

Original Paper

# Knowledge and Attitudes of Midwives Concerning the Interpretation and Use of Cardiotocographs in Jordan



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## ABSTRACT

**Introduction:** A midwife needs to know how to assess fetal heart rates, recognize and interpret fetal heart patterns, report any substandard patterns, and initiate supportive measures as necessary.

**Objective:** This study aims to assess the knowledge and attitudes of midwives concerning the interpretation and use of cardiotocographs.

**Materials and Methods:** This cross-sectional study involves 183 midwives working in maternity units across all Jordanian regions. An online survey was used to collect data, including 6 demographic questions, 10 questions about knowledge, and 25 questions about attitude. The data were analyzed using descriptive statistics (Mean±SD, No. [%]), ANOVA, and the Pearson correlation tests. The significance level was set to be <0.05.

**Results:** Most participants were 21 to 30 years old, and most midwives (59.6%) had no more than six years of experience. The result showed that the total scores for the knowledge and attitude regarding cardiotocographs (CTGs) interpretation and usage were 68.7% and 73.0%, respectively. There is a significant relationship between the knowledge about the interpretation and use of CTGs and the years of experience ( $P=0.003$ ), with higher knowledge scores among midwives with fewer than 6 years of experience. Furthermore, there is a significant relationship between the knowledge of CTGs and level of education ( $P=0.002$ ), indicating higher knowledge scores among midwives with a degree. The knowledge about classifying the CTG traces was significantly correlated with the region of work ( $P=0.018$ ), with higher scores among midwives from the southern region. Finally, there was a positive correlation between knowledge and attitude ( $r=0.007$ ,  $P<0.05$ ).

**Conclusion:** Based on the study result, the participant's knowledge and attitudes are not satisfactory; thus, comprehensive education and training should be prioritized to improve midwives' knowledge and attitudes toward using cardiotocograph.

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## Highlights

- During labor, midwives should assess fetal well-being, recognize fetal heart rate patterns, and initiate supportive measures if any pattern is unacceptable.
- The quality of midwifery skills in adopting cardiotocography (CTG) interpretation in clinical practice should be monitored regularly.
- Multi-professional collaboration should be promoted in interpreting CTG outputs and implementing interventions based on the findings.

## Plain Language Summary

Cardiotocography (CTG) is the most frequently used tool to monitor fetal well-being during pregnancy and childbirth. Midwives are mainly responsible for assessing pregnant women and assisting them in childbirth. A midwife should have ample knowledge of assessment and recognition of fetal heart rate patterns, report any non-reassuring patterns to an obstetrician, and initiate supportive measures when necessary. Therefore, CTG knowledge and skills should be taught, practiced, and clinically emphasized in all midwifery training programs in accordance with the existing national and international guidelines. However, our findings show that midwives have unsatisfactory knowledge and attitudes toward CTG utilization.

### Introduction

**F**etal well-being is the fundamental goal during pregnancy and labor. To reduce maternal and fetal adverse outcomes, non-invasive fetal monitoring during pregnancy and labor is extremely important, particularly in high-risk pregnancies [1, 2]. Cardiotocography (CTG) is a diagnostic technique that uses an electronic device to continuously monitor a woman's Fetal Heart Rate (FHR) and uterine activity. Recording this information on graph paper allows continuous monitoring of fetal well-being during labor and provides permanent documentation for medical records [3, 4].

Nowadays, most midwives and obstetricians use CTG monitoring in most labor rooms. It is one of the procedures expected to reduce neonatal morbidity and mortality [5]. Electronic fetal monitoring is used throughout the pregnancy for low-risk and high-risk women, based on the mother's and the fetus's condition [6]. FHR is a good indicator of fetal well-being in clinical practice, but its analysis is still poorly understood among midwives. Also, midwives fail to detect any signs of fetal compromise due to a lack of knowledge and skills in CTG or errors in interpreting CTG traces, causing incorrect decisions to perform a cesarean section, resulting in adverse maternal and fetal outcomes [7].

FHR monitoring is still an important clinical procedure, and CTG is the most frequently used tool. According to the International Confederation of Midwives (ICM), midwives are responsible for assessing women during pregnancy and assisting them during labor. A midwife should have ample knowledge of assessing FHR patterns, recognize and interpret fetal heart patterns, report any non-reassuring patterns to an obstetrician, and initiate supportive measures when necessary [8]. To fulfill this goal, all clinically active midwives should possess high interpretive skills and adequate knowledge [7]. Midwives have demonstrated inadequate CTG interpretation knowledge [7, 9]. There seems to be a lack of empirical data on attitudes toward CTG use in labor wards. Considering the importance of FHR monitoring in neonatal and maternal outcomes, there is a need to evaluate the knowledge of midwives regarding FHR through the correct interpretation of CTGs in hospitals and antenatal outpatient clinics. Thus, this is the first study to determine midwives' knowledge and attitudes regarding interpreting and using CTGs in Jordan.

### Materials and Methods

A cross-sectional study design was used. This study targeted all midwives from all Jordanian hospitals that provided health services to pregnant women throughout Jordan. It is impossible to present the total number of working midwives based on an official reference [10], considering that the questionnaires were distributed

through social media. Therefore, it is impossible to report the number of exact populations in the research community. The sample size was calculated using the G\*Power 3.0.10 analysis with a significant level of 0.05, a power of 80%, and a moderate effect size of 0.3 [11]. The power analysis gave a minimum sample size of 175 for an ANOVA test. Finally, the data were collected from a sample of 183 midwives.

A convenient sampling method was used for this study based on voluntary participation. To be eligible for inclusion, midwives must be clinically active with at least one year experience, work in maternity units, and be willing to participate.

The data collection tool consists of three sections. The first part includes the demographic data sheet with participant age, level of education, practice location, years of experience, any previous training course regarding CTG and its duration, and participants' multi-professional collaboration in interpreting CTG traces. The second part assesses midwives' knowledge of electronic fetal monitoring. The scale consists of 10 items, and every question is multiple-choice, asking to select one or more than one answer. For every correct answer, one point is granted. Scores below the fiftieth percentile were considered "poor knowledge," and scores above the fiftieth percentile were considered "acceptable knowledge" [12].

The third section consists of an attitude's questionnaire to assess participants' attitudes toward the CTG machine [13]. The scale is composed of 25 items on a 5-point Likert scale, with the options of "strongly disagree" (1), "disagree" (2), "undecided" (3), "agree" (4), and "strongly agree" (5). To ensure consistent scoring, negatively worded items were reverse-scored; it was considered a positive attitude towards CTG use when the score was 75 or higher (maximum score was 125).

For both questionnaires, the content and face validities were assessed by an expert panel of three PhD holders, and three clinically active midwives. Then, their recommendations, advice, and suggestions were implemented. Using the Cronbach  $\alpha$  coefficient, the  $\alpha$  levels were 0.79 for the knowledge part and 0.80 for the attitude part representing good reliability. The questionnaire was presented to the participants in its original form in English, as this is the language of education for all midwifery courses in Jordan. Permission to use the questionnaire was obtained from the authors.

The study data were collected through an online questionnaire. Invitations and an information sheet about the study and an electronic link to the questionnaire using Google Forms and post it via social media (i.e. Facebook, WhatsApp, and Messenger), social networking, and the Jordanian Nurses & Midwives Council (JNMC) website. The questionnaire was re-posted weekly for three months, from January to March 2022 to get enough responses.

Midwives were notified that participation in the study was voluntary and that they had the right to withdraw at any time without any consequences for their clinical practice. The participants were also informed about confidentiality, that there were no personal data identifiers, and that they needed to give their active, informed consent to participate in the study by pressing the "agree" button.

Data analysis was used by SPSS software, version 21 (SPSS Inc. Chicago, IL, USA). Frequency and percentages were used to describe the participants' profiles. Mean $\pm$ SD were used to describe their responses to questions. One-way analysis of variance was used to describe CTG knowledge based on midwifery's demographic profile. The Pearson correlation was used to determine the correlation between knowledge and attitude. The significance level was set for all tests to be  $<0.05$ .

## Results

A total of 180 midwives completed the survey. Most participants (57.9%) were young midwives aged 21–30, followed by 59 participants (32.2%) aged 31–40. Regarding midwifery clinical experience, most midwives had experience of fewer than 6 years (59.6%), while only 26.2% had an experience of 6–10 years. Besides, only 14.2% had an experience of more than 10 years. Moreover, most participants were from the central region of Jordan (47%), and participants from the northern and southern regions accounted for 27.3% and 25.7%, respectively. Table 1 presents more details.

Regarding education related to CTGs, most participants had received CTG education in their basic education (63.4%). In their work-related tasks, most participants have been trained on using CTGs (74.9%) in the current department, while the rest (25.1%) have not yet been trained on using CTGs in the department. Regarding CTGs, the majority of the participants (74.3%) were responsible for the interpretation of CTGs of normal deliveries. Regarding record management, almost all participants (85.8%) documented the CTG's interpretation

**Table 1.** Demographic profile of the participants (n=183)

Variables	No. (%)	
Age (y)	21–30	106(57.9)
	31–40	59(32.2)
	41–49	14(7.7)
	≥50	4(2.2)
Clinical midwifery experience (y)	<6	109(59.6)
	6–10	26(14.2)
	>10	48(26.2)
Region of work in Jordan	North	50(27.3)
	Central	86(47.0)
	South	47(25.7)
Level of education	Diploma in midwifery	118(64.5)
	BSN in midwifery	48(26.2)
	Master in maternity	17(9.3)
Type of hospital	Governmental hospital	95(51.9)
	Private hospital	37(20.2)
	Military hospital	39(21.3)
	Educational hospital	12(6.6)
Unit/Ward	Labor unit	136(74.3)
	Postpartum	31(16.9)
	Antenatal OPD	16(8.7)

OPD: Outpatient Department.

in the patients' medical records. Regarding the CTG interpretation, the results showed that more than half of the participants (55.7%) practiced regular team-based interpretation of CTGs. Similarly, the number of participants who practiced multi-professional interpretation of specific cases' CTG was almost similar to those who did not (51.9% and 48.1%, respectively).

The total scores for the knowledge of CTGs showed that 68.7% of the participating midwives had adequate knowledge, while the remaining 31.3% reported poor knowledge (Table 2). Midwives' knowledge about CTGs according to their experience, level of education, and region of work are presented in Table 3. Based on this information, the mean knowledge score according to neurological defect and years of experience was signifi-

cant ( $P=0.003$ ), with higher knowledge scores among midwives with fewer than 6 years of experience. Furthermore, the mean score of knowledge according to APGAR score, acceleration, and risk of acidosis and the level of education was significant ( $P=0.002$ ), indicating higher knowledge scores among midwives with a degree. In addition, the mean knowledge score in classifying the CTG traces was significantly correlated with the region of work ( $P=0.018$ ), with higher scores among midwives from the southern region. Table 4 presents that the overall mean score of midwife's attitudes for the sample was  $55\pm 9.6$  out of 75 (equivalent to 73%).

The results showed that 41% of the midwives agreed that CTGs could lead to unnecessary medical intervention, while 62.8% agreed that they could not imag-

**Table 2.** Knowledge level of CTG among midwives (n=183)

Variables	No. (%)	
	Poor Knowledge	Acceptable Knowledge
Normal range and determinants of FHR baseline	96(52.5)	87(47.5)
Normal range and determinants of FHR variability	67(36.6)	116(63.4)
Key characteristics of a reactive NST	46(25.1)	137(74.9)
Variable decelerations	67(36.6)	116(63.4)
Late decelerations	0(0)	183(100)
Severe bradycardia in the second stage of labor	23(12.6)	160(87.4)
Progressive hypoxia and metabolic acidosis during labor	6(3.3)	177(96.7)
High risk for neurological defect	84(45.9)	99(54.1)
APGAR score and accelerations before delivery	90(49.2)	93(50.8)
Classifying the CTG traces	93 (50.8)	90 (49.2)

Abbreviations: FHR: Fetal Heart Rate; NST: Non-stress Test; CTG: CardioTocograph.

ine working without a CTG being available in case an emergency arises. Most participants (62.8%) thought CTGs were a major benefit to midwives, while only 9.3% agreed. Regarding the opinion that CTGs are vital in helping a midwife decide when medical intervention is needed, 61.2% disagreed, 22.4% were undecided, and only 16.4% agreed. Results from the Pearson correlation indicated that the mean knowledge score and the mean attitude score were positively correlated ( $r=0.007$ ,  $P<0.05$ ).

## Discussion

This research assessed midwives' knowledge and attitudes regarding using and interpreting CTGs. The results indicated that midwives' knowledge was poor regarding the normal range and determinants of the FHR baseline; however, they had acceptable knowledge about the normal range and determinants of FHR variability. Similarly, midwives reporting adequate knowledge about the key characteristics of a reactive non-stress test (NST) based on CTG were more than those with poor knowledge. Furthermore, the midwives' attitudes differed, with a majority disagreeing on the importance of using CTG in induced labor, its importance in helping the midwife decide on medical interventions, its major benefits, and the use of CTGs.

Several studies show that midwives who receive CTG in-service training gain a greater understanding of CTG practice [14, 15]. The study results were surprising: Although most participating midwives had received CTG-related education and were trained in using CTGs in the current department, they demonstrated an inability to correctly interpret CTGs. This finding demonstrates less adequate knowledge about one of the most difficult challenges in clinical practice: interpreting the FHR patterns [16]. As a measure of competency for quality care and a critical adjunct to midwives' existing knowledge and abilities, midwives working in delivery units should be familiar with FHR monitoring and assist in safer delivery [17]. Furthermore, because the midwife has primary responsibility for promoting normal pregnancies and births, knowledge about the lack of intrapartum CTG monitoring and its associated impact on increased risks for newborn mortality should be developed and emphasized in midwifery education and practice [18]. As a result, further studies should be conducted on the quality of midwifery education and continuous assessment of their implementation strategies.

Participants' demographics were expected to influence CTG knowledge. Considering the participants' experience level, CTGs were assumed to be familiar. The midwives in the current study were qualified, advanced-practice midwives. Over a third of the participants had spent most of their careers in labor wards.

**Table 3.** Midwives' knowledge about CTG according to their experience, level of education, and region of work (n=183)

Items	Experience in Years				Level of Education			P*
	Mean±SD			P*	Mean±SD			
	<6 (n=109)	6–10 (n=26)	>10 (n=48)		Diploma (n=118)	BSN (n=48)	Master (n=17)	
Normal range and determinants of FHR baseline	54.9±19.3	57.1±20.2	55.9±18.7	0.864	53.1±19.6	58.7±18.5	62.7±17.2	0.063
Normal range and determinants of FHR variability	61.3±19.9	65.4±21.6	59.6±21.6	0.510	60.5±19.8	63.3±22	62.4±22.2	0.713
Key characteristics of a reactive NST	64.2±13.8	62.8±17.2	67.7±11.6	0.243	65.1±13.8	64.9±13.4	63.7±15.9	0.929
Variable decelerations	75.8±16.7	75.8±14.4	75.3±14.4	0.984	75.1±16.4	75.0±14.9	81.5±12.1	0.272
Late decelerations	89.3±7.6	88.5±8.1	89.9±7.2	0.738	88.7±7.2	90.2±8.4	90.8±7	0.380
Severe bradycardia in the second stage of labor	76.9±17.7	77.9±16.7	74.7±20.4	0.720	75.1±19.3	77.9±16.6	82.4±14	0.259
Progressive hypoxia and metabolic acidosis during labor	73.9±18.4	70.0±18.1	75.8±19.8	0.441	73.2±18.3	75.0±20.4	75.3±16.6	0.814
High risk for neurological defect	59.6±49.3	23.1±43	58.3±49.8	0.003	52.0±50.2	64.6±48.3	41.2±50.7	0.172
APGAR score, accelerations, and risk of acidosis	46.8±50.1	69.2±47.1	50.0±50.5	0.121	59.3±49.3	29.2±45.9	52.9±51.4	0.002
Classifying the CTG traces	48.6±50.2	50.0±51	50.0±50.5	0.984	50.8±50.2	45.8±50.4	47.1±51.4	0.831
Total score	69.6±6.3	69.0±5.4	69.8±5.4	0.847	68.7±5.8	70.7±6.2	72.3±4.8	0.016

  

Items	Region of Work			P*
	Mean±SD			
	North (n=50)	Central (n=86)	South (n=47)	
Normal range and determinants of FHR baseline	53.3±17.8	54.5±20.4	59.6±18.6	0.227
Normal range and determinants of FHR variability	60.0±18.1	64.0±21	58.3±22	0.270
Key characteristics of a reactive NST	68.3±11.8	64.7±13.9	61.7±15.1	0.059
Variable decelerations	75.1±17.7	75.6±15	76.3±15	0.937
Late decelerations	90.0±7.8	88.4±6.4	90.3±9	0.284
Severe bradycardia in the second stage of labor	79.8±14.7	77±18.0	72.1±21.4	0.109
Progressive hypoxia and metabolic acidosis during labor	78.4±17.1	71.9±20.7	72.8±15.8	0.129
High risk for neurological defect	52.0±50.5	54.7±50.1	55.3±50.3	0.939
APGAR score, accelerations, and risk of acidosis	52.0±50.5	50.0±50.3	51.1±50.5	0.975
Classifying the CTG traces	38.0±49	46.5±50.2	66.0±47.9	0.018
Total score	70.3±6.1	69.3±5.2	69.1±6.8	0.526

Abbreviations: FHR: Fetal Heart Rate; NTS: Non-Stress Test; CTG: Cardiotocograph. \*ANOVA.

**Table 4.** Attitudes toward CTG usage (n=183)

Item Statements	No. (%)		
	Disagree & Strongly Disagree	Agree & Strongly Agree	Undecided
1- I believe cardiocographs (CTGs) can lead to unnecessary medical intervention	75(41.0)	38(20.8)	70(38.2)
2- I could not imagine working without a CTG being available in case an emergency arises	29(15.8)	39(21.3)	115(62.8)
3- I feel CTGs are so routine that they are virtually invisible during birth	57(31.1)	64(35.0)	62(33.9)
4- I do not like using CTGs	94(51.4)	43(23.5)	46(25.1)
5- I think using any technology in childbirth is undesirable	77(42.1)	54(29.5)	52(28.4)
6- I think CTGs undermine my skills	46(25.1)	62(33.9)	75(41.0)
7- I like using CTGs	108(59.0)	54(29.5)	21(11.5)
8- I believe that using a CTG increases a mother's anxiety	76(41.5)	65(35.5)	42(23.0)
9- I feel I can routinely monitor the CTG signals without being distracted by the mother	87(47.5)	64(35.0)	32(17.5)
10- I think CTGs are a major benefit to midwives	115(62.8)	51(27.9)	17(9.3)
11- I believe CTGs can give rise to the wrong decisions being made	68(37.2)	54(29.5)	61(33.3)
12- I only use a CTG when it is necessary	67(36.6)	47(25.7)	69(37.7)
13- I think the CTG distracts attention away from the mother	61(33.3)	66(36.1)	56(30.6)
14- I always trust the CTG's readouts over my observations	21(11.5)	75(41.0)	87(47.5)
15- I think medical colleagues rely too much on CTGs	95(51.9)	61(33.3)	27(14.8)
16- I believe midwives' skills are undermined by over-reliance on CTGs	74(40.4)	67(36.6)	42(23.0)
17- I think CTGs are vital in helping a midwife decide when medical intervention is needed	112(61.2)	41(22.4)	30(16.4)
18- I feel vulnerable if a CTG is not available	33(18.0)	71(38.8)	79(43.2)
19- I rely on the CTG when I am not sure what is happening	44(24.0)	49(26.8)	90(49.2)
20- I think CTGs spoil the beauty of a birth	56(30.6)	53(29.0)	74(40.4)
21- I do not feel entirely confident in my ability to use a CTG	71(38.8)	45(24.6)	67(36.6)
22- I believe CTGs are essential for ensuring safe deliveries	30(16.4)	49(26.8)	104(56.8)
23- I always trust my judgment even when the CTG gives contrary indications	91(49.7)	48(26.2)	44(24.0)
24- I believe CTGs are essential when labor is being induced	105(57.4)	57(31.1)	21(11.5)
25- I feel that CTGs are often used unnecessarily	54(29.5)	46(25.1)	83(45.4)



According to the definition of advanced midwifery, this practitioner provides excellent care during pregnancy, childbirth, and postpartum [8]. As a result, participants were supposed to be aware and knowledgeable about FHR monitoring. Relying on other professionals, such as obstetricians, to interpret and approve normal or abnormal findings of the CTGs might have contributed to the reduced engagement and thus limited the knowledge about CTG interpretation [19].

Our study demonstrated significant differences between experienced and less experienced midwives regarding their knowledge about the high risk for neurological defects and the chance for acidosis. This interesting finding highlights the possible dangers the fetus might face if the assisting midwife lacks this basic knowledge. Although intrapartum CTG has been related to reduced infant convulsions and hypoxia, it is still utilized to identify asphyxiation [20]. Thus, the correct interpretation of CTGs is a basic expected level of knowledge for childbirth-assisting personnel. Further, misinterpreting CTG data could undermine midwives' ability to make informed decisions or decide to act independently. The lack of familiarity with CTGs among midwives is a cause for concern. A variation in the FHR is something clinicians should be aware of [21], as the failure to recognize faulty FHR tracings and to perform adequate FHR analysis has been reported as a major cause of fetal mortality [22].

The correlation between knowledge and attitudes is well-studied. The midwives' attitudes in the current study were unfavorable toward the use and importance of CTGs in clinical practice. The midwives reported disagreement with statements regarding the importance of CTGs in induced labor, in helping the midwife's decision-making, benefits to the midwife, and the use of CTGs. Our findings contradict previous studies reporting more positive attitudes and satisfaction with using CTG technologies [13, 23]. The current study's results might explain the low knowledge scores reported by the participating midwives, especially since there is evidence about the effect of training on supporting midwives in using CTGs [23]. Furthermore, midwives who trust machines are more disposed to their use, and trust is affected by perceived competence [13, 23]. Considering the contradicting findings and alarming results of the current study, further research is highly recommended to investigate the professional needs and possible reasons for the lack of knowledge and sound attitudes toward using CTGs among midwives in Jordan. A qualitative approach could help gain an in-depth understanding of the experiences faced by these highly specialized professionals to plan relevant educational material and

awareness campaigns about the importance of implementing the available technology (CTG) for enhancing maternal healthcare services and preventing unnecessary adverse outcomes.

There are some limitations to take into account when interpreting the results. We adopted a cross-sectional design and used an online survey as the main data collection technique, which limits the generalisability based on the nature of self-reported data, with possible over- or under-estimation of participants' knowledge [24]. In addition, the response rate was not calculated because we could not access the actual number of clinically active midwives. However, online surveys produce a lower response rate than other types of surveys by 11%–12% [25]. Repeating the study using a paper-based survey would be recommended. Another possible limitation of this study might be related to the survey completion period, which imposed a constrained data collection period, resulting in fewer participants. Future studies might need to consider a more inclusive number of participants to better reflect all regions.

Based on this study's results, comprehensive education and training should be prioritized to improve midwives' knowledge and attitudes toward this technique (CTG). Training and development of CTG utilization thus serve as a critical component in equipping midwives with the required competency in maternal care. In addition, future studies could focus on the existing training programs and how to enhance their utilization, the midwives' perception of their current practices, and the possible facilitators and barriers to the proper utilization of CTGs.

## Ethical Considerations

### Compliance with ethical guidelines

Ethical approval was granted by the Ethics and Academic Research Committee at the Faculty of Nursing, [Mutah University](#) (No.: SREC-6-2021). Participants were notified that participation in the study was entirely voluntary and that they had the right to withdraw at any time without any consequences for their clinical practice. The participants were also informed about confidentiality, that there were no personal data identifiers, and that they needed to consent to participate in the study by pressing the "agree" button. This study is not expected to involve any psychological, social, physical, or legal risks of harm to participants.



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## Authors' contributions

Conceptualization: Arwa Alsaireh; Data collection, analysis, and drafting of the manuscript: Dalal Yehia, Arwa Alsaireh; Drafting the result and discussion section: Atika Khalaf and Arwa Alsaireh; Critical review of the manuscript and Final approval: All authors.

## Conflict of interest

The authors declared no conflict of interest.

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