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Exploring antenatal exercise: Knowledge, attitudes, and practices among pregnant women in KSA

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الملخص

أهداف البحث: قد يؤدي الخمول أثناء الحمل إلى آثار سلبية، مثل زيادة خطر الولادات القيصرية. تماشيا مع التحول الصحي في المملكة العربية السعودية، يُمكن أن تساعد معرفة ممارسة التمارين الرياضية قبل الولادة بين النساء السعوديات الحوامل في تعزيز صحة الأفراد، والتركيز على الرعاية الوقائية، وتحسين خدمات الرعاية الصحية الأولية للأمومة. تهدف هذه الدراسة إلى تقييم مستويات معرفة النساء السعوديات الحوامل ومواقفهن والتزامهن بتوصيات الكلية الأمريكية لأطباء التوليد وأمراض النساء حول ممارسة التمارين الرياضية قبل الولادة، والارتباطات بينها.

طرق البحث: أُجريت دراسة استطلاعية مقطعية باستخدام استبانة ذاتية الإبلاغ. واستُخدمت طريقة أخذ العينات المريحة لإدراج 254 امرأة سعودية حامل، ممن راجعن العيادات الخارجية أو عيادات المرضى الداخليين في مستشفى جامعي ومركز طب الأسرة والمجتمع في الدمام، في الفترة بين 1 أبريل و3 أغسطس 2023. شملت معايير الإدراج النساء السعوديات الحوامل، اللواتي تتراوح أعمارهن بين 18 و45 عاما، ولديهن جنين واحد على قيد الحياة في أي عمر من الحمل.

النتائج: بلغ معدل الاستجابة 94.4%. والتزمت 15.5% فقط من المشاركات بإرشادات الكلية الأمريكية لأطباء النساء والتوليد لممارسة التمارين الرياضية قبل الولادة. وبلغ متوسطمقياس المعرفة الكلية لممارسة التمارين الرياضية قبل الولادة 20.4±5.1، ومتوسطمقياس الموقف 10.4±2.7. وارتبط الالتزام بإرشادات الكلية الأمريكية لأطباء النساء والتوليد بمتوسطات أعلى للمعرفة الكلية والمعرفة العامة والمعرفة بالفوائد ومقاييس الموقف مقارنةً بمن لم يلتزمن. وأظهر الانحدار اللوجستي أن زيادة احتمالية الالتزام بإرشادات الكلية الأمريكية لأطباء النساء والتوليد ارتبطت ارتباطا إيجابيا بارتفاع درجات الموقف تجاه ممارسة التمارين الرياضية قبل الولادة.

الاستنتاجات: كان الالتزام بإرشادات الكلية الأمريكية لأطباء النساء والتوليد لممارسة التمارين الرياضية قبل الولادة منخفضا، وتأثر بموقف النساء، مما يُبرز الحاجة إلى برامج تثقيفية.

الكلمات المفتاحية: الحمل؛ ممارسة التمارين الرياضية؛ المعرفة؛ الموقف؛ رعاية ما قبل الولادة؛ المملكة العربية السعودية؛

Abstract

Objectives: Sedentary behavior during pregnancy may have adverse effects, such as an increased risk of operative deliveries. In alignment with the health transformation in KSA, exploring antenatal exercises among pregnant Saudi women can help promote individual well-being, emphasize preventive care, and improve primary maternity healthcare services. This study aimed to assess levels of knowledge, attitudes, and adherence to the American College of Obstetricians and Gynecologists (ACOG) antenatal exercise recommendations among pregnant women in KSA, and their associations.

Method: An exploratory cross-sectional study was conducted using a self-reported questionnaire. Between April 1 and August 3, 2023, a convenience sampling method was used to recruit 254 pregnant Saudi women who attended outpatient clinics or inpatient wards at a university hospital and family and community medicine center, Dammam, KSA. Inclusion criteria were pregnant

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Saudi women, aged 18–45 years, with a single live fetus at any gestational age in pregnancy.

Results: The response rate was 94.4 %. Only 15.5 % of the participants adhered to ACOG antenatal exercise guidelines. The mean antenatal exercise total knowledge scale score was 20.4 ± 5.1 (0–30) and the mean attitude scale score was 10.4 ± 2.7 (0–15). Adherence to ACOG exercise guidelines was associated with higher mean total knowledge, general and benefit knowledge, and attitude scale scores compared with those who did not adhere. Logistic regression analysis showed that an increased likelihood of adherence to antenatal exercise guidelines was positively correlated with higher scores for attitude toward antenatal exercise.

Conclusion: Adherence to ACOG antenatal exercise guidelines was low and influenced by the attitudes of women, highlighting the need for educational programs.

Keywords: Antenatal care; Attitude; Exercise; Knowledge; KSA; Pregnancy

Introduction

During pregnancy, physical activity is beneficial for maintaining health, reducing complications, and facilitating childbirth.[1–3] However, a large proportion of women tend to be inactive or reduce their physical activity throughout pregnancy.[4–7] In KSA, less than 46 % of pregnant women exercise.[8,9] Antenatal exercise is recommended in the Saudi antenatal care guidelines, but there are no antenatal exercise guidelines in KSA. In addition, there are gaps in the antenatal exercise recommendations provided by credible organizations,[10] such as the recommended duration of antenatal exercise per week. In this context, the Saudi Ministry of Health introduced a healthcare transformation strategy to fulfill the Saudi 2030 vision. The transformation strategy identified gaps in primary care services, such as a lack of protocols and standardized clinical guidelines.[10] The strategy introduced a new care model that aims to empower individuals by informing them and using preventive rather than curative approaches. The new care program model emphasizes providing health education programs and having a safe birth, including improving maternity care services.[10] Consequently, exploring antenatal exercise in pregnant Saudi women is beneficial for assessing the current situation. The findings obtained can help improve maternity care services by developing evidence-based antenatal exercise educational programs that promote normal birth and emphasize preventive measures. The current study aimed to explore the levels of knowledge, attitude, and practice (KAP) regarding the American College of Obstetricians and Gynecologists (ACOG) recommended exercise guidelines among pregnant Saudi women.

Physical activity and exercise overlap due to the engagement of muscular activity, but they vary in terms of their structure and objective.[11,12] It is essential for pregnant women to differentiate between exercise and physical activity to manage their time and efforts effectively. For example, studies have shown that a significant number of pregnant women prioritize housework over exercise due to the demanding nature of household chores.[9,13] The American Pregnancy Association defines physical exercise during pregnancy as bodily activity to improve or maintain a pregnant woman's physical health.[14] The World Health Organization (WHO) defines physical activity as body movements involving muscle contractions that increase energy consumption, including exercise.[15] Furthermore, exercise is a subtype of physical activity defined as planned movement with purpose and organization.[11,12,16] International health services such as the WHO, ACOG, US Department of Health and Human Services (US-DHHS), and UK National Health Service recommend exercising during pregnancy to maintain health and reduce the risks of health problems.[1,15,17,18] Guidelines recommend pregnant women without pregnancy complications or risk to practice mild to moderate intensity exercise for at least 150 min per week.[1,17–19] Furthermore, ACOG guidelines suggest that non-active women should gradually increase their daily exercise routine up to 30 min and then progress to 30 min five times per week.[1] The current study followed the ACOG guidelines due to their international recognition and acceptance.

Physical exercise among pregnant women in KSA

Low exercise levels among the female population in KSA can lead to low levels of exercise practice during pregnancy. In this context, an exercise practice assessment of the general female population in KSA found that the majority were inactive, with 88.7 % and 77 % in 2019 and 2021, respectively.[20–22] The KSA General Authority for Statistics census followed the WHO recommendations that adults should practice physical activity at least 150 min per week to be considered physically active, and less than that was considered inactive.[21] The WHO and ACOG recommend that pregnant and non-pregnant women engage in mild to moderate exercise for at least 150 min per week.[1,15] Subsequently, most pregnant women were found to be inactive. The available studies conducted in KSA showed that less than 46 % of pregnant women exercised for at least 150 min per week.[8,9,23] In addition, most pregnant women practiced walking for exercise.[8,24]

Physical exercise associated factors during pregnancy

Women's knowledge of antenatal exercise

The Saudi Ministry of Health's website provides antenatal physical activity and exercise health educational content, which aligns with ACOG recommendations.[1,25,26] However, it lacks information regarding the weekly exercise duration, benefits, and contraindications.[25,26] Informing women about antenatal exercise includes general information (e.g., safe exercise types such as walking, aerobics, and stretching), exercise benefits (e.g., reducing pregnancy-induced problems and preparing for normal

childbirth), precautions (e.g., drinking water, avoiding hot weather, and prolonged lying on the back), and dangerous signs or contraindications (e.g., vaginal bleeding, dizziness, and headache).[1,17,18,27–29]

Previous studies of antenatal exercise knowledge among Saudi women indicated satisfactory knowledge levels, but the use of different scales means that the assessments are not comprehensive.[8,13,23,30] Alaglan et al.[8] reported a mean total knowledge scale score (standard deviation (SD)) of 77.7 (9.7) and a range of 40–95, but did not provide further details. Al-Youbi and Elsaid[30] developed their own tool to assess knowledge of exercise types and benefits among pregnant women, and reported that walking was the most widely known type of exercise. Using the antenatal exercise KAP assessment tool, Al-Rowais et al.[23] found that 84.7 % of the participants incorrectly agreed that they needed to drink plenty of caffeine while exercising as a precaution, and Gari et al.[13] found that 33.4 % did not know exercise can help reduce the risk of gestational diabetes. Unexpectedly, social media was the most widely used source for acquiring information about antenatal exercise.[8,31] These previous studies of women's knowledge of antenatal exercise lacked depth, making it challenging to draw definitive conclusions.[8,13,23,30]

Attitudes of women toward antenatal exercise

The findings obtained in previous studies in KSA indicate that women have a favorable attitude toward antenatal exercise but the assessment approaches differed.[8,13,23] Alaglan et al.[8] reported that 86 % of pregnant women believed in the importance of antenatal exercise. Using the antenatal exercise attitude scale, Al-Rowais et al.[23] found that most women considered that antenatal exercise can facilitate normal delivery. However, Gari et al.[13] obtained inconsistent results, where 70.7 % of the participants believed that antenatal exercise is important, 45.9 % believed that it is not a priority, and 40.8 % believed that household activities are sufficient. The different assessment and reporting methods make it difficult to comprehensively understand the attitudes of women toward antenatal exercise in KSA.

Adherence to antenatal exercise an associations with Women's knowledge and attitudes

In KSA, the associations between knowledge, attitudes, and practices regarding antenatal exercise have rarely been studied, although Alaglan et al.[8] found an association between the practice of exercise and attitudes toward antenatal exercise (viewing it as important).

Research problem

Studies in KSA indicate that despite women having adequate knowledge and favorable attitudes toward antenatal exercise,[23,30] their actual practices during pregnancy remain inadequate and do not meet the recommended guidelines.[13,23,30]

Comprehensiveness assessments of antenatal exercise in KSA are lacking and definitive conclusions cannot be made based on previous studies. Therefore, as part of a larger investigation to assess antenatal exercise and associated factors among Saudi women, the present study aimed: (1) to explore the levels of knowledge, attitudes, and adherence to ACOG guidelines among pregnant Saudi women; and (2) to examine the associations of demographic characteristics, knowledge, and attitudes with adherence to ACOG guidelines in this population.

Materials and Methods

Theoretical framework

No single theory or model can capture all the factors that influence antenatal exercise. The present study was based on the Theory of Planned Behavior (TPB) and complemented by KAP surveys as a theoretical framework[32–36] (Figure 1).

Study design and setting

The present study used an exploratory, descriptive, and cross-sectional design with a target population of pregnant women in KSA. Participants were recruited via convenience sampling from those under antenatal care at outpatient clinics or as inpatients at King Fahad University Hospital (KFUH) and the Family and Community Medicine Center (FCMC), Imam Abdulrahman bin Faisal University (IAU). The KFUH is a government-run hospital that provides free maternity healthcare to citizens referred to by any primary healthcare center in the Eastern Province. The FCMC is a primary healthcare center that includes a maternity outpatient clinic serving IAU-affiliated personnel, their families, and current and graduate students. The FCMC is linked with KFUH to ensure comprehensive care.

The study inclusion criteria were women aged 18–45 years, literate in Arabic, and pregnant with a single, naturally conceived, living fetus at any gestational age. Exclusion criteria were anyone pregnant with: (1) a high-risk pregnancy (e.g., multiple pregnancy or low-lying placenta); (2) a medical problem impacting physical activities, excluding diabetes mellitus (e.g., heart disease or asthma); (3) psychological conditions (e.g., anxiety); or (4) mental or physical disability. The sample size was calculated to assess multivariate relationships among demographic characteristics, knowledge, attitudes, and practices using logistic regression analysis. Using a ratio of 15 cases per predictor,[37] the required sample size was 210 participants. However, 10 % was added to the sample size to account for potential missing data for key study variables and to ensure a robust sample.[37] The final sample size of 254 participants was collected from April 1, 2023, to August 3, 2023.

Recruitment and data collection procedure

Institutional review board approvals and approvals from data collection sites were secured. All Saudi women who attended the maternity care outpatient clinics (in the hospital and primary care center) or were admitted to the inpatient wards (in the hospital) between the ages of 18 and 45 years underwent a two-step screening process at the sites for selecting participants, starting with the nurse identifying pregnant women from outpatient and inpatient registration lists (if the pregnancy condition was clear) and informing the primary researcher, who was responsible for data collection. Second, if the pregnancy status was unclear, women were directly asked if they were pregnant. Confirmed pregnancies

received a flyer outlining inclusion and exclusion criteria, and if eligible, participants were provided with a consent form. If they agreed to participate, informed consent was discussed and the parts of the questionnaire were explained, addressing any questions raised by the participants. They were informed that the estimated time required for completing the questionnaire was 15–20 min. They were informed that participation was voluntary, and they could withdraw at any time for any reason without affecting their healthcare service. Next, a pen-and-paper, de-identified, self-reported questionnaire was handed to each participant. In the outpatient clinics, the participants had the choice to complete the questionnaire in the waiting area or a private area. In the inpatient wards, the participants completed the questionnaire in their beds. The researcher was available to answer any questions. After completion, the questionnaire was returned to the researcher, who thanked the participants and gave them antenatal exercise educational flyers. The completed questionnaires were stored in an envelope in a locked computer bag.

Measures

The dependent variable in this study was adherence to the ACOG antenatal exercise guidelines, which was measured in minutes per week and categorized into two activity levels according to adherence to the ACOG recommended guidelines: "*adhered to the guidelines*" if exercise was performed for ≥150 min per week, and "*did not adhere to the guidelines*" if exercise was performed for <150 min per week or not performed at all. In the present study, adherence to ACOG guidelines did not align with ACOG's recommendations[1] because non-active women who started exercising gradually during pregnancy were categorized as not adhering if they did not exercise for at least 150 min per week.

The independent variables included sociodemographic characteristics, and knowledge and attitudes of women regarding antenatal exercise. Sociodemographic characteristics were measured on categorical (i.e., academic level, employment, and family arrangement) and continuous levels (i.e., age, gravidity, number of children, gestational age, and exercise before pregnancy), which were then categorized for analysis. Exercise before pregnancy was measured in minutes per week and then categorized according to the US-DHHS[18] into "*adhered to the guidelines* if exercising ≥150 min/week" and "*did not adhere to the guidelines* if exercising <150 min/week or not exercising at all." The knowledge and attitudes of women regarding antenatal exercise were measured using scales and subscales.

In the present study, a modified measurement tool consisting of five subsections was used to collect data about antenatal exercise and associated factors. The modified measurement tool for assessing knowledge, attitudes, and adherence to the ACOG guidelines was derived from that described by Janakiraman et al.,[34] which is open for use and modification online, and the reliability of the tool was demonstrated by testing–retesting (1 week apart) with a reported interclass coefficient of 0.96. The measurement tool was cross-culturally translated into Arabic in KSA by Al-Rowais et al.,[23] and the permission of the authors to adapt and utilize their Arabic-translated instrument was obtained through e-mail. The modifications included shortening the knowledge and attitude scales, and an in-depth assessment of the factors that influence antenatal exercise based on previous studies. The modified questionnaire consisted of 61 items and the components were arranged into five parts: women's background characteristics (seven items requiring the selection of suitable responses), general information about antenatal exercise (seven items, with a mixture of open-ended and yes or no responses), women's knowledge scale (30 items scored on a three-point Likert scale, with a total score of 60), women's attitude toward antenatal exercise scale (15 items, with yes (a score of 1) or no (a score of 0) responses, and a total score of 15), and women's antenatal exercise practice (two items, with a mixture of open-ended and yes or no responses) (see Appendix A). The women's knowledge scale comprised three responses initially scored as "yes" with 2, "no" with 1, or "I do not know" with 0. The scoring of the responses was then modified to scores of "yes" with 1, and "no" and "I do not know" merged under the "no" category with a score of 0 for statistical analysis. These changes meant that the total scale was scored out of 30. The overall knowledge scale, knowledge subscales, and attitude scale were evaluated utilizing continuous levels of measurement. Higher scores on the scales indicated greater knowledge and a more favorable attitude.

The forward-backward translation and face validity of the modified questionnaire were evaluated by four bilingual (Arabic and English) experts, one of whom was a nurse maternity specialist. The translators' suggestions for modification were considered, and among their suggestions, the most familiar words to the public were selected after discussion with the translators. Furthermore, comprehensibility and content validation for cultural relevance were assessed with a sample of six Saudi women volunteers. The questionnaire was administered in Arabic in the study.

Data analysis

The collected data were reviewed and coded for data analysis using the Statistical Package for the Social Sciences (SPSS) version 29. Furthermore, in the knowledge and attitude scales, negative questions were reversed during statistical analysis (Table 2). Descriptive statistics were used for the sample characteristics, and the levels of Saudi women's antenatal adherence to ACOG exercise guidelines, knowledge, and attitude were assessed using frequencies, valid percentages, means, SDs, and ranges. Independent *t*-tests and Chi-square tests were conducted to assess the bivariate associations between demographical characteristics, knowledge, attitude, and adherence to ACOG antenatal exercise guidelines among Saudi women. Simultaneous logistic regression analysis was also performed to assess multivariate relationships. Statistically significant differences were accepted at a significance level of $p < 0.05$.

Results

Sample characteristics

This study included a sample of 254 pregnant women. A small percentage of missing data was found for all variables, i.e., less than 5 % (total of 1–3 missing for all variables). The

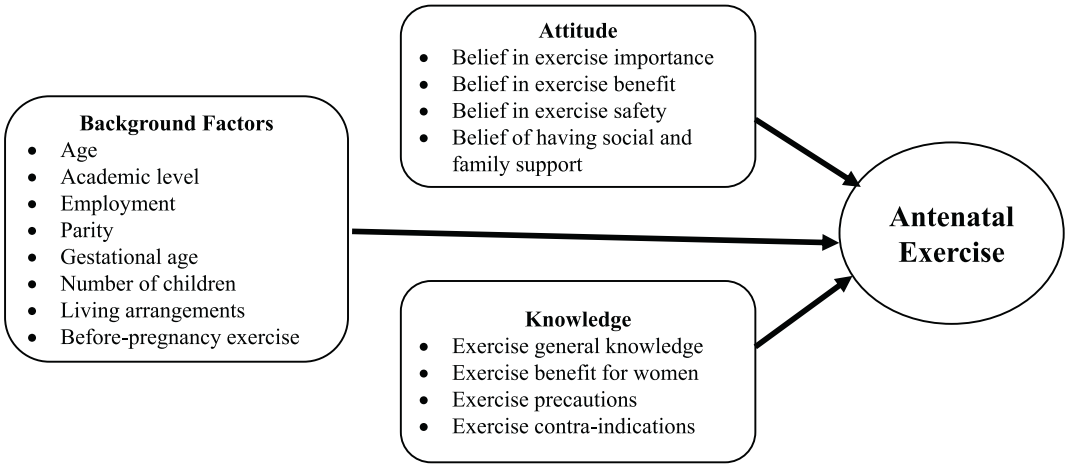

Figure 1: Conceptual model for assessing knowledge, attitudes, and practice of antenatal exercise among Saudi women.

mean age (SD) of participants was 31.0 (5.77) years and the majority were aged 30 years or more (59.4 %). Among the participants, 66.9 % had a bachelor's degree or higher level of education, 59.5 % were not employed, 77.2 % were multigravida, 70.5 % had one child or more, 58.5 % were in their third trimester, and 61.0 % lived in a nuclear family with children. A small percentage (17.0 %) received counseling about antenatal exercise practice. Most mothers (82.8 %) did not know the recommended duration of antenatal exercise. Before pregnancy, 63.4 % of the participants practiced exercise, and 60.9 % did not adhere to the guidelines (Table 1).

Level of adherence to antenatal exercise practice guidelines

Assessment of antenatal exercise practice showed that 66.1 % of pregnant Saudi women did not practice exercise during their current pregnancy, and 84.5 % did not adhere to the antenatal exercise practice guidelines (Table 2). Most

Table 1: Sample characteristics (N = 254).

Background Characteristics	N (%)	Mean (standard deviation), Range
Age (years)		31.0 (5.77), range: 19–44
29 years or less	103 (40.6)	
30 years or more	151 (59.4)	
Academic level		
High school or less	84 (33.1)	
Bachelor or more	170 (66.9)	
Employment		
Not employed	151 (59.4)	
Employed	90 (35.4)	
Working from home	13 (5.1)	
Gravidity		
Primigravida	58 (22.8)	
Multigravida	196 (77.2)	
Total number of children		
No child	75 (29.5)	
One child or more	179 (70.5)	
Current gestational age (weeks)[a]		
0–13 weeks (1st trimester)	29 (11.5)	
14–26 weeks (2nd trimester)	76 (30.0)	
27 or more weeks (3rd trimester)	148 (58.5)	
Family arrangement		
Nuclear family without children	65 (25.6)	
Nuclear family with children	155 (61.0)	
Extended family	34 (13.4)	
Counseled about antenatal exercise[a]		
No	210 (83.0)	
Yes	43 (17.0)	
If yes, who provided the counseling?[a]		
Doctor	36 (87.8)	
Nurse	5 (12.2)	

Table 1 (*continued*)

Background Characteristics	N (%)	Mean (standard deviation), Range
What is the recommended duration of exercise during pregnancy?[a] (minutes per week)		
Do not know	207 (82.8)	
Know	43 (17.2)	134.6 (76.5), range: 30−360
Incorrectly identified	22 (51.2)	
Correctly identified	21(48.8)	203.3 (59.3), range: 150−360
Exercise practice before pregnancy		
No	93 (36.6)	
Yes	161(63.4)	
Exercise adherence to guidelines before pregnancy		137.4 (163.7), range: 0−840
Exercise duration ≥150 min/week	97 (39.1)	301.1 (145.8), range: 150−840
Exercise duration <150 min/week	151 (60.9)	32.3 (45.5), range: 0−135

[a] Missing N data count ranged from 1 to 3.

participants practiced antenatal exercise by walking (97.7 %), aerobic exercises (47.7 %), and stretching exercises (34.9 %) (Table 2).

Knowledge level of women

The mean total level of knowledge about antenatal exercise (SD) was 20.4 (5.1), with a range between 0 and 30. The knowledge scale consisted of four subscales: general knowledge with a mean (SD) of 6.2 (2.1) and range between 0 and 10, benefits knowledge with a mean (SD) of 5.6 (1.7) and range between 0 and 7, precautions knowledge with a mean (SD) of 3.0 (1.1) and range between 0 and 4, and dangerous signs knowledge with a mean (SD) of 5.7 (2.3) and range between 0 and 9 (Table 2). Higher scores indicated a higher level of knowledge regarding antenatal exercise.

The assessment of general knowledge showed that 88.2 % of the participants had heard about antenatal exercise. The most widely known exercise was walking (94.9 %). The assessment of antenatal exercise benefits knowledge showed that 31.1 % did not know that antenatal exercise can help reduce the risk of gestational diabetes mellitus. The assessment of antenatal exercise precautions knowledge showed that 83.4 % correctly disagreed that pregnant women need to drink plenty of caffeine while doing antenatal exercise. The assessment of antenatal exercise dangerous signs or contraindications knowledge showed that 62.6 % of the mothers incorrectly agreed that having diabetes mellitus is a danger sign during pregnancy that requires immediate cessation of exercise and consulting a healthcare provider. In addition, 48.0 % and 55.9 % of the participants did not know that chest pain and headache after exercise are dangerous signs, respectively (Table 3).

The assessment of sources that pregnant women used to obtain information about antenatal exercise showed that pregnant Saudi women mainly (90.1 %) depended on social media (e.g., WhatsApp and Instagram), followed by browsing Internet websites (72.7 %), asking healthcare providers (61.7 %), asking family (48 %), and asking friends and neighbors (43 %).

Level of Women's attitude toward antenatal exercise

The mean attitude of Saudi women toward antenatal exercise score (SD) was 10.4 (2.7) (range: 0−15, where a higher score indicates a more favorable attitude) (Table 2). The assessment

Table 2: Levels of knowledge, attitudes, and adherence to antenatal exercise practice guidelines among Saudi women (N = 254).

Exercise Practice	N (%)	Mean (standard deviation), Range
Exercise practice during current pregnancy (minutes/week)		
No	168 (66.1)	
Yes	86 (33.9)	
Adherence to exercise guidelines during current pregnancy		54.1 (98.3), 0−480
Exercise duration ≥150 min/week	39 (15.5)	251.7(91.1), 150−480
Exercise duration <150 min/week	213 (84.5)	18.0 (38.2), 0−145
Women's knowledge[a]		
Total scale (Possible range: 0−30)[b]		20.4 (5.1), 1−30
General knowledge subscale (Possible range: 0−10)		6.2 (2.1), 0−10
Benefits knowledge subscale (Possible range: 0−7)		5.6 (1.7), 0−7
Precautions knowledge subscale (Possible range: 0−4)[b]		3.0 (1.1), 0−4
Contraindications knowledge subscale (Possible range: 0−9)		5.7 (2.3), 0−9
Women's attitude (Possible score range: 0−15)[a]		
Total scale[b]		10.4 (2.7), 2−15

[a] Higher scores indicate a higher knowledge level on the knowledge scale and more favorable attitude on the attitude scale.
[b] Missing N data count ranged from 1 to 3.

Table 3: Women's knowledge and attitudes regarding exercise during pregnancy (N = 254).

Women's Knowledge		Yes N (%)	No N (%)
General knowledge subscale			
1.	Have you ever heard about ante-natal exercise?	224 (88.2)	30 (11.8)
2.	Have you ever heard about walking exercise during pregnancy?	241 (94.9)	13 (5.1)
3.	Have you ever heard about back strengthening exercise during pregnancy (e.g., lower back stretches)?	125 (49.2)	129 (50.8)
4.	Have you ever heard about abdominal strengthening exercise (e.g., side lying hip abductions or ball exercises)?	144 (56.7)	110 (43.3)
5.	Have you ever heard about ankle-toe exercise?	50 (19.7)	204 (80.3)
6.	Have you ever heard about swimming and water aerobics exercise?	158 (62.2)	96 (37.8)
7.	Have you ever heard about stretching exercise (e.g., yoga)?	198 (78.0)	56 (22.0)
8.	Have you ever heard about stationary cycling exercise?	52 (20.5)	202 (79.5)
9.	Do you know about pelvic floor strengthening exercise (e.g., pelvic tilt or kegel exercises)?	198 (78.0)	56 (22.0)
10.	Exercise planning during pregnancy should be individualized according to the pregnancy situation	178 (70.1)	76 (29.9)
Subtotal score general knowledge (Possible range: 0–10)		6.2 ± 2.1 (0–10)	
Benefits knowledge subscale			
11.	Exercise reduces risk of back pain during pregnancy	192 (75.6)	62 (24.4)
12.	Exercise prevents excessive weight gain during pregnancy	199 (78.3)	55 (21.7)
13.	Exercise helps strengthen pelvic floor muscles during pregnancy	228 (89.8)	26 (10.2)
14.	Exercise reduces risk of gestational diabetes mellitus	175 (68.9)	79 (31.1)
15.	Exercise increases energy and stamina during pregnancy	204 (80.3)	50 (19.7)
16.	Exercise enhance ability to cope with labor and delivery	226 (89.0)	28 (11.0)
17.	Exercise during pregnancy enhances rapid post-natal recovery	191 (75.2)	63 (24.8)
Subtotal score benefits (Possible range: 0–7)		5.6 ± 1.7 (0–7)	
Precautions knowledge subscale			
18.	You need to drink plenty of water before and during antenatal exercise[a]	238 (94.1)	15 (5.9)
19.	You can exercise outside during pregnancy when it is hot and/or humid weather[a,b]	93 (36.8)	160 (63.2)
20.	You can stand or lie on your back for a long time during antenatal exercise[a,b]	107 (42.3)	146 (57.7)
21.	You need to drink plenty of caffeine while doing antenatal exercise (e.g., tea and coffee)[a,b]	42 (16.5)	211 (83.4)
Subtotal score precautions[a,b] (Possible range: 0–4)		3.0 ± 1.1 (0–4)	
Contraindications knowledge subscale			
22.	Chest pain during or after practicing antenatal exercise	132 (52.0)	122 (48.0)
23.	Difficulty breathing during or after practicing antenatal exercise	202 (79.5)	52 (20.5)
24.	Abdominal pain during or after practicing antenatal exercise	185 (72.8)	69 (27.2)
25.	Having diabetes mellitus[b]	159 (62.6)	95 (37.4)
26.	Uterine contractions during or after practicing antenatal exercise	177 (69.7)	77 (30.3)
27.	Vaginal bleeding during or after practicing antenatal exercise	214 (84.3)	40 (15.7)
28.	Headache during or after practicing antenatal exercise	112 (44.1)	142 (55.9)
29.	Dizziness during or after practicing antenatal exercise	177 (69.7)	77 (30.3)
30.	Decreased fetal movement during or after practicing antenatal exercise	150 (59.1)	104 (40.9)
Subtotal score contraindications[b] (Possible range: 0–9)		5.7 ± 2.3 (0–9)	
Total knowledge scale [a,b] (Possible range: 0–30)		20.4 ± 5.1 (1–30)	
Attitudes regarding antenatal exercise		**Yes N (%)**	**No N (%)**

Table 3 (*continued*)

Women's Knowledge		Yes N (%)	No N (%)
1.	Do you think doing exercise during pregnancy is essential?	213 (83.9)	41 (16.1)
2.	Doing exercise during pregnancy reduces/prevents complications during pregnancy?[a]	183 (72.3)	70 (27.7)
3.	Do you think regular exercise during pregnancy facilitates normal delivery?[a]	241 (95.3)	12 (4.7)
4.	Do you think antenatal exercise will help you recover sooner after delivery?[a]	224 (88.5)	29 (11.5)
5.	Do you feel that prescribed exercises during pregnancy are safe for your baby?[a]	198 (78.3)	55 (21.7)
6.	Do you think that exercising during pregnancy does not suit our culture?[b]	42 (16.5)	212 (83.5)
7.	Any pregnant woman can perform exercises without the advice and recommendations of healthcare professionals?[a,b]	39 (15.4)	214 (84.6)
8.	During pregnancy, the priority should be improvement of nutrition and rest and not physical exercise?[b]	106 (41.7)	148 (58.3)
9.	Performing day to day household activities is sufficient physical exercise for pregnant women and they do not have to perform recommended exercises during pregnancy.[b]	85 (33.5)	169 (66.5)
10.	Do you think you will feel energetic doing exercise during pregnancy?[a]	206 (81.4)	47 (18.6)
11.	Do you personally like doing exercise during pregnancy?	146 (57.5)	108 (42.5)
12.	Do you have enough time to do daily exercise during pregnancy?	70 (27.6)	184 (72.4)
13.	Do you think antenatal exercises are safe for you to practice?[a]	195 (77.1)	58 (22.9)
14.	Do you have sufficient information on exercising during pregnancy?	82 (32.3)	172 (67.7)
15.	Do you get enough family support for doing exercise during pregnancy?[a]	128 (50.6)	125 (49.4)
Total attitude scale (Possible range: 1–15)[a]		10.4 ± 2.7 (2–15)	

Notes. A higher score indicates a greater knowledge level on the knowledge scale and more favorable attitude on the attitude scale.
[a] Missing N data count = 1.
[b] Negative questions were reversed in the statistical analysis.

of the attitudes of pregnant Saudi women toward antenatal exercise showed that the majority (83.9 %) of the participants considered that antenatal exercise was essential and that they liked to exercise (57.5 %). Culturally, 83.5 % believed that antenatal exercise did suit the Saudi culture. Furthermore, 50.6 % stated that they had their family's support to exercise during pregnancy. Moreover, 84.6 % correctly disagreed that pregnant women can exercise without consulting healthcare professionals, and 66.5 % correctly disagreed that performing household activities is sufficient physical exercise during pregnancy (Table 3).

Associations of demographic characteristics, knowledge, and attitude with adherence to ACOG guidelines in pregnant Saudi women

Chi-square tests were conducted to assess the associations between adherence to antenatal exercise and sociodemographic characteristics. Significant associations were found between employment, gestational age, receiving professional healthcare counseling, exercise practice before pregnancy, and adherence to antenatal exercise guidelines ($p < 0.05$) (see Appendix B). Table 4 shows the independent *t*-test results,

Table 4: Associations between adherence to ACOG antenatal exercise guidelines with knowledge and attitudes toward exercise among Saudi women.

	Adherence to Exercise Practice Guidelines During Current Pregnancy (N = 250)		*p*-value[a]
	Exercise Duration ≥150 min/week Mean (SD)	Exercise Duration <150 min/week Mean (SD)	
Women's knowledge (total scale)	22.4 (3.8)	20.1(5.2)	$p < 0.008$
General knowledge (subscale)	7.2 (1.7)	5.99 (2.2)	$p < 0.001$
Benefits knowledge (subscale)	6.2 (1.1)	5.4 (1.8)	$p < 0.001$
Precautions knowledge (Subscale)[a]	3.2 (1.0)	2.9 (1.1)	$p = 0.18$
Contraindications knowledge (subscale)	5.6 (2.1)	5.7 (2.3)	$p = 0.80$
Women's attitude (total scale)	12.0 (2.1)	10.1 (2.7)	$p < 0.001$

[a] Based on independent *t*-tests. A higher mean indicates a higher knowledge level on the knowledge scale and more favorable attitude on the attitude scale.

which indicate that significantly higher means ($p \leq 0.05$) were found in the total knowledge scale, general knowledge subscale, benefit knowledge subscale, and attitude scale for participants who adhered to the antenatal exercise guidelines compared with those who did not adhere to the guidelines.

Logistic regression analysis (Table 5) showed that participants who were not employed (odds ratio [OR], 0.067; 95 % confidence interval (CI), 0.01−0.39) and those who were employed (OR, 0.116; 95 % CI, 0.18−0.76) were less likely to adhere to antenatal exercise guidelines than participants who worked from home. Moreover, participants in their second trimester (14−26 weeks) were less likely to adhere to antenatal exercise guidelines than those in their third trimester (27 or more weeks) (OR, 0.273; 95 % CI, 0.09−0.78). Adherence to exercise guidelines before pregnancy was significantly associated (OR, 9.2; 95 % CI, 3.36−24.97) with higher odds of adherence to antenatal exercise guidelines than those who did not adhere to exercise guidelines before pregnancy. A one-unit increase in the attitude scale score was significantly associated with an increase of 1.4 (OR, 1.385; 95 % CI, 1.10−1.74) higher odds of adherence to antenatal exercise guidelines.

Table 5: Associations between adherence to antenatal exercise with background characteristics and women's knowledge and attitude regarding antenatal exercise (N = 254).

Predictors	OR	95 % CI	
		Lower	Upper
Age			
29 years or less	1		
30 years or more	1.500	0.54	4.13
Academic level			
High school or less	1		
Bachelor or more	0.563	0.19	1.64
Employment			
Not working	0.067*	0.01	0.39
Working	0.116*	0.18	0.76
Working from home	1		
Gravidity			
Primigravida	1		
Multigravida	3.376	0.62	18.22
Number of children			
No child	1		
One child or more	0.689	0.07	6.44
Gestational age			
0−13 weeks (1st trimester)	0.127	0.01	1.34
14−26 weeks (2nd trimester)	0.273*	0.09	0.78
27 or more weeks (3rd trimester)	1		
Family arrangement			
Nuclear family without children	1		
Nuclear family with children	0.263	0.03	2.53
Extended family	1.306	0.20	8.72
Exercise adherence before pregnancy			
Exercise duration ≥150 min/week	9.159*	3.36	24.97
Exercise duration <150 min/week	1		
Women's knowledge (total scale)	1.002	0.90	1.12
Women's attitude (total scale)	1.385*	1.10	1.74

Notes.
OR = odds ratio, CI = confidence interval, and * significantly different at $p < 0.05$.
Dependent variable: adherence to antenatal exercise (adhering vs. not adhering).
Model (Likelihood Ratio) $X^2 = 65.000$, $df = 13$, $p < 0.05$.
−2 Log likelihood = 142.993, Nagelkerke R Square = 0.407.
Hosmer and Lemeshow Test = 10.097, df = 8, $p = 0.258$, Percentage correct classification = 88.2 %.

Discussion

The findings obtained in the present study showed that most Saudi pregnant women did not adhere to ACOG antenatal exercise guidelines. The high proportion of non-adherence to antenatal exercise guidelines among pregnant Saudi women in the present study (84.5 %) is in line with the general inactivity levels among the female population of KSA according to the censuses in 2019 and 2021 (88.7 % and 77 %, respectively).[21,22] Similarly, Al-Youbi and Elsaid[30] found that a large proportion (84.2 %) of women did not exercise during pregnancy. By contrast, Alaglan[8] reported that a higher proportion of women (75 %) exercised during pregnancy, and that 42 % of the participants adhered to the ACOG antenatal exercise guidelines. This discrepancy can be explained by the use of different assessment tools. In general, the adherence of pregnant Saudi women to the ACOG guidelines was found to be low in the present study and other Saudi studies.[23,30]

Women's knowledge about antenatal exercise could be associated with adherence to the guidelines. Alaglan et al.[8] highlighted the importance of informing pregnant women about antenatal exercise and the benefits of healthy lifestyle practices. In the current study, Saudi women had high overall antenatal exercise knowledge level scores, thereby agreeing with other studies that reported high total mean scores.[23,30] Most participants knew that antenatal exercise benefits are directly related to childbirth and supporting pelvic muscles (89.0 % and 89.8 %, respectively), but they did not know the general health benefits because more than one-third (37.4 %) of the participants disagreed that antenatal exercise could reduce the risk of gestational diabetes. Similar proportions of participants also lacked this detailed knowledge regarding the benefit of antenatal exercise for reducing the risk of gestational diabetes in previous Saudi studies.[13,23,30] The assessment of antenatal exercise precautions knowledge in the current study showed that more than one-third of the participants incorrectly agreed that pregnant women can exercise outdoors in hot or humid weather and can stand or lie on their backs for a long time while exercising (36.8 % and 42.3 %, respectively). The ACOG guidelines recommend that pregnant women do not exercise outdoors in hot or humid weather and to avoid standing or lying on their backs for prolonged periods while exercising.[1] Thus, the assessment of women's knowledge identified a gap in their detailed understanding of antenatal exercise, including its benefits, precautions, and contraindications.

The personal views and beliefs of women have been shown to motivate their actions and practices.[30] In the current study, most participants believed that exercise practice was important during pregnancy (83.9 %) and they liked to exercise (57.5 %), but adherence to the exercise guidelines was low (15.5 %). These findings are consistent with previous research, where antenatal exercise was considered

to be essential by 86.0 % and 70.7 % of the participants in studies by Alaglan et al.[8] and Gari et al.,[13] respectively. Culturally, 83.5 % of the participants in the current study disagreed that antenatal exercise does not suit Saudi culture. However, the response rate of participants to a similar question in a study by Gari et al.[13] was not as high (disagreed = 28.9 %) compared with the current study, possibly because their data were collected through social media. The present study found mixed beliefs among women regarding antenatal exercise, with most believing that it is important, but over half considered that household chores are sufficient as physical activity.

Adherence to antenatal exercise requires commitment, and thus extra effort by pregnant women. Previous studies in KSA found non-directional associations between antenatal exercise practice and age, employment, number of children, and gravidity.[8,23,24] The findings obtained in the current study were based on the TPB and KAP antenatal exercise survey framework. The average knowledge and attitudes of participants who adhered to the antenatal exercise guidelines were significantly higher than those of participants who did not. Multivariate analysis showed that only women's attitudes had a positive association with adherence to the antenatal exercise guidelines. Similarly, Alaglan et al.[8] found that antenatal exercise practice was significantly associated with women's attitude, but not with women's knowledge. Enhancing women's attitudes toward exercise can improve antenatal exercise adherence rates, but further research is needed to understand the relationship between knowledge and antenatal exercise practice.

Limitations

The study setting may restrict the generalizability of the findings to other Saudi regions due to sociocultural and climate variations.[9,13] Using the convenience sampling method limited generalizability to the Saudi population. In addition, the sampling method resulted in most participants being in their third trimester (Table 1), which might affect the generalizability of the findings to pregnant women in general. Employing a cross-sectional design prevented the establishment of causal relationships between antenatal exercise adherence and women's knowledge and attitudes toward antenatal exercise. Furthermore, the definition of adherence to ACOG guidelines in the present study did not align with ACOG recommendations because those who started exercise gradually during pregnancy were categorized as not adhering to the 150 min of exercise per week recommended by ACOG.

Strengths

Few studies have assessed exercise in pregnancy by Saudi women using valid tools, making it challenging to draw clear conclusions. The response rate was 94.4 % in the current study but adherence to the ACOG guidelines was low among pregnant Saudi women in the current study (15.5 %) and in previous research. Furthermore, the findings obtained in this study can help to provide scientific evidence regarding exercise practice among pregnant women and to highlight potential gaps in their knowledge and conflicting beliefs. The results obtained in the current study align with the health transformation strategy in KSA, which aims to improve primary maternity care. They highlight the need to empower women with knowledge by promoting counseling sessions at primary healthcare services, especially by promoting the benefits of exercise for general health as well as obstetric benefits. In addition, they highlight the need for increased awareness about antenatal exercise safety, precautions, contraindications, and dangerous signs to enhance overall safety and well-being of pregnant women. In addition, most pregnant Saudi women (83 %) believed that antenatal exercise is important, but more than half (58 %) believed that nutrition and rest during pregnancy is a more important priority. Moreover, 50 % of the participants considered they had family support to exercise during pregnancy, whereas 50 % did not. These conflicting beliefs highlight intriguing areas for further investigation. These findings can facilitate the development of educational programs to enable healthcare professionals to improve overall well-being and promote normal birth.

Conclusion

The findings obtained in the current study indicated a low level of adherence to the ACOG antenatal exercise guidelines among Saudi women, despite their high total knowledge and attitude scores. Low adherence levels to exercise were related to the lack of detailed knowledge about antenatal exercise and conflicting beliefs among the participants. These findings can help to develop tailored antenatal exercise educational programs and healthcare services for pregnant Saudi women.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

Ethical approvals were obtained from the Ethics and Research Committee of GMU (ID: 2015567-1, March 24, 2023). Data collection ethical approval was obtained from the IAU in KSA, which oversees data collection sites: King Fahad University Hospital (KFUH) and Family and Community Medicine Center (FCMC) (Number: IRB-2023-04-119, March 9, 2023).

Consent

Verbal consent was obtained before responding to the de-identified self-reported questionnaire.

Authors contributions

Donna Alhajiri: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization,

Writing - original draft. Panagiota Kitsantasm, Ali A. and Kyeung Mi and Oh Weinstein: Conceptualization, Visualization, Methodology, Formal analysis, Writing - Review & Editing, Supervision, Data Curation, Validation. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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Appendix A. Supplementary data

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