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Original Article

Effect of Body Mass Index, Caffeine Consumption and Physical Activity on in vitro Fertilization Outcome in Erbil City/Iraq"

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ABSTRACT

Background and Objective: Several factors influence the success of in vitro fertilization. In recent years, there has been a lot of focus on how lifestyle factors like body weight, physical activity levels, cigarette smoking, alcohol, and caffeine consumption affect In vitro fertilization (IVF) outcome (biochemical pregnancy). The term "biochemical pregnancy" is defined as a pregnancy that can only be determined by the presence of serum levels of the hormone Human Chorionic Gonadotrophin (HCG). This study aimed to assess the effect of women's lifestyle factors, such as body mass index, caffeine consumption, and physical activity, on the outcome of In vitro fertilization (biochemical pregnancy).

Methods: A descriptive cross-sectional study design was conducted from September 2021 to September 2022.A convenience sampling technique was used among 110 women in total who consented to take part in this study, but because 10 of them cancelled (IVF) treatment before embryo transfer or oocyte retrieval, were excluded from analysis, only 100 infertile women undergoing (IVF) were included in the analysis in the Maternity Teaching Hospital's (in vitro fertilization center) and some private hospitals in Erbil, Kurdistan Region, Iraq. The women in the study ranged in age from 20 to 45, were undergoing IVF.

Result: (44%) of infertile women had a successful biochemical pregnancy (positive beta hCG test). The majority (74%) of the study sample consumed caffeinated beverages. Results showed a significant difference between caffeine consumption and IVF outcome (biochemical pregnancy) (P=0.01), but there was no statistically significant difference between body mass index (BMI), and physical activity (vigorous, moderate) with IVF outcome (biochemical pregnancy). Only walking showed a significant difference with IVF outcome (biochemical pregnancy) (P=0.017).

Conclusion: Increased caffeine consumption is a significant factor that can affect IVF outcome.

Keyword: Physical Activity; BMI; Caffeine Consumption; In vitro Fertilization; Biochemical Pregnancy.

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INTRODUCTION

In vitro fertilization success is influenced by several factors. In recent years, there has been a lot of focus on how lifestyle factors like body weight, physical activity levels, cigarette smoking, alcohol, and caffeine consumption affect IVF outcomes [1]. Obesity has become much more prevalent in recent decades, particularly in Europe and North America. It has a wide range of health implications, including the function of reproduction. Obesity is linked to an increased risk of dysovulation and anovulation [2]. Physical activity has been demonstrated to improve reproductive outcomes during pregnancy; the majority of the researchers concluded that moderate physical activity improves female fertility [3].

Being overweight and obese are the results of a persistent imbalance between energy intake and energy expenditure. Although energy consumption has increased calorically, there has been a concomitant decline in the amount of physical activity, which has contributed to the obesity pandemic [4]. Infertility and a higher likelihood of miscarriage also occur in overweight and obese women who do not exercise. Changes in the release of gonadotropin-releasing hormone, luteinizing hormone (LH), and ovarian and adrenal hormones are thought to be the mechanism, leading to anovulation, slowed follicular development, stunted fetal growth, and unsuccessful implantation [5]. Caffeinated beverages, diet sodas, and sugary sodas are among the most popular drinks drunk by reproductive-age women. Caffeine is a central nervous system stimulant. Caffeine consumption is linked to reduced estrogen levels during the luteal phase [6]. Wilcox et al. were the first to report that "women who drank more than one cup of coffee per day were less likely to become pregnant than women who drank less" [7]. Assessing the outcomes of in vitro fertilization by biochemical pregnancy can only be identified by the presence of the hormone Human Chorionic Gonadotrophin (HCG) in the serum after a frozen egg transfer, clinics advise waiting two weeks before performing a pregnancy test (HCG), as doing so frequently yields incorrect results [17]. Human Chorionic Gonadotropin, often known as HCG, is frequently referred to as the pregnancy hormone because it is produced by cells in the placenta, which feeds the egg after it has been fertilized and connected to the uterine wall. About 11 days after conception, a blood test can be used to identify levels; about 12–14 days later, a urine test can be used to identify levels [18].Both infertile couples and professionals now view how to enhance assisted reproductive outcomes as a key issue. Many patients want to collaborate with their doctors and want to learn specific practices to have a healthy lifestyle and increase their chances of having a successful IVF. This study aimed to assess the potential effect of women's lifestyle factors, such as body mass index, caffeine consumption, and physical activity, on the outcome of in vitro fertilization (biochemical pregnancy).

METHODS

This cross-sectional descriptive study was conducted on a convenience sample of 110 women in total who consented to take part in this study, but 10 of them cancelled (IVF) treatment before embryo transfer or oocyte retrieval and were excluded from analysis. Only 100 infertile women undergoing IVF were included in the analysis during the period between 1st September 2021 and 1st September 2022 at the IVF unit of a maternity teaching hospital and some private hospitals in Erbil, Kurdistan Region, Iraq. Due to the small number of patients in public hospitals and the lack of support for the

study in most private hospitals. Women included were aged 20–45 years were having in vitro fertilization (IVF). The researcher obtained ethical approval from the scientific committee and ethical committee of College of Nursing / Hawler Medical University (code No.110, date: 7/10/2021). Permission was also obtained from the General Directorate of Health/Erbil as well as the administration of Maternity Teaching Hospital in Erbil city. Informed consent was obtained from all the participants who were included in the study. Direct interviewing was used to gather the information, which was then documented in a questionnaire that included socio-demographic characteristics of couples such as age, occupation, religion, level of education, and economic status. Data of study participants obtained from the baseline questionnaire. A detailed history was collected for each woman about past medical, surgical, family, and gynecological history, obstetrical data, and data about the menstrual cycle. It also included questions on lifestyle and health habits, which contain data about caffeine consumption, body mass index, and performing physical activity. To assess body mass index, the researcher was extracting body weight and height from clinical records; when missing, data was calculated from the self-reported height and weight. In this study, the researcher measured obesity using an index called BMI, which is calculated and defined as women's weight in kilograms divided by the square of their height in meters (kg/m2). The women were grouped according to the World Health Organization classification of BMI (<18.50 underweight, 18.50 –24.99 normal , 25.00–29.99 overweight, and obese ≥30.00 kg/m2)[8]. To assess and collect information on physical activity, the investigator used simple language for communication, and questions about the international physical activity questionnaire - short form (IPAQ-SF) ask questions about three specific forms of activities (Walking, moderate-intensity activities, and vigorous-intensity activities) [9]. They were designed to be used by people aged between (18–65 year) [10]. Each type of activity was measured by the frequency of vigorous, walking, and moderate activity per week and recorded time per day [11]. These physical activity data was converted to metabolic equivalent tasks (MET). The (MET) is ratio at which a person expends energy while engaging in a certain activity, according to that person's mass, the quantity of oxygen consumed while sitting at rest, and is equal to 3.5 ml O2 per kg body weight x min [12]. The metabolic equivalent of task (MET) values was used, as well as equations for calculating MET minutes. For each type of activity, a total MET score was calculated. For instance, all types of walking were added, and a walking average MET value was calculated. Moderate-intensity and vigorous-intensity activities were both subject to the same technique. For the analysis of IPAQ data, the following values are being used: Walking equals 3.3 METs, moderate physical activity (PA) equals 4.0 METs, and vigorous PA equals 8.0 METs. researcher summed all of the activities' frequency in minutes per week, and the score was used to categorize the amount of physical activity as low, moderate, or high. and other domains of activity, including the number of hours spent sitting ≤ 3 hours per week of moderate-intensity exercise or ≤ 5 hours per week of low-intensity exercise, were considered to be inactive [13].The type of beverages consumed and the average amount consumed were recorded. The frequency with which tea, coffee, soda, or energy drink is consumed was recorded in cups per day, each cup=250 ml. The daily caffeine intake (mg) was calculated based on the number of cups of caffeine

beverage consumed [14]. The researcher calculated each person's total caffeine intake by assuming that one cup of instant (coffee had 65 mg of caffeine, 40 mg of caffeine in soft drinks, and 50 mg of caffeine in tea) [15].Total caffeine consumption was grouped into four categories: 0–800 mg/week, 801–1400 mg/week, and > 1400 mg/week [16].To assess IVF outcome, researchers obtained (biochemical pregnancy). According to hospital policy, a positive β-hCG pregnancy test 12-14 days after embryo transfer was used to detect pregnancy, and successful biochemical pregnancy was defined as a serum β-hCG level over 10 mIU/mL The pilot study was conducted from 1st January to 15th January 2022on 10% of the women surveyed (10 women) to assess the clarity of the questions and to identify any additional issues or challenges that would aid in making the necessary changes that would necessitate reconstructing the questionnaire. The data was analyzed using Statistical Package for Social Science (SPSS) Version 26, to calculate descriptive statistical analysis (frequency and percentage). Inferential statistical analysis (independent sample t-test) was used to determine the difference between variables. A Chi-Square test used to find out the association between two variables; and the P-value ≤ 0.05 is considered statistically significant [31].

RESULT

Table1shows the descriptive statistics for all demographic questions such as the age of the husband and wife, type of hospital, level of education, nationality, religion, residence, duration of the marriage, economic status, and occupation. The percentage of patients from the public hospital (61%) is higher than the percentage of patients from private clinics or hospitals (39%). The mean age (+ SD) of husbands was (37 ± 7.07) years, ranging from 20 to 45 years. Table 1 shows that the highest 31% of the study sample (husband) were aged 41 years and over, and only 6% were 26 years. The mean age (+ SD) of wives was (33 ± 5.91) years, most of the study sample (wives) 30% were aged between 36 and 40 years, and only 7% were 41 years and over. The highest duration of marriage in this study is higher than 9 years (34%) followed by 7-9 years (22%), 4-6 years (29%), and 1-3 years (15%) since the average of their duration of marriage is 9 years. The majority of the study sample (75%) is unemployed individuals, followed by employed (25%). The most prevalent type of infertility in the study sample was primary infertility (58%).

Table1: Distribution of the socio-demographic characteristics of the study sample (n=100)

Variable	Category	F.	(%)
Hospital	Public	61	(61)
	Private	39	(39)
Age group husband(years)	≤25	6	(6.0)
	26-30	12	(12)
	31-35	25	(25)
	36-40	26	(26)
	≥41	31	(31)
Age group wife (years)	≤25	14	(14)
	26-30	24	(24)
	31-35	25	(25)
	36-40	30	(30)
	≥41	7	(7)
Marriage Duration (years)	1-3	15	(15)
	4-6	29	(29)
	7-9	22	(22)
	more than 9	34	(34)
	(Mean ± SD)	(9 ± 5.68)	
Occupation	Employed	25	(25)
	Non employed	75	(75)
Type of infertility	Primary	58	(58)
	Secondary	42	(42)

Table 2 shows the descriptive statistics for lifestyle and health habit characteristics such as drinking caffeine in tea, coffee, soda, energy, and the total caffeine group. Caffeine is consumed by the majority of patients (74%), as opposed to those who did not consume it (26%), because the majority of them drink tea (68%), coffee (31%), soda (21%), and energy drinks (8%), respectively. Most of the caffeine group is between 0 and 800 mg/week (44%), followed by greater than 1400 mg/week (19%), and 801–1400mg/week (11%) respectively, since 26% of them do not drink at all.

Table 2 : Descriptive Statistics for caffeine consumption

Variable	Category	F	(%)
Did you drink any caffeine beverages?	Yes	74	(74)
	No	26	(26)
Tea	Yes	68	(68)
	No	32	(32)
Coffee	Yes	31	(31)
	No	69	(69)
Soft drinks	Yes	21	(21)
	No	79	(79)
Energy drinks	Yes	8	(8)
	No	92	(92)
Total caffein consumption mg/weak	0–800	44	(44)
	801–1400	11	(11)
	> 1400	19	(19)

Figure 1 Depending on BMI results, most of the patients in this survey are obese (43%) followed by overweight (30%), and normal (27%).

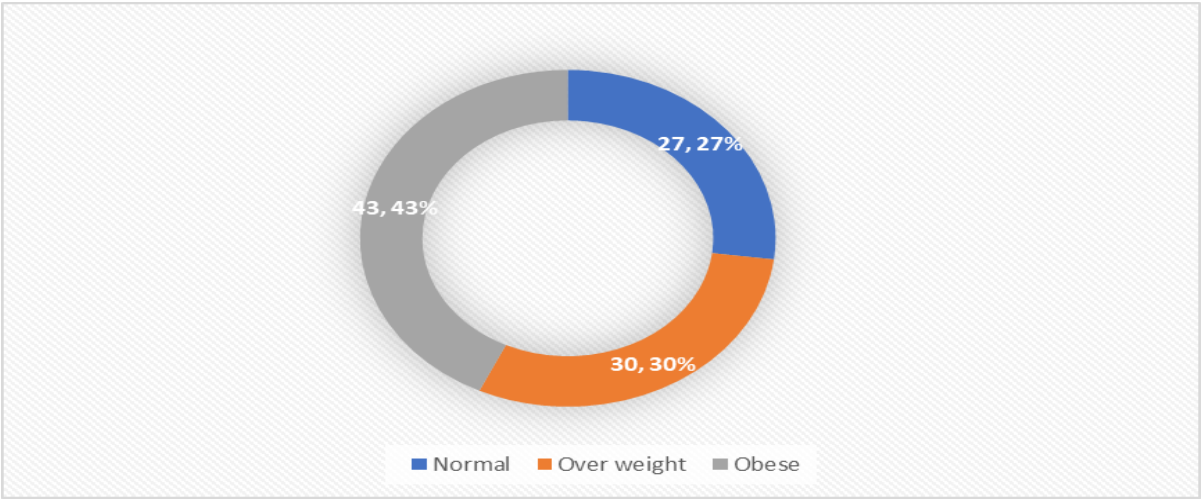

Figure 1 percentage about Body mass index classification

Figure 2 shows the classification of physical activities, depending on the physical activity results, most of the patients in this survey have low activity (66%) followed by moderate (25%).

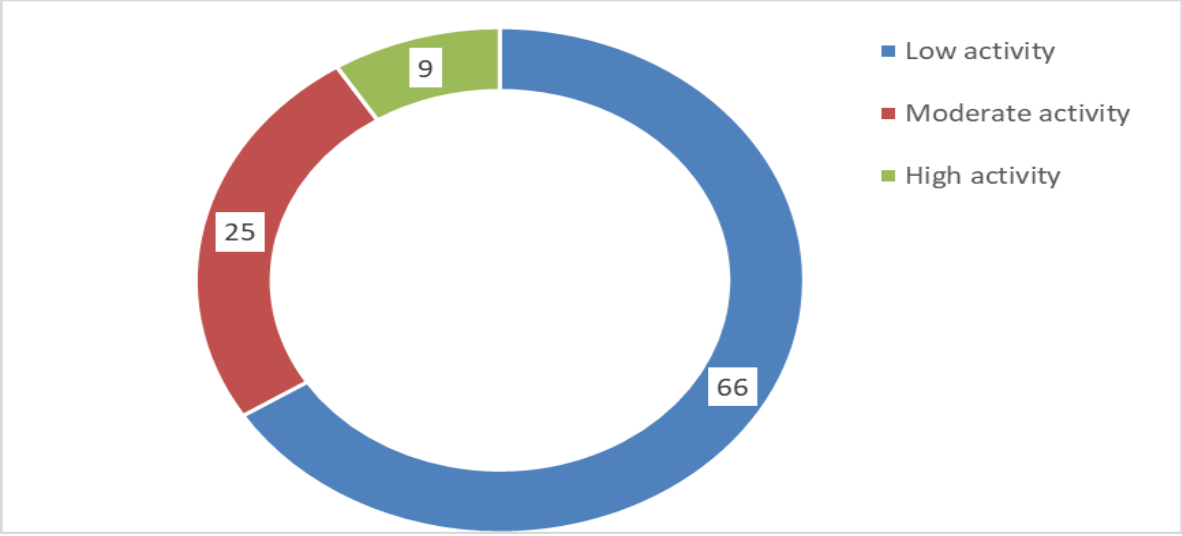

Figure 2 level of physical activity

Figure 3 shows the percentage about the biochemical pregnancy rate, depending on the result , the percentage of failed results(56%) is higher than the percentage of successful results of IVF (44%).

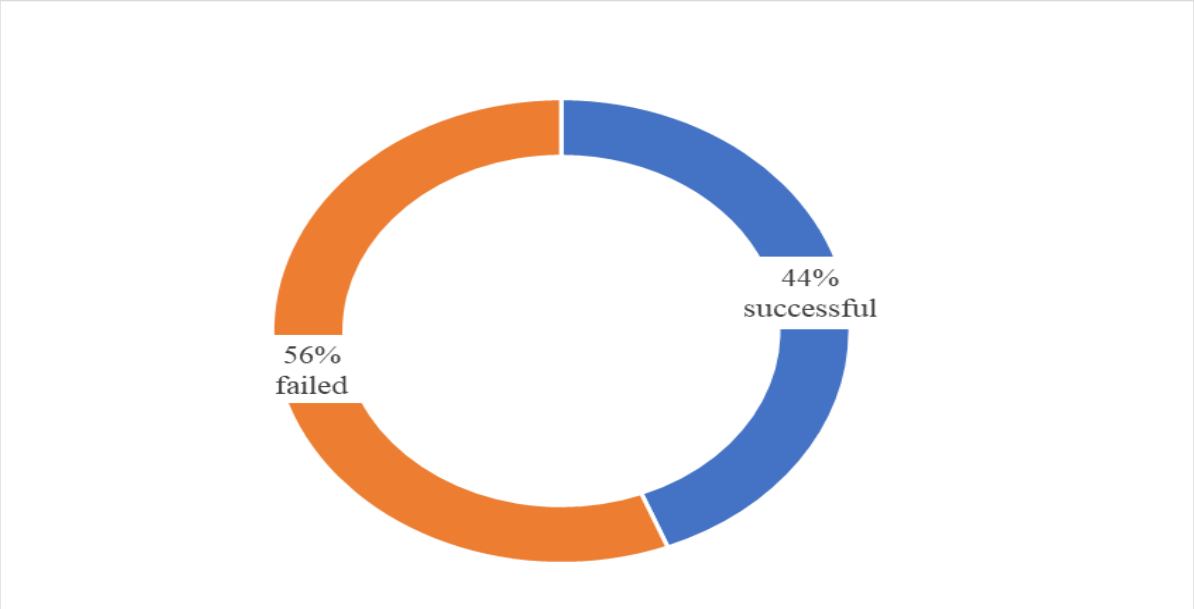

Figure3 Percentage of biochemical pregnancy Rate (successful and failed)

Table 3 shows there is a statistically significant difference between the mean of biochemical pregnancy with each of the drinking tea/ mg, energy drink/mg, and total caffeine separately because their (P= 0.004, 0.044, and 0.001) respectively are less than the significant level of α=0.05.For example, the mean of successful IVF patients who drink tea/mg (274.709) is lower than the mean of those patients who have failed IVF (827.273).For example, the mean of successful IVF patients who drink energy mg (6.364) is lower than the mean of those patients who have failed IVF (35). Next, the mean of successful IVF patients who drink caffeine in general (382.965) is lower than the mean of those patients who have failed IVF (1022.795). There is no statistically significant difference in the mean of the biochemical pregnancy with each of the drinks separately, including coffee (mg) and soda (mg) because their p-values (0.234, 0.201) respectively, are higher than the significant level of α=0.05.

Table 3 : Difference between biochemical pregnancy (success and failure) with caffeine consumption

Biochemical pregnancy		N	Mean	SD	t-value	P-value
How much tea mg/weak	Success	44	274.709	314.085	-2.99	0.004
	Failure	56	827.273	1178.374		
How much coffee mg /weak	Success	44	82.727	163.398	-1.198	0.234
	Failure	56	132.031	231.373		
How much soda mg/weak	Success	44	27.045	69.536	-1.286	0.201
	Failure	56	48.750	93.363		
How much energy drink mg/weak	Success	44	6.364	42.212	-2.043	0.044
	Failure	56	35.000	93.439		
TOTAL caffeine mg /weak	Success	44	382.965	423.134	-3.435	0.001
	Failure	56	1022.795	1295.720		

Table 4 shows that there is no statistically significant difference between a biochemical pregnancy and BMI classification using the Chi-square test because the p-value (0.489) is greater than the significance level of α = 0.05.

Table 4: Association between the classification of BMI and biochemical pregnancy (success and failure)

			biochemical pregnancy		Total	Chi-square	p-value
			Success	failure			
classification of BMI	normal	F	13	14	27	1.432	0.489
		%	48.1	51.9	100.0		
	over	F	15	15	30		
		%	**50.0**	50.0	100.0		
	obese	F	16	27	43		
		%	37.2	62.8	100.0		
Total		F	44	56	100		
		%	44.0	56.0	100.0		

Table 5 shows there is a statistically significant difference between the mean of biochemical pregnancy (success and failure) and walking as a physical activity because its p-value (0.017) is less than the significant level of α=0.05. For example, the mean of successful IVF patients who walk in physical activities (434.615) is higher than the mean of those patients who have failed IVF (262.232).

There is no statistically significant difference between the means of biochemical pregnancy (success and failure) with each of the vigorous, moderate, walking, and total physical activities because their (P-values=0.557, 0.334, and 0.508) are higher than the significant level of α=0.05.

Table 5: Difference between biochemical pregnancy (success and failure) with Physical activities

Physical activity	biochemical		N	Mean	SD	t-value	P-value
vigorous		Success	4	3560.000	2678.507	0.605	0.557
		Failure	9	2808.889	1783.231		
moderate		Success	26	434.615	709.897	0.976	0.334
		Failure	28	295.000	254.944		
Walking		Success	44	487.875	549.038	2.426	0.017
		Failure	56	262.232	317.348		
Total Physical Activity		Success	44	1068.330	1558.646	0.664	0.508
		Failure	56	861.161	1540.145		

*There is a sample missing because not all sample engaged (vigorous and moderate) activities like (swimming, or running ..) you can skip that question if you do not engage.

Discussion

Socio-demographic characteristic of the sample The present study aimed to assess the effect of women's lifestyle factors, such as body mass index, caffeine consumption, and physical activity, on the outcome of in vitro fertilization. The subjects in this study included (n =100) infertile women; the majority of the sample was in a public hospital. According to our finding, the highest percentage of the age group for the study sample (husbands) was (≥41) with a mean of 37 years. The mean age of husband in Milan, Italy in (2018) who studied 339 couples. The mean age husband who seeking infertility treatment was 39.4 years. This result higher than what it has been reported in our study [19]. While the mean age for infertile husbands in Erbil (2016) was 35.28 years [20]. The highest percentage of the age group for women looking for infertility treatment in the current study was ranged between (36 and 40) with a mean of 33 years. This is comparable to the reported mean ages of women in Erbil (2018) and (2016) which were 33.36 ± 4.5, 31.25 ± 7.0 years [17,20]. While in the UK, which mean age was 31± 6 years [21]. In Italy (2018), the women's mean age was 36.6 [19]. In our study, the mean ± SD for marriage duration was 9 ±5.68, while in Iraq (2015) was 7.4 ± 4.5 years [23].The majority of the

sample was unemployed (housewives) (75%). This finding is nearly consistent with other studies done in Erbil (2018) for 1158 infertile couples, showing that the highest percentage (73.9 %) of wives were unemployed [20].In this study, the highest percentage of the sample (58%) was primary infertility. This finding is nearly consistent with other studies done in Iraq (2020), and in Erbil (2016), primary infertility (64%,63%) higher than secondary infertility [20,22]. In Duhok (2002), a primary infertility rate was (77.2%) and a secondary infertility rate was (22.8%) [23]. Regarding IVF outcome, (44%) of infertile women had a successful biochemical pregnancy (positive HCG test). These results are similar to a study carried out on 107 infertile women done by Sõritsa et al., which mentioned that (43.6%) of the women who underwent an HCG test had a positive result [24].Caffeine consumption: The majority (74%) of the study sample reported drinking caffeinated beverages such as tea, coffee, soft drinks, and energy drinks and tea was the most common source of caffeine consumption. No association was found between coffee or soda drinking and biochemical pregnancy; while there is a statistically significant difference between tea or energy drinks and biochemical pregnancy, only caffeine consumption by women was significantly associated with the biochemical pregnancy of IVF (p = 0.001).

While a study conducted by Al-Saleh et al., for 619 women showed that the majority of the study sample (97%) was drinking caffeinated beverages, and coffee was the most common source of caffeine consumption, and there is a significant association between coffee drinking and IVF outcome [25]. These results are not coordinated with a previous study conducted in Egypt for 200 women, which reported that the majority (72%) of the study sample was not drinking any caffeinated beverage and that only (20%) of participants reported drinking caffeinated beverages [26]. A study carried out on 339 infertile couples in an Italian fertility clinic showed that caffeine consumption was not associated with a negative effect on IVF outcome [19]. The finding in the present study shows that most of the study sample (44%) indicated they consumed 0 - 800 mg/week. Which is nearly consistent with a study conducted by Choi et al., which shows that most of the study sample consumed 0 -800 mg/week [16].

Body Mass Index: Regarding BMI, our findings show that the highest percentage (43%) of the sample were obese and the lower percentage was normal weight. However, this disagrees with the result of a study by Cesta et al., for 485 women receiving fertility treatment, in which the highest percentage (69.9%) of the sample was of normal weight and the lowest percentage was obese [27]. There were no statistically significant differences between the BMI and IVF outcome. However, our study is not the first that has failed to demonstrate any association between female obesity and IVF outcome [28]. Similar findings have been validated in other recent studies, which found no link between rising female body weight and poor IVF outcome and live birth rate, showing that BMI should not be used as a cause to refuse IVF therapy [29]. These results are not consistent with a result of previous studies conducted by Kudesia et al., indicate that female obesity negatively affects the success of IVF [30].Physical activity: Based on the analysis, the majority (66%) of the sample has low physical activity, and the lowest percentage (9%) of the study sample has high physical activity. It is worth mentioning that the results of the present study do not agree with the findings of a study by Youness in Egypt (2018) showing that the highest percentage (52%) of infertile women was highly active while only

(29%) of infertile women was low activity [26]. The main finding of our study is that there is no statistically significant difference between women's physical activity (vigorous, moderate activity) and IVF outcomes. Only there is a statistically significant difference between walking and biochemical pregnancy because (P=0.017). Few women in our sample engaged in vigorous activity before IVF. This is in line with previous findings, where no associations of physical activities in women before and during IVF treatment with IVF outcomes such as positive HCG, clinical pregnancy and live birth were detected [24].

CONCLUSION

It has been concluded that caffeine consumption and physical activity (walking) are significant factors that can affect IVF outcome.

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