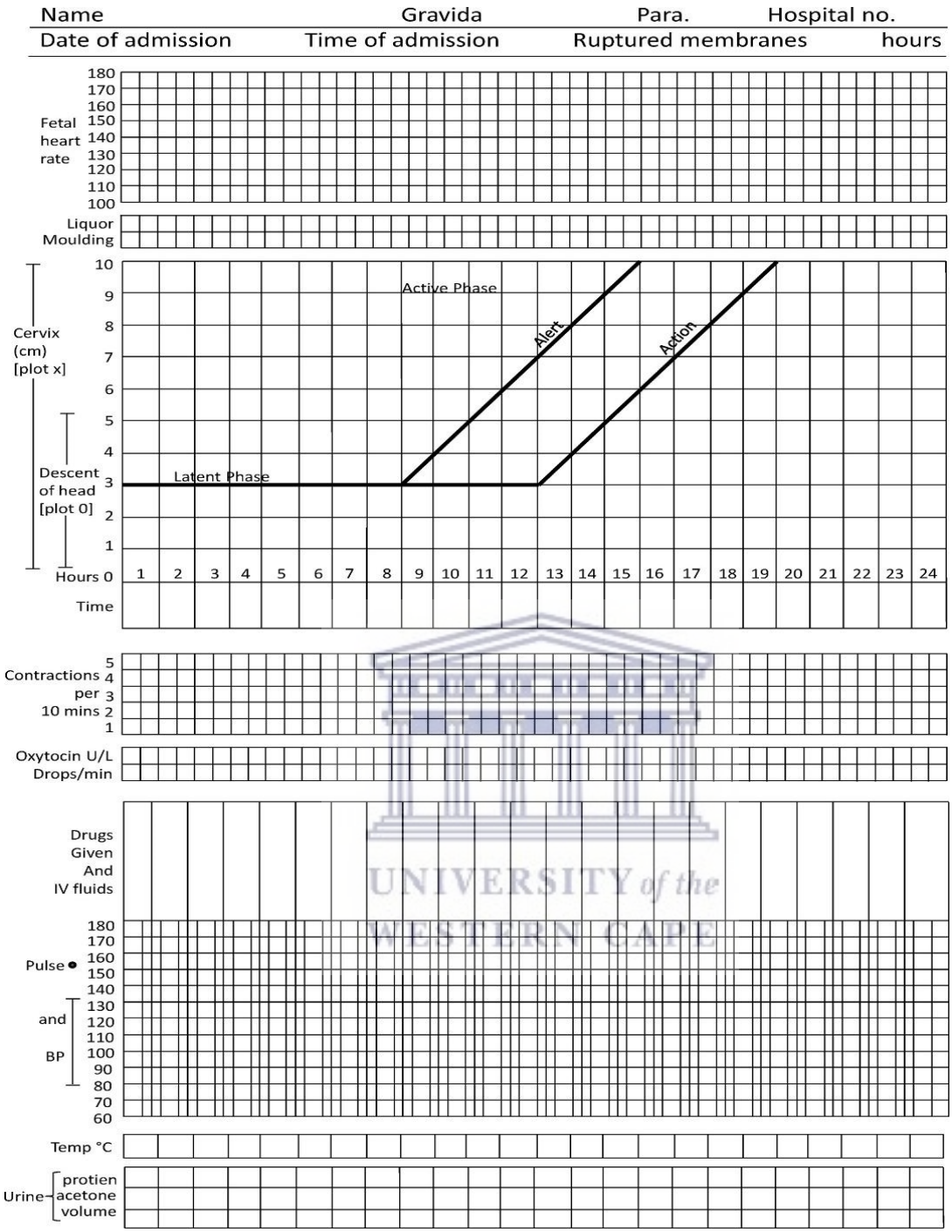

Figure 2: The WHO partograph (WHO, 1996)

The accurate execution of the CTG and the recording and interpretation of the partograph are central to successful FS and represent the core of the practical training module of midwifery students. A review involving searching five databases, up to May 2016, concluded

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that the partograph is associated with improved perinatal outcomes, and recommends it for use with intermittent auscultation for intrapartum monitoring in low-resource settings (Housseine et al., 2018). The study also associated cardiotocography with higher caesarean section rates without necessarily improving perinatal outcomes, and consequently advised against its use in low-resource settings (Housseine et al., 2018). Such a body of evidence is needed to determine the optimal fetal monitoring strategy, as well as the focus of midwifery training in low-resource settings. Students are placed in hospitals to practice alongside experienced midwives to gain exposure to the practice of FS using the partograph. However, students who were found to be competent in performing FS under supervision during training often tend to struggle when left unsupervised upon graduation, reflecting a limitation in the mode, knowledge integration and assimilation of training (Merriman & Westcott, 2010).

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2.2.2 Intermittent fetal monitoring

Intermittent fetal monitoring (IFM) or auscultation involves the use of non-electronic devices, mostly hand-held ultrasound transducers, like the Pinard/Laennec or Doppler devices, to monitor the FHR for short periods during labour (Patey et al., 2017). Many international obstetrics organisations, including those in the United States of America and Canada, have shown a preference for IFM over EFM for low-risk pregnant women, due to the lack of scientific evidence of any clear advantages of the latter. However, the impact of this choice remains to be seen in hospitals, as EFM is still the most popularly used method of FS (Patey et al., 2017). While the scientific proof seems to affirm that IFM may be the best method of FS in low-risk women, there is no clarity on the best IFM protocol to follow (Blix et al., 2019; Martis et al., 2017). As a result, IFM techniques and skills vary

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across the perinatal care workforce, with minimal or no training. This necessitates the implementation of skill-honing programmes aimed at strengthening the IFM skills of nurse-midwives and nurses.

2.3 The role of quality training in fetal surveillance on neonatal outcomes

Improving neonatal health, one of the unfinished agendas of the Millennium Development Goals, remains a high priority area in the era of the Sustainable Development Goals (Heidkamp et al., 2021). Recognition of the capacity of midwives to contribute to this global agenda has gained traction over the years. *The Lancet* Series on Midwifery (2014) indicated that through the provision of interventions the midwifery workforce could reduce maternal and new-born deaths and stillbirths in low-middle-income countries by 30–80%, depending on the level of intervention coverage (Nove et al., 2021). The Series showed improved outcomes with workforces comprising educated, fully trained and regulated midwives (Nove et al., 2021).

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The impact of FS training on the quality of healthcare being delivered by midwives and obstetricians has been extensively studied in various population settings. The overall evidence points to the conclusion that training and re-training on use and interpretation of the CTG, for example, boosts the morale, confidence, and competence of personnel to undertake the procedure during labour, which may lead to an improvement in outcomes (Pehrson et al., 2011). Also, a study in Queensland, Australia revealed that effective FS training was strongly associated with increased skills in interpretation of CTG tracings and better management of intrapartum CTG, and these amounted to a reduction in HIE (Byford et al., 2014). Another retrospective cohort study on neonatal outcomes following a

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national FS educational programme in Australia reported a significant reduction in the intrapartum hypoxic death rate, that did not elevate the caesarean operation rate (Brown et al., 2017). However, a recent study reported a paucity of pertinent evidence linking CTG training to neonatal and maternal outcomes (Kelly et al., 2021). The authors attributed this to the complexity of training methods employed, the wide variability of study outcome indices, inconsistency of results, and the generally low quality of study tools. In most instances there were no clear descriptions of the themes and presentations of the CTG training, indicating a disregard for good reporting practice (Kelly et al., 2021). Therefore, there is a need for the continuous harmonisation of study protocols, methods and endpoints employed by different researchers, to allow data integration and enable a holistic standpoint on the effects of CTG training on neonatal outcomes.

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Moreover, the 2014 State of the World's Midwifery Report showed that midwives trained and regulated according to international standards can provide over 80% of the essential care needed for women and neonates (Michel-Schuldt et al., 2020). A pre-/post-observational study by Kamala et al. (2018) among women with low-risk pregnancies at a tertiary hospital indicated that use of Moyo, a novel continuous fetal Doppler which measures FHR, was associated with greater detection of abnormal FHR (8.0%) compared with Pinard (1.6%) ($p<0.001$). There were also higher rates of non-assessment/documentation of FHR pre- (45.7%) compared to post-implementation (2.2%) ($p<0.001$). This suggests a direct association between implementation of Moyo and improved quality of FHR monitoring practices and the detection of abnormal FHR. These improvements were found to yield more frequent and timely obstetric responses (Kamala et al., 2018). Another study (Tay et al., 2019), which investigated the relationship between

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maternal cardiac output, vascular resistance and fetoplacental Doppler ultrasound in healthy and complicated pregnancy, established some degree of correlation between impedance within fetoplacental arterial vessels and maternal cardiovascular function. This relationship may have important implications for FS and could inform therapeutic options in obstetric care and improve medical outcomes (Tay et al., 2019).

Nevertheless, the lower NMR seen in high-income countries can be directly linked to the quality of their health personnel's FS training. The fact that the low-middle-income countries have the highest number of preventable neonatal deaths globally (Maaløe et al., 2018) may be due to limitations in access to and availability of such quality training. It has been suggested that the focus should also be on limiting the influence of indirect factors such as poverty, lack of housing and social amenities, etc., on pregnant women and newborns in these countries (Hedstrom et al., 2019). Enhancement of the health, personal, social, and environmental welfare of would-be mothers can eventually result in a reduction in high-risk pregnancies. Improving the level of FS training and assimilation by midwives and midwifery students in low-middle-income countries must be championed by political leaders and policymakers to achieve lower NMRs. The reality on the ground in such resource-constrained regions does not allow strict adherence to international recommendations on FS education and training; hence, significant adaptations to the guidelines with full cognizance of what can be actualised are essential if neonatal outcomes are to be improved (Maaløe et al., 2018; Yoshida et al., 2016).

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2.4 Challenges faced by health personnel in carrying out effective fetal surveillance

Despite the widespread use of intrapartum EFM, challenges encountered during the procedure by midwives and obstetricians have limited its effectiveness in achieving a near-zero negative neonatal outcome. The most common contributors to positive outcomes include accurately interpreting the CTG trace; promptly diagnosing the clinical complication if any; immediately communicating the complication; and starting an early intervention (Viswanatha et al., 2017). As expected, these contributors are not unconnected to the limitations in the FS training of personnel. The incorrect use of the FS apparatus and wrong interpretation of the data have been identified as factors contributing to delayed interventions, which may otherwise have prevented the development of HIE in neonates (Byford et al., 2014). In addition, a lack of knowledge and skill in the use of the partograph by health personnel can lead to poor labour outcomes in South Africa (Maphasha et al., 2017).

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Moreover, in contrast with the medical management model of care, which views the feminine body as being imperfect at giving birth and thus encourages close monitoring and control of the birth process, the midwifery model is based on respect for the intricacy of the natural physiology of childbirth and the assumption that the woman's body is well designed for birth. Midwives try to protect, support, and avoid interfering with the normal processes; thus, they try to avoid unnecessary use of obstetric interventions (Maillefer et al., 2015; Murrary-Davis et al., 2020).

2.4.1 Interpretation of intrapartum cardiotocograph

The accurate interpretation of CTG tracings is essential during intrapartum FS. For example, a report published in 2000 indicated that many negative neonatal outcomes (including the

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development of HIE) could have been prevented in Australia and New Zealand if the use and interpretations of CTG by doctors and midwives were appropriate (Byford et al., 2014). This led to the development of an intrapartum FS guideline by the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (Byford et al., 2014). While significant improvements in neonatal outcomes have been observed after enforcement of internationally approved guidelines, these guidelines often advise that classification of CTG be based only on the structure of the FHR patterns, instead of also on the pathophysiological responses of the fetus to the challenges of labour, which allow the health personnel to understand the potential complexity of each FHR pattern (Ugwumadu et al., 2016). Since these guidelines are also the basis for the CTG training modules, it is opined that immediate priority must be placed on acquiring CTG interpretation skills by incorporating the knowledge of maternal and fetal pathophysiology, stress biology, and so on with asphyxia in training modules (Ugwumadu et al., 2016). An example of such fetal physiology-based CTG training was recently implemented in France, where a notable upswing in correct CTG interpretations by health personnel was reported (Zhu et al., 2021).

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2.4.2 Accurate recording of the partograph

The partograph outlines the condition of the fetus and mother and gives a clear picture of the progression of labour, as it includes an overview of the cervical dilatation and effacement observations, as well as uterine contractions (Lavender & Bernitz, 2020). Its extensive use may be due to its availability in both soft and hard copies, thus allowing easy and seamless transfer of medical information and administered care to a patient from one personnel member to another during the routine shifts in hospitals (Bedwell et al., 2017; Lavender et al., 2018). However, to achieve effective FS, doctors, and midwives with the important task of accurately

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making the relevant recordings on the partograph must be well trained. The absence of quality training in the use of the partograph resulted in a lack of confidence in the tool by practitioners in low-income settings (Munabi-Babigumira et al., 2017). A similar reason was given by doctors and midwives in a hospital in Gauteng, South Africa for the incorrect use of the partograph (Maphasha et al., 2017). The fear of legal issues has also limited its prompt use, with many health personnel only completing the partographs retrospectively (Bedwell et al., 2017). A study reported lack of adherence to the use of partograph which led to instructing the administration of oxytocin to approximately 43% of low-risk pregnant women (Bernitz et al., 2014). Besides, the standardised labour progression monitoring tool as per the guidelines may not be robust enough to accommodate customised management of labour from one pregnant woman to another (Lavender & Bernitz, 2020).

In South Africa the 2-hour action line partograph was endorsed; this indicates poor progress of labour, and at which point an intervening action must be taken (National Department of Health, 2015). The inappropriate use of the partograph by midwives during labour has been observed in many South African hospitals (Yazbek & Jomeen, 2019). This prompts the need for continual assessment of the level of FS knowledge and evaluation of the content or modes of training modules used for midwifery students.

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2.5 Conclusion

This chapter discussed the main theoretical rudiments of this study, starting with the historical perspective before moving on to the different methods of FS. The roles of quality training in FS on neonatal outcomes and the possible challenges currently facing the achievement of effective FS were also highlighted.

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CHAPTER THREE

METHODOLOGY

3.1 Introduction

In this chapter the research design utilised for the study is described, together with details of the study's setting, population, and sampling techniques. The methods of data collection, including the instrument, process and analyses are also mentioned. Finally, the ethical considerations and principles followed in this study are clearly stated.

3.2 Study design

The research design is the overall plan for addressing the research objectives, including specifications for enhancing the study's integrity (Polit & Beck, 2020). To achieve the objectives outlined in this study, a descriptive survey design was used to collect and analyse data, as described by Neuman (2016). The survey design was appropriate for this study, as it has the advantages of being able to reach a larger group of people in limited time, and providing respondents with some sense of anonymity, with the format of collecting the data being independent of the researcher (Babbie, 2020).

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3.3 Study setting

The School of Nursing (SON) at a university in the Western Cape runs an undergraduate nursing module (Bachelor of Nursing degree), which includes a clinical learning component taught in clinical laboratories and a variety of primary, secondary, and tertiary hospitals within the Western Cape province of South Africa. The midwifery module is taught during the third year of study to nursing midwifery students at the university. This study targeted midwifery students who have completed the course module during their first semester in the third year.

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The midwifery module is and exit module and upon completion, students are expected to demonstrate competence in performing fetal surveillance as well as performing normal vertex deliveries, because they have been exposed to and practiced fetal surveillance as well as performed normal vertex deliveries during the clinical component of the midwifery module. The South African Nursing Council requires that a student must have performed fifteen normal vertex deliveries upon completion of the midwifery module in order to qualify and be registered with the council as a midwife and therefore must demonstrate competence in conducting FS. The study is set around the SON premises in the Faculty of Community and Health Sciences at a university in the Western Cape, South Africa, where the midwifery students hold their classes. This university is chosen for it renounce school of nursing which offers midwifery as a module in the nursing course toward attainment of bachelor degree in nursing and due to the personal experience of the researcher as a student who offered midwifery at University of the Western Cape. The environment at the SON creates the natural setting where learning challenges occur and the perceptions of students develop and should be sustained in order to get the best possible results (Neuman, 2016).

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3.4 Study population

The population of the undergraduate students at the SON who completed the midwifery module in 2020 (N=197), comprising male and female learners aged between 21 and 51 years. This is the target population for this study, chosen due to their familiarity with the subject matter under investigation, and because they are expected to possess the information needed to answer the research question (Moule et al., 2016). The target population included persons of different races, sex, and religions who originated from various backgrounds.

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3.4.1 Inclusion criteria

To be included in the study, participants had to be student midwives in the Bachelor of Nursing programme, in their third year of study, who had completed the practical placement in MOUs and tertiary hospitals in 2020.

3.4.2 Exclusion criteria

The researcher selected an all-inclusive sampling technique to recruit participants for this study. Hence, no particular exclusive criteria was identified as the inclusive technique ensured a homogenous sample.

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3.5 Sampling techniques

An all-inclusive sampling technique was employed to recruit participants for this study. All the nursing midwifery students (N=197) who had completed the midwifery module for the year 2020 and were willing to participate were selected for the study.

3.6 Data collection instrument

The data collection instrument used in this study is a structured self-administered questionnaire, adapted from Maduna (2016). Permission to use the questionnaire was obtained via email. The questionnaire is made up of 47 items divided into the four sections A, B, C, and D (see Annexure A), used to determine the level of competence and knowledge of midwives in conducting electronic FS. The questionnaire was adapted for this study because it addresses the objectives of the study, which are to assess the knowledge and competence of midwifery students in conducting FS upon completion of their module. The questionnaire

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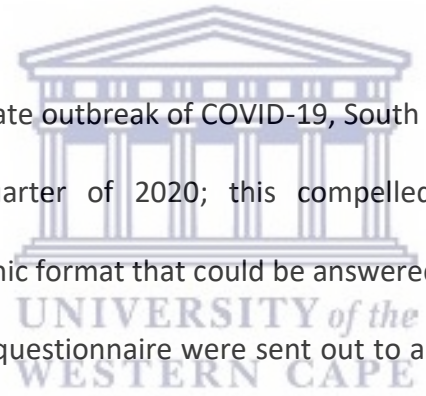
has been modified to accommodate non-electronic FS procedures such as abdominal palpation and vaginal examination. In this regard, the following areas were modified:

- Section A: Q1 was reduced to just the question relating to the age of the participants.
- Section A: Q2 was modified to determine how long students spent at clinical placement.
- Section B: Q2 was added to assess students' knowledge of cervical dilation.
- Section D: Q15-25 were added to assess students' knowledge of other aspects of FS. The questions which were added in this section were selected from the recommended text book for midwifery students at the University of the Western Cape.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However, due to the unfortunate outbreak of COVID-19, South Africa enforced a nationwide lockdown in the second quarter of 2020; this compelled conversion of the paper questionnaires into an electronic format that could be answered online via email. Therefore, several emails containing the questionnaire were sent out to all potential participants, thus allowing online completion of the survey. Three follow-up emails were sent to each participant to remind them to complete the survey.

The lockdown required university teaching and research to be done almost wholly online and this had to be implemented as soon as possible, which resulted in many consequences for students (Hedding et al., 2020). One of these consequences may be a minimised access to the internet, which is relevant in this case as conversion of the paper-based questionnaire to an electronic one which was sent via email meant students had to log in to fill in their answers. Also, a survey involving South African university students and looking at the impact on their mental health of the COVID-19-lockdown revealed that students experienced psychological

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challenges and subjective anxiety and depression (Visser & Law-van Wyk, 2021). This may also have affected the interest of the students in participating in a study such as this one.

3.6.1 Pre-testing of questionnaire

A total of 10 students who met the inclusion criteria were selected at random to complete a manual questionnaire in a pre-test. This questionnaire written in English which is the language of instruction at UWC was administered to examine the robustness of the research questions, acceptability of the recording instruments, and timing of the research, and to identify any ambiguous areas in the questionnaire (Brink et al., 2017). The aims and objectives of the study, information sheet and consent form as well as the questions were fully explained to the pre-test participants. The pre-test questionnaire was done manually at a placement facility where the students where students were placed for clinical leaning. There was enough space to allow for social distancing as the researcher planned and met each student during tea break. Student were provided with surgical gloves and a pen which were then discarded after the student returns the completed questionnaire. The participants of the pre-test completed the questionnaire well under fifteen minutes and raised concern of ambiguity in the structure and or language of the questionnaire. This allowed the researcher to proceed with the study without further modification of the questionnaire. Pre-test participants were also informed of their removal from the actual research study to prevent bias.

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3.6.2 Reliability of questionnaire

The reliability of the questionnaire was established by making sure the questions in the tool were clearly and explicitly written and easy for the participants to understand, as recommended by others (Strydom et al., 2005). The same set of questions was asked of all

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study participants. The questionnaire was subjected to the Cronbach's alpha test to confirm its reliability. The Cronbach's alpha test is the statistical test usually employed to determine the internal consistency of interval and ratio level data (Gray et al., 2016), such as those obtained in this study. The test has been commonly employed as a measure of consistency showing the level of relatability of a given set of items to a concept. In this study an overall Cronbach's alpha coefficient of 0.68 was obtained for all the questions in the questionnaire which measured the same underlying construct during the pre-test using 10 respondents. However, the result varies for the different sub-components: $\alpha = 0.63$ for the level of competency concerning FS; 0.81 for knowledge of the CTG; 0.52 for knowledge of electronic FS; and 0.83 for knowledge questions.

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The Cronbach's alpha reliability coefficient usually ranges between 0 and 1, and the higher the value is, the higher the assurance that the questions are measuring the same construct (Woods et al., 2015). While many studies opined that the required coefficient of reliability should be at least 0.70, an overall $\alpha = 0.60–0.70$ is considered within the lower limit of acceptability (Hair et al., 2009; Woods et al., 2015), especially given that a couple of the sub-themes in this study also returned α values > 0.80. A previous similar study had an overall Cronbach's alpha coefficient of 0.69 (Casey et al., 2011). Therefore, the obtained overall $\alpha = 0.68$ during pre-test in this study is acceptable for research purposes.

3.6.3 Validity of questionnaire

For construct validity, all meanings of concepts as they pertain to this study were clearly defined. The content validity was also ascertained by an extensive review of the literature, and each question was carefully examined for validity. Face validity of the questions was

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ensured by the research supervisor and an advanced midwife educator before they were selected to be included in the questionnaire. A statistician was also involved in ensuring the validity of the questionnaire by helping the researcher to ensure that the variables mentioned in the research objective are well accommodated in the questionnaire.

3.6.4 Data collection process

Upon ethical approval of this study, the permission of the director of the SON was sought via email regarding contacting prospective participants who met the inclusion criteria for an online information session. At this session, the study was introduced and the procedure for data collection was clearly explained to the students. Students were also informed of ethical issues related to the research before they consented to participate. Although appointment dates for the participants to complete questionnaires were set based on the students' availability and absence of any disturbance, and at the end of examinations as researchers have previously advised (Green & Thorogood, 2018; Moule et al., 2016), these dates were jettisoned due to the COVID-19 pandemic disruptions. Instead, initial and follow-up emails containing the questionnaire were sent out to all potential participants for online completion of the survey and the responses where automatically captured on a google spread sheet.

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3.6.5 Presentation and interpretation of results

The response to each question in the online questionnaire by each participant was extracted into a Microsoft Excel® spreadsheet. Then codes and numbers were generated for each variable in the data and analysed using Prism version 6.02 software (GraphPad Software, San Diego, USA). Data were presented using descriptive statistics such as mean, range, frequencies, and percentages where appropriate (Gray et al., 2016).

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To assess the level of knowledge of midwives on FS, a scoring scale of the 25 questions asked during the pre-test (Addendum A – Questionnaire Section C) was developed. Each correct answer attracted one point, while a wrong answer was scored zero; only all answered questions were scored. Thereafter, the total score on the level of knowledge was calculated for each respondent from the 25 items and divided into three categories: sufficient or good knowledge (≥70%), average knowledge (50-69%) and insufficient or poor knowledge (<50%). This classification was based on previous studies on the level of knowledge of electronic FS or the CTG (Gourounti et al., 2020; Parhizkar et al., 2012; Thellesen et al., 2017).

Furthermore, the Chi-square test was conducted to assess the relationships between the responses on the knowledge of FS versus clinical placement and adequacy of the midwifery training programme in preparing students with the necessary skills to conduct electronic FS. Finally, the Kruskal-Wallis test was used to determine relationships between the age or gender of respondents and their knowledge of FS. In these tests a p-value <0.05 was considered statistically significant.

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3.7 Ethical Considerations

Permission to conduct this study was obtained from the University of the Western Cape Ethics Committee (see Annexure B). Permission was also obtained from the Registrar of the university (see Annexure C) and the Director of the SON where the study was undertaken.

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3.7.1 Informed consent

An informed consent form was designed (see Annexure D) and sent via email to all potential participants before the commencement of data collection. The informed consent form contained the relevant information about the study, why it is being conducted and the voluntary nature of participation. Each participant was assured of their right to withdraw from the study if they wished to do so. All possible risks such as failure to protect personal information and discomfort associated with the study such as displacement of students from on area to another for the purpose of the study were fully discussed in the email, so that participants read about and understood this before consenting to take part in the study. The researcher indicated on the information form that students who were not happy to participate in the survey can reply if they needed further clarity while those who are happy to take part should not boarder to reply if they are happy with the information sent to them regarding the study. However, no student replied to report discontent with the information about the research and or their unwillingness to take part in the study. This indicated that every student was happy and has consented to participate in the study.

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The anonymity of participants was ensured by not writing names on the questionnaires or disclosing any form of identity during participation in the study. Only code numbers were allocated to the questionnaires, so that participants were not connected to their responses. Confidentiality of the information was ensured by protecting and not sharing information given by participants with anyone who had not obtained consent from participants to access the information. The information was encrypted end-to-end as it was exchanged between the researcher, students, and supervisor. The information will be secured under a password system for five years after the findings of the research have been published. The password is

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known only to the supervisor and the researcher, so that the confidentiality of the information is not breached. This information collected from study participants will be destroyed by degaussing after five years. This method of destroying stored information will be achieved by erasing the magnetic field of the storage media.

3.7.2 Respect for persons

The researcher respected the autonomy and dignity of the research participants through obtaining informed consent, maintaining confidentiality, anonymity, and privacy, and the right of participants to withdraw at any time should they wish to do so without any punitive measures taken against them. Participation in this study was voluntary and the researcher did not use his position as a senior student at the SON which is the study setting as a position of power to influence students to participate.

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3.7.3 Principle of beneficence

The well-being of the participants was secured by protecting them from harm and discomfort, as every participant will be kept anonymous, and the collected data will be kept confidential. The researcher ensured that risks associated with the research, such as psychological and social risks, were minimised.

3.7.4 Justice

Respondents in this study were chosen fairly without any discrimination by sex, age, or race, if the inclusion criteria for this study were met. They were also selected fairly using an all-inclusive sampling technique.

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3.8 Conclusion

The methods, protocols, procedures, and ethical considerations followed in the conduct of this study have been fully described in this chapter.

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CHAPTER FOUR

FINDINGS

4.1 Introduction

In this chapter the results of the analysis are presented as per the objectives of the study: a) to determine the level of knowledge of nursing midwifery students in using the CTG, and b) to determine the level of competence of nursing midwifery students in recording and interpreting the partograph. The analyses of the data collected from the electronic self-administered questionnaire given to participants (N=197) are presented in bar graphs, pie charts, and tables to determine the level of readiness and competence of midwifery students in conducting FS during labour. The relatively low response rate of this study can be attributed to the COVID-19 pandemic-induced disruptions in the academic programme, that prevented the researcher from physically introducing the questionnaire to the students. Nevertheless, the response rate of 69.5% that was obtained provides a representative sample of the population, given the challenges.

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4.2 Demographic characteristics of participants

A total of 137 respondents completed the questionnaire, although it was sent electronically to all the students (N=197) who were eligible. This gave a response rate of 69.5%. The ages of the participants ranged from 21 to 51 years, with a mean age (standard deviation) of 29 (5.8) years. Of this population, the majority are in the age range between 21 and 30 years (n=89; 65%), followed by those in the 31–35-year age group (N=29; 21%), as illustrated in Table 1. As expected, there are more females (N=116; 85%) than males. Only about 15% (N=21) of the participants across all ages were males, and they were almost equally distributed across all the age groups.

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Table 1: Demographic characteristics of respondents

Respondents (n=137)	n	%
Age (years)		
21 – 25	45	33
26 – 30	44	32
31 – 35	29	21
>35	19	14
Gender		
Female	116	85
Male	21	15

4.3 Clinical placement

In terms of the amount of time spent in the clinical placements in hospitals and health centres, specifically in the MOUs for the midwifery module, the responses ranged from 2 students who spent less than a month, to 71 students who spent 4–6 months there. Students spent their clinical placements in both low-risk (52%; N=71) and high-risk (47%; N=64) MOUs (Figure 3). These are closely followed by those who spent 1–3 months in clinical placements (40% or N=54 in low-risk units, and 44% or N=60 in high-risk units). Only 9 (6.6%) respondents had clinical placements in low- or high-risk MOUs for less than a month or more than 6 months this disparity in time spent at clinical placement is due the fact that some students failed to complete their clinical hours during this period while others did. However, it's a SANC requirement to complete 1200 clinical hours to meet the criteria to be registered as a midwife. The students with less clinical hours will proceed to complete their clinical hours to 1200 hrs in their fourth year.

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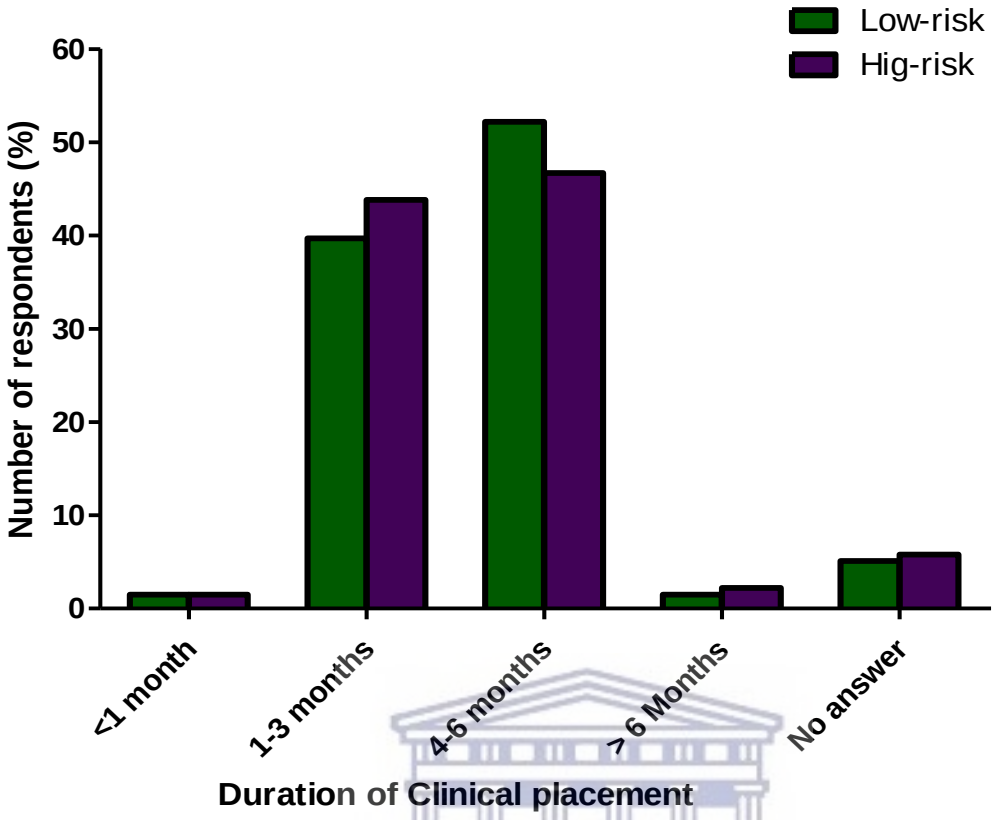

Figure 3: Duration of clinical placement of respondents during clinical training on fetal surveillance.

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4.4 Competence of respondents in electronic fetal surveillance and the cardiotocograph

The competency of FS during gestation and labour can improve the preparedness or confidence of students to deploy the technique when required. Participants were asked key questions to assess their competence in electronic FS and the CTG. As shown in Figure 4, less than 30% (N=37) were competent in understanding the indications for electronic FS to take the necessary actions once these indications present themselves. The rest were either incompetent (33%) (N=46) or require some level of supervision (40%) (N=55).

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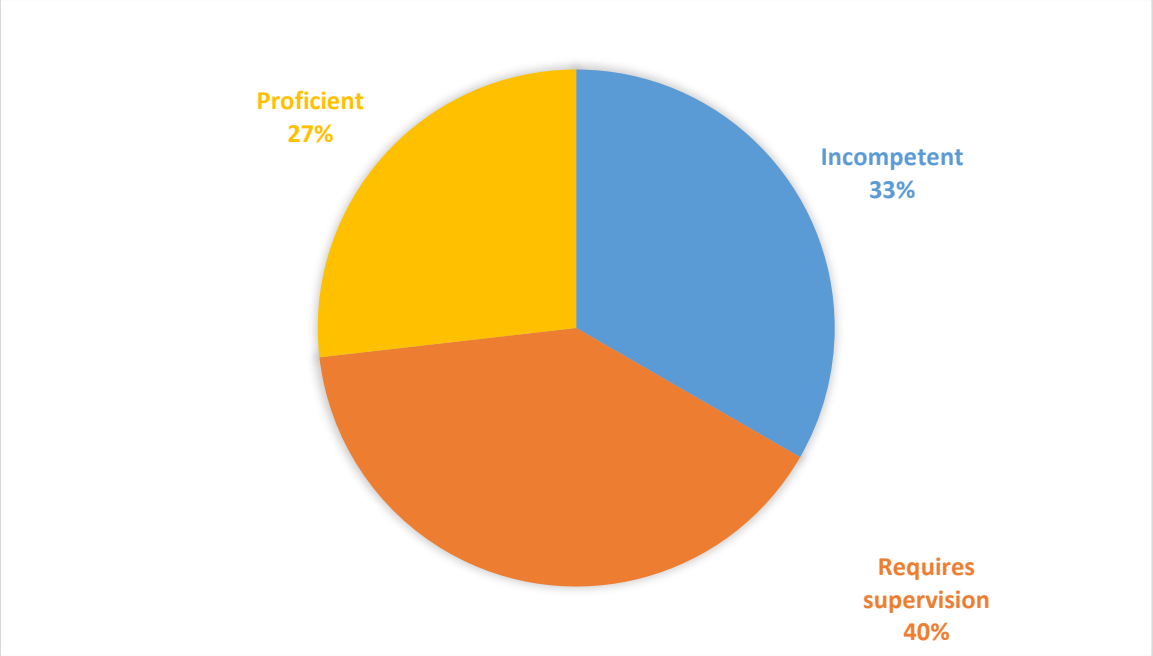

Figure 4: The level of competence of midwifery students in electronic fetal surveillance and who "can take necessary action once these indications present".

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Despite this lack of competence, most of the students are aware of the use of the CTG in midwifery (65%; N=90), have initiated interventions based on interpretations of CTG data (70%; N=96), and know the implications of CTG data misinterpretation on labour (68%; N=94). Interestingly, about 54% of the midwifery students answered in the affirmative when asked if CTG is required for every pregnancy category (Figure 5).

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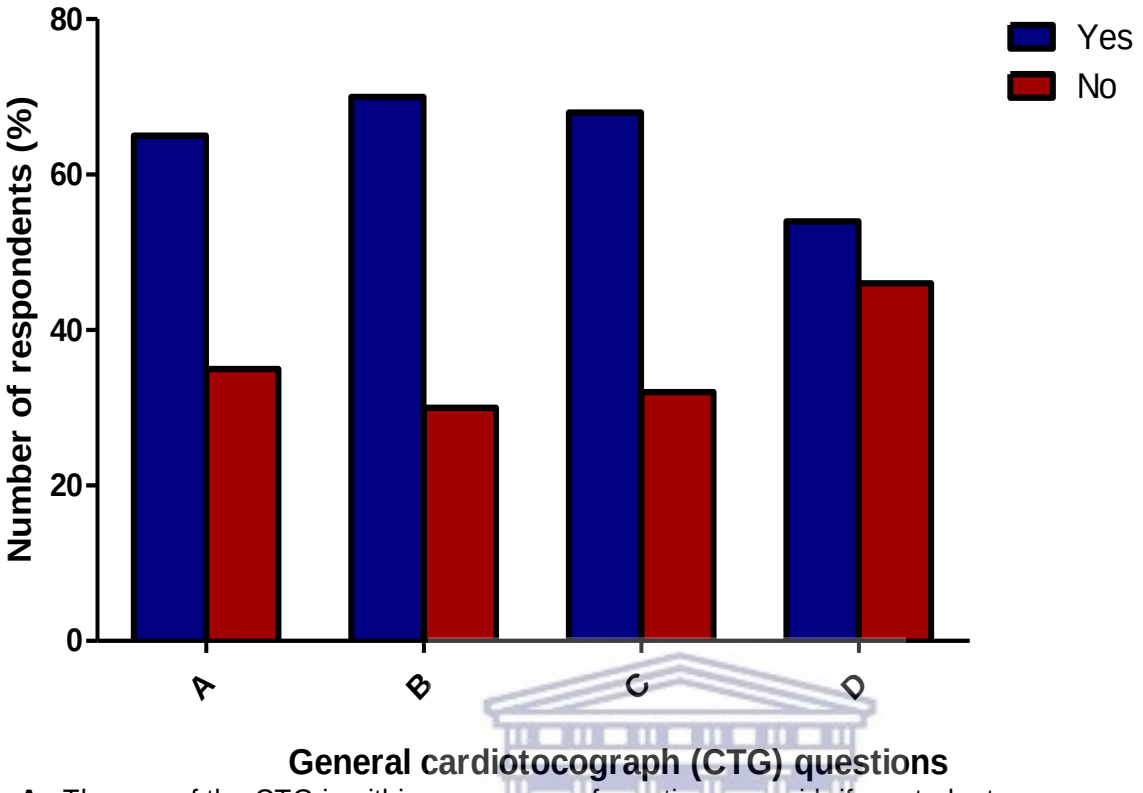

A - The use of the CTG is within your scope of practice as a midwifery student
B - Have you initiated interventions based on your interpretations of data from CTG?
C - Can misinterpretation of data from CTG result to delay or unnecessary intervention during labour?
D - CTG is necessary in every category of pregnancy

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Figure 5: The responses to the general cardiotocograph questions.

Furthermore, only 48% of the midwifery students (N=65) gave positive responses ('Agreed' or 'Strongly agreed') regarding the role of the midwifery clinical experience in equipping them with CTG implementation and data interpretation skills (Figure 6). A simple majority (56%; N=77) of the students also positively opined that the length of time spent at the clinical placement allowed enough exposure to the clinical practice of FS. Only 48% (N=65) were positive that the mentorship provided during clinical practice led to improvement in FS knowledge. When asked if a reassuring CTG is an indication that the fetus is doing fine *in utero*, about 52% (N=71) of the midwifery students were in accord with the statement. As can

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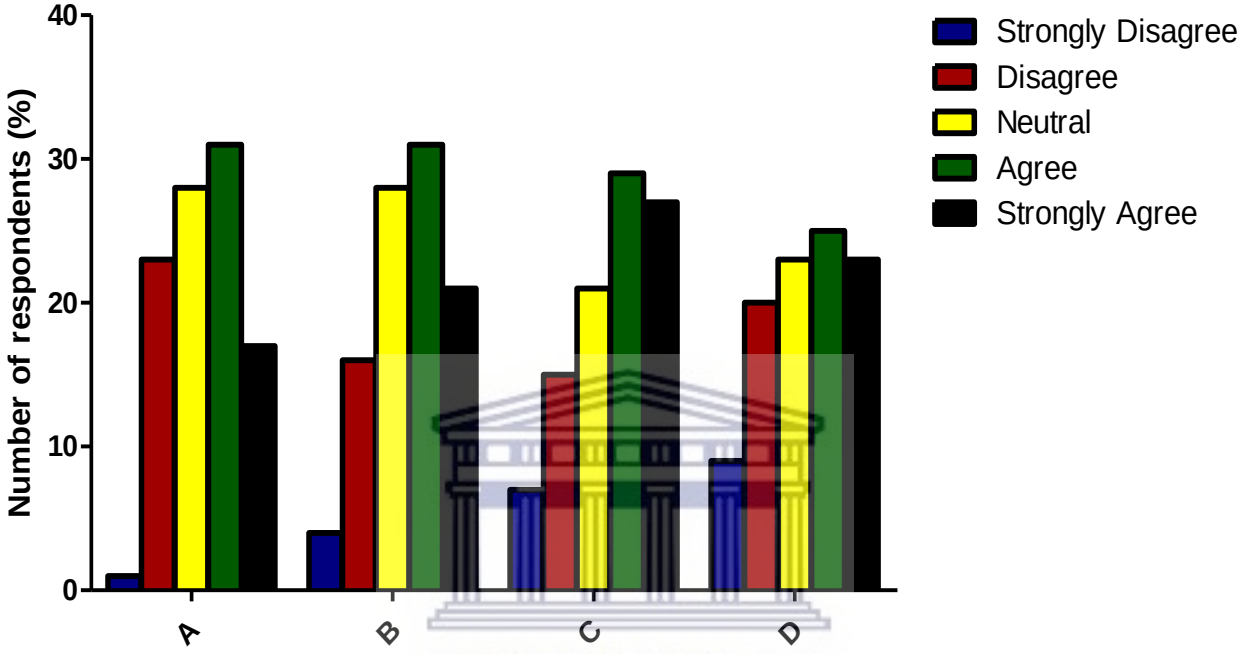
be seen in Figure 6, around 21–28% (N=29–38) of the respondents in this study were undecided ('Neutral') in their answers to these CTG knowledge questions.



Knowledge of electronic fetal surveillance/cardiotocograph (CTG) questions

A - My current midwifery clinical experience has equipped me with skills in the implementation and interpretation of data from electronic fetal surveillance/CTG
B - A reassuring CTG is indication that the fetus is doing fine in-utero
C - The length of time for the clinical placement permitted me to get enough exposure to the practice of fetal surveillance.
D - I had adequate mentorship during the practice of fetal surveillance which has greatly improved my knowledge on the practice

Figure 6: Responses regarding questions on knowledge of electronic fetal surveillance and cardiotocograph.

4.5 Pathological cardiotocograph skills

To better understand the competence of the students to undertake the hands-on aspects of the CTG, they were asked questions about pathology. The students admitted the need for supervision in identifying features of a pathological CTG (40%; N=54), the interventions to

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initiate when the features manifest (38%; N=51), and knowing a sinusoidal pattern on a CTG tracing paper (37%; N=49); however, 25% (N=34), 36% (N=49)and 34% (N=46) of the students, respectively, admitted that they were incompetent in these areas (Figure 7). The majority (51%; N=69) of the students can competently connect the patients to a CTG, although 28% (N=38) and 20% (N=27) stated that they require supervision and were incompetent to do so, respectively.

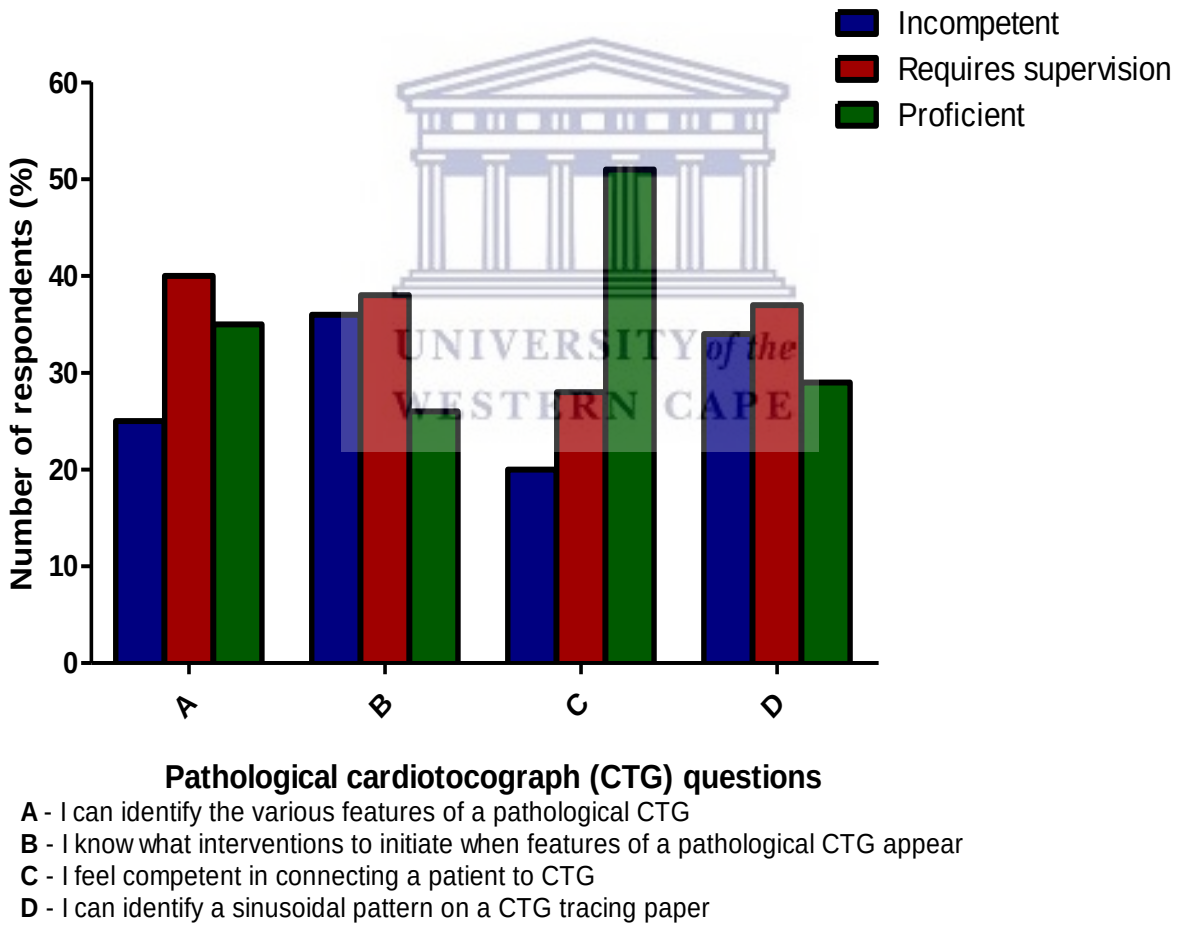

Figure 7: Responses to the pathological cardiotocograph questions.

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4.6 Midwifery training programme's role in preparing students to conduct electronic fetal surveillance

Nursing midwifery students were asked if the midwifery module adequately prepares them for conducting electronic FS. The students' responses were split nearly evenly between 'Agree' (27%; N=38) and 'Disagree' (28%; N=39), with the remainder of responses being 'Neutral' (19%; N=26), 'Strongly agree' (16%; N=22), or 'Strongly disagree' (10%; N=14), as shown in Figure 8.

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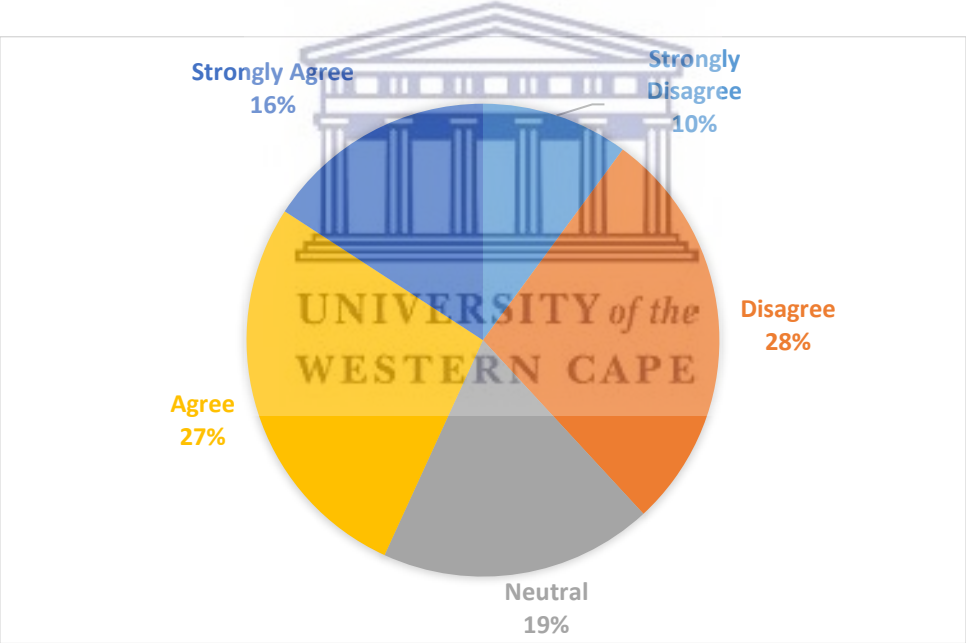

Figure 8: Distribution of responses to the question: *"The midwifery module prepared me with the required skills to conduct electronic fetal surveillance".*

4.7 competence in use of the partograph

The accurate recording of all relevant observations on the partograph is an important task for an effective FS, as it allows for a seamless interpretation of data and interventions to improve maternal and neonatal outcomes. As presented in Table 2, less than half of the participants

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reported that they are competent in the use of the partograph after taking the midwifery module, with most of the students reporting being incompetent or requiring supervision. Respondents could competently conduct abdominal palpation to determine the orientation of the fetus (46%; N=62), and record information on the partograph and identify deviations from normal (43%; N=59). Almost half (49%; N=66) of the respondents fully understood when to use the partograph. Similarly, about 48% (N=64) and 47% (N=61) understood the indication of the alert and action lines on the partograph and could use the partograph to diagnose a prolonged active phase of labour as per the national guidelines for the practice of midwifery, respectively. Regarding the identification of the various indicators of fetal well-being on the partograph, 42% (N=56) where competent, 34% (46) (require supervision), and 24% (32) where incompetent. Regarding identifying the key indicators for referral on the partograph, 36% (N=48) of the respondents were competent, 32% (43) of required supervision, and 33% (44) were not incompetent. Overall, the total percentage competence of respondents was 44%, while those requiring supervision or who were incompetent each made up 26% (Table 2).

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Table 2: Responses to questions on competence in using the partograph

Questions	Responses (Percentage (N))		
	Incompetent	**Requires supervision**	**competent**
I can conduct abdominal palpation to determine the orientation of the fetus.	26% (35)	28% (38)	46% (62)
I can correctly record information on the partograph and identify any deviations from normal.	24% (33)	32% (44)	43% (59)
I fully understand when to use the partograph.	24% (32)	28% (38)	49% (66)

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I understand the indication of the alert and action line on the partograph.	27% (36)	25% (33)	48% (64)
I can use the partograph to diagnose prolonged active phase of labour as per the national guidelines for the practice of midwifery.	21% (29)	32% (43)	47% (61)
I can identify the various indicators of fetal well-being on a partograph.	24% (32)	34% (46)	42% (56)
I can identify the key indicators for referral on the partograph.	33% (44)	32% (43)	36% (48)

4.8 Competence in monitoring fetal heart rate (FHR) patterns and interpretations

When questions were asked to assess the midwifery students' degree of competence in interpreting FHR patterns, 29% (N=40), 43% (N=47) and 36% (N=49) of respondents perceived themselves to be competent in correctly interpreting CTG data and identifying abnormal patterns; identifying a change in the baseline; and identifying a late deceleration, respectively (Table 3). Respondents knew the primary intervention to initiate in the event of a late deceleration in FHR pattern (32%; N=43); could identify a prolonged deceleration (42%; N=57); and could differentiate between a suspicious, abnormal, or reassuring FHR pattern (39%; N=53). They could also define the risk in pregnancy as high or low (49%; N=65), as well as identify the baseline of an FHR pattern on a CTG (42%; N=57). On average, 39% of respondents affirm that they are competent, while 35% require supervision and 26% are incompetent (Table 3).

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Table 3: Competence in fetal heart rate patterns and related activities

Questions	Responses (Percentage (N))		
	Incompetent	Requires supervision	competent
I can correctly interpret data on cardiotocograph and identify the different types of abnormal fetal heart rate patterns.	20% (27)	51% (69)	29% (40)
I can identify a change of baseline in a fetal heart rate pattern.	26% (34)	32% (42)	43% (57)
I can identify what is a late deceleration on a fetal heart rate pattern.	27% (37)	37% (50)	36% (49)
I know the primary intervention to initiate in event of a late deceleration on fetal heart rate pattern.	27% (37)	41% (55)	32% (43)
I can identify a prolonged deceleration on a fetal heart rate pattern.	27% (37)	30% (41)	42% (57)
I can differentiate between a suspicious, abnormal and a reassuring fetal heart rate pattern.	30% (40)	31% (42)	39% (53)
Based on available data, I can define the risk in a pregnancy as high or low.	21% (28)	31% (41)	49% (65)
I can identify the baseline of a fetal heart rate pattern on a CTG.	29% (40)	29% (39)	42% (57)

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4.9 Level of knowledge of fetal surveillance and cardiotcograph interpretation

As described earlier (section 3.5.5), a scoring scale of the 25 questions (Table 4) was designed to determine the level of knowledge of midwives on FS and CTG interpretation. The level of knowledge is either sufficient or good (≥70% score), average or fair (50–69% score), or

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insufficient or poor (<70% score). Results presented in Table 5 indicated that only about 1 in 3 (33%; N=45) midwifery students had sufficient knowledge of FS in this study. Most of the students had average knowledge, scoring 50–69% (N=47; 35%), while the rest had insufficient knowledge, scoring less than 50% (N=44; 32%). The overall mean score obtained in this study was approximately 57%, while percentage scores ranged between 4% and 80%.

Table 4: Responses to the general knowledge on fetal surveillance questions

	Questions	True % (N)	False % (N)
1	Auscultation of fetal heart tones is not desired prior to application of the fetal monitor.	52% (71)	48% (65)
2	It is important to consider the impact of maternal and fetal physiology on the fetal heart rate when conducting fetal surveillance.	82% (110)	18% (25)
3	Confirmation of fetal heart can be best accomplished by using hand-held Doppler if the ultrasound transducer failed to detect the fetal heart rate.	72% (97)	28% (37)
4	Variable decelerations are uniform in shape and size.	58% (78)	42% (56)
5	The minor baseline FHR fluctuations are measured by estimating the difference in beat per minute between the highest peak and lowest trough of fluctuation in 1-minute segments of the CTG trace between contractions.	86% (118)	14% (19)
6	Variable decelerations are only a periodic pattern; they are never non-periodic.	64% (84)	36% (48)
7	A variable deceleration nadir < 80 beats per minute has no clinical significance.	57% (77)	43% (58)
8	Variable decelerations lasting 60 or more seconds and falling to less than 70 beats per minute are associated with fetal acidaemia.	68% (90)	32% (42)
9	A biphasic variable deceleration is related to an umbilical cord less than 50 cm in length.	66% (86)	34% (44)

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10	A prolonged deceleration lasts 2 to 15 minutes.	67% (90)	33% (43)
11	A prolonged deceleration may be due to head compression.	70% (93)	30% (40)
12	Fetal tachycardia following fetal bradycardia is a reassuring sign.	64% (87)	36% (48)
13	Corrective interventions during a prolonged deceleration include fetal scalp stimulation.	65% (86)	35% (47)
14	Maternal hypotension may precede a prolonged deceleration.	67% (88)	33% (44)
15	Supplemental oxygen is not useful when a prolonged deceleration occurs.	55% (72)	45% (60)
16	It takes 15 minutes for supplemental oxygen to reach the fetus.	56% (73)	44% (58)
17	Late decelerations last more than 2 minutes.	68% (90)	32% (43)
18	Late decelerations are indicative of fetal hypoxia.	72% (93)	28% (36)
19	Sinusoidal pattern is pathological fetal heart rate pattern.	70% (91)	30% (39)
20	A fetal heart rate less than 80 beats per minute is a reflection of fetal hypotension and decreased fetal brain perfusion	70% (92)	30% (39)
21	I can identify the difference between the maternal and fetal heart rate patterns on a CTG paper.	73% (96)	27% (35)
22	A uterine resting tone of 8–12 mmHg is normal	5% (7)	95% (122)
23	Maternal hypotension may precede a prolonged deceleration in a fetal heart rate	68% (91)	32% (42)
24	Tetanic contractions suggest rapid labour progress, imminent delivery, or a response to cocaine	65% (86)	35% (47)
25	Meconium-stained liquor is an indication for continuous CTG monitoring during labour.	9% (11)	91% (116)

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Table 5 below summarises the above responses, to determine the level of knowledge of FS.

Table 5: Levels of knowledge of fetal surveillance

Levels of knowledge (percentage scores)	Frequency	Percentage
Sufficient (≥70%)	45	33%
Average (50–69%)	47	35%
Insufficient (<50%)	44	32%

4.10 Associations between variables of duration of clinical placement, training programme and knowledge of fetal surveillance

The associations of the independent responses between variables in this study were determined using the well-established Chi-square and Kruskal-Wallis tests. Results obtained indicate that the respondents' knowledge of electronic FS is significantly (p=0.00001) associated with the duration of their clinical placement (Table 6). The midwifery training programme used in the preparation of students is also significantly related to their knowledge of electronic FS (p=0.0028). However, the age and gender of respondents did not influence their knowledge of electronic FS (p>0.05), as can be seen in Table 6.

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Table 6: Chi-square and Kruskal-Wallis tests to determine associations between responses

Knowledge of cardiotocograph versus:	p-value
Duration of clinical placement	0.00001
Midwifery programme	0.0028
Age / Gender	0.9517

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4.11 Conclusion

This chapter detailed the presentations and descriptions of the results obtained after careful analysis of the data collected from the electronic self-administered questionnaire given to respondents.

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CHAPTER FIVE

DISCUSSION

5.1 Introduction

Each of the sets of data on results obtained in this study is discussed in this chapter according to the study objectives: to determine the level of knowledge of midwifery students in using the cardiotocograph, and b) to determine the level of competence of midwifery students in recording and interpreting the partograph.

5.2 Demographic characteristics of participants

Most respondents in this study were in the 21–25-year (33%; N=45) and 26–30-year (32%; N=44) age ranges (Table 1). The young age (an average of 29 years is recorded) of most of the participants in this study is encouraging, as it shows that their nursing careers may still be at an early enough stage to accommodate any potential adjustments needed to make them competent in conducting FS. As is common among students enrolled for the nursing degree worldwide, the female sex are in the majority among the respondents in this study, which reflects the global gender bias for the nursing profession (Golden, 2018; Maphasha et al., 2017).

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5.3 Clinical placement

Generally, the clinical placements in hospitals and health centres represent the environment where practical instruction is given on what has been taught in theory in the classroom. In this study, most of the students spent 4–6 months or 1–3 months in their clinical placements in low-risk (52%; N=71 or 40%; N=54) and high-risk (47%; N=64 or 44%; N=60) MOUs for the

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midwifery module (Figure 3). It has been shown that the satisfaction of nursing midwifery students and the availability of learning opportunities can be affected by the duration of clinical placement. Students who are exposed to more learning opportunities and a conducive clinical learning environment during clinical placement tend to become more confident and competent. The time spent in clinical placements, which is usually about half of the total hours spent in the year of the programme, is crucial for the readiness of the students to work independently (Fadana & Vember, 2021). A longer duration may give more room to become competent in the acquisition of important practical skills than a shorter duration (Abouelfettoh & Al Mumtin, 2015). A short durations (7–14 days) of clinical placement was found to be insufficient for learning and bonding with patients (Warne et al., 2010).

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5.4 Determining the level of competence of midwifery students in recording and interpreting the partography

Most of the respondents admitted to being incompetent (33%; N=46) or to requiring supervision (40%; N=55) in understanding the indications for electronic FS enough to undertake any necessary actions once these indications present themselves (Figure 4). Only 30% (N=37) stated they were competent. The participants' responses to the questions indicate an inadequate knowledge of and skill in the CTG among students who had taken the midwifery module that included clinical placements in MOUs. The findings agree with those of earlier reports on midwives in public hospitals in KwaZulu-Natal province in South Africa (James et al., 2019). A thorough mastery of the FS deployed during gestation and labour can result in a reduction in the neonatal mortality rate (NMR) (Viswanatha et al., 2017). Therefore, the midwifery module being taught to the nursing midwifery students is expected to lead to the enhancement of their confidence, knowledge, and skills in conducting FS.

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Many respondents in this study stated their awareness of the use of the CTG in midwifery (65%; N=90) and have initiated interventions based on CTG data (70%; N=96) or understood implications of CTG data misinterpretation on labour (68%; N=94), as illustrated in Figure 5. These findings suggest sufficient knowledge in administering CTG. However, the lack of competence of the respondents in this study can also be confirmed by more than half of the respondents (54%; N=74) believing that CTG is required for every pregnancy category (Figure 5). Intrapartum CTG monitoring may not be required for every pregnancy category; for instance, a recent report based on a meta-analysis of pooled data from randomised clinical trials in mixed- and high-risk populations suggests the those at risk of poor outcome do not benefit from CTG (Small et al., 2020).

In terms of the influence of the midwifery clinical experience, length of time spent at the clinical placement, and type of mentorship in equipping them with CTG implementation and data interpretation skills, 48% (N=65), 56% (N=77), and 48% (N=65) respondents, respectively, opined that these factors positively improved their FS knowledge (Figure 6). The need for a good balance between clinical practice and theory has been emphasised in midwifery educational systems to enhance the preparedness of students for practice (Lukasse et al., 2017). Continuous training in CTG and electronic FS for nurses, together with structured CTG education, have been advised in order to fill in the gaps in knowledge (Goldman & Naidoo, 2021).

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5.5 Pathological cardiotocograph skills

As shown in Figure 7, in this study 40% (N=54) of the respondents require supervision in identifying features of a pathological CTG, the interventions to initiate when the features

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manifest (38%; N=51) and knowing a sinusoidal pattern on a CTG tracing paper (37%; N=49). About 25% (N=34), 36% (N=49) and 34% (N=46), respectively, stated their incompetence in identifying features of a pathological CTG, knowing the interventions to initiate when the features manifest, and knowing a sinusoidal pattern on a CTG tracing paper.

From the students' responses, the main challenge of nursing midwifery students in this study seemed to relate primarily to CTG interpretation skills, rather than just inability to use the equipment. This has been noted previously in midwives domiciled in KwaZulu-Natal public hospitals in South Africa (James et al., 2019). Focusing CTG training modules on also including in-depth knowledge of maternal and fetal pathophysiology and stress biology may improve the interpretation skills of nursing personnel (Ugwumadu et al., 2016; Zhu et al., 2021).

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5.6 Role of the midwifery training programme in preparing students to conduct electronic fetal surveillance

More than 43% of the respondents agree or strongly agree about the sufficiency of the training programme in preparing them to perform FS (Figure 8), while about 38% disagree or strongly disagree that the training programme was sufficient. The absence of a clear consensus indicates some limitations in the current programme. These limitations may be associated with the shortage of skilled nurses in South Africa, which has necessitated increased student enrolments, to the point where educational institutions have been overstretched and classrooms or clinical facilities too congested to allow quality training (Bvumbwe & Mtshali, 2018). A national FS educational curriculum improvement in Australia led to increased competence of the personnel to undertake FS (Brown et al., 2017). Also, in Norway midwives preferred having extended time during clinical practice and simulation

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training of key midwifery practical skills included in the education curriculum (Lukasse et al., 2017). These interventions may also be emulated by South Africa soon.

5.7 competence in the use of the partograph

Altogether, less than half (44%) of all the participants stated that they were competent in the use of the partograph after taking the midwifery module, with other students admitting incompetence (26%) or that they required supervision (26%) (Table 2). The partograph is a crucial component of the FS (Lavender & Bernitz, 2020), so these findings – where most of the nursing midwifery students are lacking in competence in the use of the partograph – further demonstrate lack of sufficient knowledge of FS. This may be related to limitations of the current training methods and clinical learning environments. This is a common issue in South Africa and other low-middle-income countries (Munabi-Babigumira et al., 2017; Yazbek & Jomeen, 2019), requiring urgent attention to overcome this challenge. There has been an elevated number of students admitted to the nursing programmes to compensate for the critical skills shortage in South Africa in recent years, and this may have placed a burden on the capacity of the higher educational systems to deliver quality teaching and learning.

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5.8 Competence in monitoring fetal heart rate (FHR) patterns and interpretations

In this study, an average of 39% of respondents reported being competent, while 35% stated that they require supervision and 26% that they were incompetent to monitor and interpret the FHR, as shown in Table 3. Comprehensive competence of monitoring the FHR patterns and their accurate interpretation is essential to FS for positive neonatal and maternal outcomes. Recently, a clinical practice package of FHR monitoring education that was added

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to the normal procedure in a tertiary hospital in South Africa was reported to have the possibility of lowering the rate of unnecessary caesarean sections (Allanson et al., 2019). In this study, the nursing midwifery students who participated confirmed the inadequacy of the midwifery training in improving their competence in monitoring and interpreting FHR, as most of them are either incompetent or require supervision.

5.9 Level of knowledge of fetal surveillance and cardiotocograph interpretations

As described earlier, in section 3.5.5, a scoring scale was designed for the 25 questions (Table 4) (Gourounti et al., 2020; Parhizkar et al., 2012; Thellesen et al., 2017), to determine the level of knowledge of midwives on FS and CTG interpretation. In this study, two-thirds of all the respondents displayed insufficient knowledge of FS and CTG, by scoring less than 70% on the questions, with the average score being 57% (Table 5).

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This confirms earlier reports from studies conducted among midwives in hospitals in Gauteng and KwaZulu-Natal in South Africa (James et al., 2019; Maphasha et al., 2017). In Athens, Greece, fewer years of experience (mostly under five years) among midwives and doctors at two public hospitals was suggested to be responsible for the limited level of knowledge of FS and CTG (Gourounti et al., 2020). Hence, the low level of knowledge among respondents in this study can be remedied through urgent actions focused on training and re-training of nursing midwifery students in FS programmes. An in-depth knowledge of FS and CTG interpretation boost the competence of midwives to practice and can greatly influence positive fetal and neonatal outcomes. For example, a knowledge deficit in interpretation of the CTG can result in an incorrect decision to undertake a caesarean section (Parhizkar et al., 2012).

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5.10 Associations between knowledge of nursing midwifery students and duration of clinical placement

Student midwives usually spend a major portion of their study at clinical placements, learning critical components of midwifery practice. A significant ($p<0.05$) relationship was found between the time spent in low-risk and high-risk clinical placements by respondents in this study and their knowledge of electronic FS. Besides the clinical placement duration, the central role of the midwifery module used in training students was also highlighted in this study, by its significant ($p<0.05$) association with knowledge of electronic FS. This finding has also been similarly reported earlier (Brown et al., 2017).

The duration and the environment of clinical placement have been shown to affect the satisfaction, knowledge and competence of midwifery students (Abouelfettoh & Al Mumtin, 2015). Thus, these results suggest two main areas where focus should be placed to improve the insufficient FS knowledge currently displayed among respondents in this study: firstly, in the duration of time spent during clinical placement, and secondly, in the midwifery training programme. When improved, these areas will also play significant roles in enhancing the attainment of competence by students to perform FS.

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5.11 Conclusion

In this chapter, each set of results generated from this study was critically examined in relation to recent relevant scientific literature, to determine the level of knowledge and competence of midwifery students in conducting FS during labour.

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CHAPTER SIX

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

6.1 Introduction

This concluding chapter provides an overview of the key findings of the study, followed by the limitations encountered during the study. The chapter ends with an outline of the main recommendations for future research or implementation.

This study showed that although the undergraduate midwifery student nurses at a university in Western Cape metropole understand the purpose of the cardiotocograph (CTG) and partograph in fetal surveillance (FS), majority of the students reported that they were either incompetent or required supervision to interpret the CTG data accurately. Indeed, approximately 70% of them had insufficient FS knowledge. Also, the midwifery module, duration of clinical placements and overall midwifery clinical experience are associated with the CTG implementation and data interpretation skills of respondents.

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6.2 Conclusion

All the respondents in this study have completed the midwifery module that is normally taught during the third year of study towards the attainment of their nursing degrees at the university though some students had outstanding clinical placement hours to complete, they were qualified via passing their class exams as completed the module. This module encompassed the theoretical fundamentals of FS, as well as the clinical component; therefore, respondents, were expected to be knowledgeable and competent to conduct FS.

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Since this may have profound implications on neonatal and maternal health in South Africa, the objectives of the study were to assess the level of knowledge and competence of midwifery students at a university in the Western Cape in conducting FS. The researcher wanted to determine if students had sufficient knowledge and competence in the use of the CTG and partograph during labour, and interpretation of the data generated from this equipment.

The findings of this study indicated that most respondents perceived themselves as understanding the use of the CTG for FS in midwifery and have initiated interventions based on the CTG data. However, they were identified to be either incompetent or to require supervision to interpret the CTG data accurately. About two-thirds of the respondents had insufficient FS and CTG knowledge, which may be responsible for the inability to interpret the CTG data. In addition, most of the students admitted not being competent to use the partograph effectively. They also identified that the midwifery module, duration of clinical placement in the low- or high-risk MOUs and overall midwifery clinical experience are positively related to their CTG implementation and data interpretation skills, although only half felt that these significantly led to a boost in FS knowledge. There also was not clear consensus among respondents on the adequacy of the training programme in preparing them to perform electronic FS better, but the results indicate that there were limitations in the midwifery module.

In Summary, these findings point to a significant deficit in FS knowledge in midwifery students at the university, which may have affected their readiness to conduct FS. Therefore, measures should be put in place to further train and re-train midwifery students in conducting FS –

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especially on improving their FS knowledge and CTG data interpretation competence – to achieve more favourable neonatal and maternal outcomes in South Africa.

6.3 Limitations

The research study outlined here was based on respondents from only one university in the Western Cape Province and had a response rate of 69.5% (137 midwifery students). While this can be considered a good sample from the undergraduate population in the province, each school or university has independent learning styles for the nursing curriculum, even while adhering to the regulations of the SANC. Therefore, the findings from this study should be interpreted accordingly, without an over-extrapolation of results to other schools/universities. The results of this study cannot be generalised to the other nursing training universities or colleges. Self-reporting is also a limitation in this study. The student might have either perceived themselves as not competence or have overrated themselves as competent.

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Furthermore, the data collection instrument (questionnaire) used in this study was sent to respondents electronically (via email), during the COVID-19 global pandemic. The possible influences of the method and timing of data collection on the findings of the study cannot be fully ascertained nor overruled by the researcher.

6.4 Recommendations

Based on the findings of the data emanating from this study, and despite the limitations, the following recommendations are proposed to potentially increase the level of knowledge and

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readiness of midwifery students in conducting FS, to mitigate any identified gaps in the preparation of undergraduate nurses for midwifery practice.

6.4.1 Education

Emphasis must be placed on improvement of the university's midwifery educational curriculum on FS, by ensuring a good balance between theory and clinical practice. While the theoretical modules on CTG and the partograph must include more comprehensive coverage of the maternal and fetal pathophysiology and stress biology topics to enhance data recording and interpretations, a longer duration of clinical placement at the MOUs and academic hospitals may provide more opportunity for students to become more proficient in conducting FS.

6.4.2 Clinical placement

Practical sessions at clinical placements should be more individualised, the school of nursing should make efforts towards placing fewer students per MOU and or academic hospital. The number of students placed per institution should be based on the availability of practicing opportunity and mentoring by skilled mid-wives. Once MOUs become overcrowded by students learning becomes a challenge. Every effort must be included to allow nursing midwifery students to gain more hands-on experience and readiness in performance of their skills.

6.4.2 Implication for the research

Further higher-scale research in which the students are observed in the practice is recommended to assess the level of knowledge and competence of midwifery students to

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conduct FS in South Africa, particularly to determine the level of competence and potential challenges in achieving proficiency.

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ANNEXURE A

ADDENDUM 19: QUESTIONNAIRE OF MIDWIFERY CARDIO-TOCOGRAPHY SURVEY

Thank you for the time you dedicated to complete this questionnaire that comprise of four sections.

1) What is your age?

2) What is the length of your clinical midwifery experience at low risk and high risk?

Low risk clinical placement	High risk clinical placement

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Section B: Questions related to your perceptions regarding your level of competency related to cardiotocography, vaginal examination and abdominal palpations

1. Please rate your competence level regarding the following tasks as 1. Incompetent, 2. Require supervision, 3. competent,

1.1 Effectively recording data on partograph interpreting	1	2	3	4
1.2 Interpreting data on partograph and initiating possible intervention.	1	2	3	4
1.3 conducting vaginal examination to determine cervical dilation and station	1	2	3	4
1.4 conducting abdominal palpation to determine the orientation of the fetus to maternal body	1	2	3	4

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2. Please answer the following questions pertaining to your use of cardiotocograph:

	yes	no
2.1 Is interpreting a CTG within your scope of practice?		
2.2 Do you initiate interventions based on your CTG interpretations?		
2.3 Have you ever misinterpreted a CTG that resulted in wrong intervention?		
2.4 are you competent in conducting abdominal palpation?		
2.5 Are you competent in conducting vaginal examination		

3. Please indicate to what extent you agree with the following statements where 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neutral (N), 4 = Agree (A), 5 = strongly Agree (SA

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	SD	D	N	A	SA	
3.1 The midwifery training programme prepared me with the required skills for the use of CTG	1	2	3	4	5	
3.2 My current midwifery clinical experience has equipped me with skills in the implementation and interpretation of CTGs	1	2	3	4	5	
3.3 My colleagues can efficiently perform CTG	1	2	3	4	5	
3.4 I've noticed inconsistencies and disagreements on the interpretation of the CTG amongst my colleagues	1	2	3	4	5	
3.5 I still need further training on CTG	1	2	3	4	5	

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3.6. my midwifery training has equipped me with skills to effectively conduct abdominal palpation	1	2	3	4	5	
3.7 my midwifery training has equipped me with skills to effectively conduct vaginal examination	1	2	3	4	5	

SECTION C: Questions on your CTG knowledge and competency

1. List the four main features that should be systematically examined to assist with the interpretation of the CTG.

1……..

2……

3……..

4……..

2. What does mnemonic „DR C BRAVADO" stand for?

DR…….

C……

Bra……

V…….

A…….

D…….

O……

3. Please list three indications for which CTG monitoring would be required

1.

2.

3.

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4. Mention two main things that you should do first when initiating CTG to avoid the risk of maternal heart rate confusion

1.

2.

5. What information should you write on the first square of the paper? Indicate the correct option(s):

3.1	Woman's name and surname	1
3.2	Hospital number	2
3.3	Date and time of commencement	3
3.4	Maternal heart rate	4
3.5	Signature of the midwife	5
3.6	All the above	6

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6. What is the paper speed of your unit CTG monitors? Indicate the most correct answer. a. 1cm, b. 1.5cm, c. 2cm, d. 2.5cm, e.3cm, f. 3.5cm

7. Please indicate whether the following statements are true or false:

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	rnal heart rate and fetal heart rate confusion that can occur during CTG as led to ected fetal outcomes when gone undetected		
	tation of fetal heart tones is not desired prior to application of the fetal monitor		
	tant to consider the impact of maternal and fetal physiology on the fetal heart rate		
	of fetal heart can be best accomplished by using hand-held Doppler if the ound transducer failed to detect the fetal heart rate		
	lerations are uniform in shape and size		
	lerations are only a periodic pattern, they are never non-periodic		
	celeration nadir < 80 beat per minute has no clinical significance		
	lerations lasting 60 or more seconds and falling to less than 70 beat per minute are ated with fetal academia		
	iable deceleration is related to an umbilical cord less than 50 cm in length		
	leceleration lasts 2 to 15 minutes.		
	leceleration may be due to head compression.		
	ardia following fetal bradycardia is a reassuring sign.		
	erventions during a prolonged deceleration include fetal scalp stimulation		
	otension may precede a prolonged deceleration		
	Supplemental oxygen is not useful when a prolonged deceleration occurs		

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	16. A fetal heart rate less than 80 beats per minute indicate possible fetal hypotension and decreased fetal brain perfusion		
	nutes for supplemental oxygen to reach the fetus		
	tions last more than 2 minutes		
	Late decelerations are indicative of fetal hypoxia		
	Sinusoidal pattern is pathological fetal heart rate pattern		
	Maternal tachycardia occurs when there is chorioamnionitis or maternal fever		
	An occiput posterior position is related to uterine contraction coupling		
	A uterine resting tone of 8-12mmHg is normal		
	Maternal hypotension may precede a prolonged deceleration		
	Tetanic contractions suggest rapid labor progress, imminent delivery, or a response to cocaine		

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ANNEXURE B

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50 YEARS *of hope, action & knowledge*

28 July 2020

Mr B Anye Nso
School of Nursing
Faculty of Community and Health Sciences

Ethics Reference Number: HS20/5/28

Project Title: Undergraduate midwifery students' perceived readiness to conduct foetal surveillance at a University in Western Cape

Approval Period: 27 July 2020 - 27 July 2023

I hereby certify that the Humanities and Social Science Research Ethics Committee of the University of the Western Cape approved the methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

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Please remember to submit a progress report by 30 November each year for the duration of the project.

The permission to conduct the study must be submitted to HSSREC for record keeping purposes.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Director: Research Development
University of the Western Cape
Private Bag X 17
Bellville 7535
Republic of South Africa
Tel: +27 21 959 4111
Email: research-ethics@uwc.ac.za

NHREC Registration Number: HSSREC-130416-049

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

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ANNEXURE C

The University of the Western Cape is a Public Higher Education institution established and regulated by the Higher Education Act, No. 101 of 1997 (Republic of South Africa), with the language of instruction being English. The University is duly accredited by the Council on Higher Education and its degrees and diplomas are registered on the National Qualifications Framework in terms of the South African Qualifications Authority Act, No. 58 of 1995.

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT THE UNIVERSITY OF THE WESTERN CAPE

This serves as acknowledgement that you have obtained and presented the necessary ethical clearance and your institutional permission required to proceed with the project referenced below:

Name of Researcher:
BLASIUS ANYE NSO

Research topic:
Undergraduate midwifery students' perceived readiness to conduct fetal surveillance at a University in Western Cape

Period permission is valid for
04 August 2020 – 27 July 2023
(or as determined by the validity of your ethics approval)

Reference code
UWCRP040820BN

You are required to engage this office in advance if there is a need to continue with research outside of the stipulated period. The manner in which you conduct your research must be guided by the conditions set out in the annexed agreement: *Conditions to guide research conducted at the University of the Western Cape*.

Please be at liberty to contact this office should you require any assistance to conduct your research or require access to either staff or student contact information.

Yours sincerely

DR AHMED SHAIKJEE
DEPUTY REGISTRAR
UNIVERSITY OF THE WESTERN CAPE

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ACADEMIC ADMINISTRATION
04 AUGUST 2020
This document contains a qualified electronic signature and date stamp. To verify this document contact the University of the Western Cape at researchperm@uwc.ac.za.

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ANNEXURE D

Leverne Gething, M.Phil., t/a WHIZZ@WORDS

PO Box 1155, Milnerton 7435; cell 072 212 5417

e-mail: leverne@eject.co.za

19 November 2021

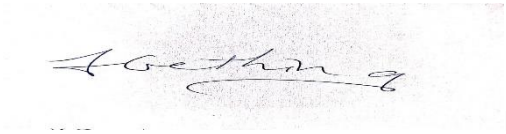
Declaration of editing of a mini-thesis submitted in partial fulfilment of the requirements for the degree of Master in Nursing (Education) at the School of Nursing, Faculty of Health and Community Sciences

TITLE: Undergraduate midwifery students' perceived readiness to conduct fetal surveillance at a University in Western Cape

I hereby declare that I carried out language editing of the above thesis on behalf of Blasius Anye Nso.

I am a professional writer and editor with many years of experience (e.g., 5 years on *SA Medical Journal*, 10 years heading the corporate communication division at the SA Medical Research Council), who specialises in Science and Technology editing - but am adept at editing in many different subject areas. I have edited a great deal of work for various academic journals, universities, and publishers.

I am a full member of the South African Freelancers' Association as well as of the Professional Editors' Association

Yours sincerely  LEVERNE GETHING

leverne@eject.co.za

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ANNEXURE E

3408664:Undergraduate_midwifery_students_percieve_readi...

ORIGINALITY REPORT

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