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Effect of Ages on Fertility and some Physiological parameters in Women of Reproductive Age

Research project

Submitted to the Department of Biology in partial fulfillment of the requirements for the degree of BSc. In Biology

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Supervisor's Certification

I certify that this project was prepared under my supervision at the Department of Biology, College of Science, Salahaddin University-Erbil, and I do hereby recommend it to be accepted as a partial fulfillment of the requirements for the BSc. in **Biology/Animal Physiology.**

Signature:

Supervisor

Prof. Dr. Edrees M. Ameen

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Dedicated to

To my family and friends

Salih and Chiman

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Abstract

The present study was done to assess the effect of age on fertility and some physiological parameters including body mass index (BMI), blood pressure, heart rate, and vital capacity,) of women of reproductive age. One hundred twenty samples were used and divided into the following groups (Group 1 with ages 15-20 years, Group 2 with ages 21-39 years, and Group 3 with ages ≥40 years, each group includes 40 samples). Pearson chi-square showed significant differences between regular and irregular menstrual cycles among different groups of ages, and low regular menstrual cycles were observed with younger (group 1) and older ages (group 3) when compared with group 2. A higher prevalence of amenorrhea was recorded in ages ≥40 years when compared with the other 2 groups. Revealing the physiological parameters, the results showed that the group of ≥40 years had significantly lower vital capacity and higher BMI and systolic and diastolic blood pressure when compared with the other 2 groups. A significantly lower value of heart rate was recorded in groups 2 and 3 of ages when compared with group 1.

Keywords: Fertility; Blood pressure; Ages; Vital capacity; Heart rate; BMI.

1. Introduction

Over centuries, the number of older people worldwide has increased, although at an increasingly rapid rate. An estimated 461 million people were 65 years of age or older worldwide in 2004—a 10.3 million rise from the previous year. The yearly net gain is expected to remain above 10 million for the next ten years—more than 850,000 every month—according to projections. Twenty-six countries had at least two million older citizens in 1990, while thirty-one countries had two million or more older citizens by 2000. By 2030, there will be at least 2 million persons 65 and older in more than 60 nations, according to projections (Kinsella and Phillips, 2005).

Aging is the result of complex interactions involving biological, physical, and biochemical processes that cause dysfunctions in cells and organs. Changes in menstrual cycle and physiological processes occur with aging. The quality of fertility (rate of pregnancy) drastically decreases with the qualitative deterioration of oocytes due to aging, analyzed the age-related changes in follicular, luteal, and endocrine, in women (aged over 37 years old). Both functional and structural degradation of the luteal capabilities occurs owing to aging. Younger women typically have menstrual cycles that are more regular and have a constant length of 28 days. But as women get older, their periods would get longer or shorter, and irregularities would happen more frequently. The menstrual cycle undergoes its most major alteration during menopause, which usually strikes women between the ages of 45 and 55. Hormone levels drastically drop during menopause, resulting in the end of menstruation and decreased fertility (Shirasuna and Iwata, 2017).

Traditionally, blood pressure (BP) is measured using the auscultatory method with a sphygmomanometer and stethoscope. According to the American College of Cardiology/American Heart Association (ACC/AHA), normal systolic and diastolic blood pressure for adults is <120 mm Hg and <80 mm Hg, respectively (Giles et al., 2009). In patients 65 years of age and older, the target blood pressure is < 130/80 mmHg (Flack and Adekola, 2020). Physiologic changes associated with aging lead to an increase in systolic blood pressure (SBP), mean arterial pressure (MAP), and pulse pressure (PP), as well as a decreased ability to respond to abrupt hemodynamic changes (Pinto, 2007). Age-related ailments including diabetes, hypertension, and heart disease can also affect heart rate variability (HRV). Although HRV generally decreases with age, healthy habits and regular exercise can help counteract some of these effects (Garavaglia et al., 2021). Women's declining vital capacity is a complicated process that is impacted by alterations in skeletal structure, respiratory muscle strength, chest wall compliance, lung tissue elasticity, and general health. As women age, their respiratory health can be maintained and their vital capacity can be lessened by engaging in regular physical activity, abstaining from smoking and other environmental contaminants, and managing their chronic illnesses properly. (Torrelles et al., 2022). Several things can influence a woman's BMI as she ages. The process of metabolism Women's metabolisms typically slow down with age. This implies that if individuals don't modify their food and exercise routines, they can burn fewer calories while at rest and find it easier to put on weight. A woman's weight and body composition might also be impacted by hormonal changes that occur during menopause. A greater BMI may result from an increase in belly fat brought on by a decrease in estrogen levels (Wahyuni et al., 2022).

Based on inadequate research in our area, which raises the risk of aging on the female fertility, cardiovascular, and respiratory systems, the current study assessed the impact of aging on fertility, BMI, blood pressure, heart rate, and vital capacity in women of reproductive age.

2. Materials and methods

2.1. Subject

The study was carried out in Erbil City from October 2023 to March 2024. All samples of females used in the present study were taken from different places such as secondary Schools and Universities. The samples were divided into the following groups:

Group 1: 15-20 years old (40 females).

Group 2: 21-39 years old (40 females).

Group 3: ≥ 40 years (40 females).

2.2. BMI

The body mass index (BMI), or Quetelet index, is a measure of relative weight based on an individual's mass and height. Devised between 1830 and 1850 by the Belgian polymath Adolphe Quetelet during the developing "social physics", it is defined as the individual's body mass divided by the square of their height – with the value universally being given in units of kg/m^2 (Eknoyan, 2008).

$$BMI = \frac{mass(kg)}{(height(m))^2}$$

For these individuals, the current value settings are as follows: a BMI of 18.5 to 25 may indicate the optimal weight, a BMI lower than 18.5 suggests the person is underweight, a number above 25 may indicate the person is overweight, a number above 30 suggests the person is obese.

2.3. Blood pressure and heart rate

Blood pressure (BP) is the pressure exerted by circulating blood upon the walls of blood vessels and is one of the principal vital signs. A person's blood pressure is usually expressed in terms of the systolic (maximum) pressure over diastolic (minimum) pressure and is measured in millimeters of mercury (mm Hg). Normal resting blood pressure for an adult is approximately 120/80 mm Hg. Heart rate, or heart pulse, is the speed of the heartbeat measured by the number of pounds of the heart per unit of time — typically beats per minute (bpm). The heart rate can vary according to the body's physical needs, including the need to absorb oxygen and excrete carbon dioxide. The standard resting adult human heart rate ranges from 60–100 bpm. In the present study blood pressure and heart rate were measured by using of Digital blood pressure monitor (FULL auto Fuzzy, United Kingdom).

2.4. Vital capacity

Forced vital capacity (FVC) is the volume of air that can forcibly be blown out after full inspiration, measured in liters. Vital capacity is measured by using a simple spirometer.

2.5. Statistical analysis

The data analysis was done with SPSS (Version 17). The findings are shown as mean ± S.E. Tukey's post-hoc test, along with analysis of variance (ANOVA), was utilized to compare the BMI, heart rate, blood pressure, and vital capacity among various age groups. The chi-square test is used to compare the menstrual cycle states (amenorrhea, irregular, and regular) among several populations. P-values below 0.05 were regarded as statistically significant.

3. Results and discussion

3.1. Age and female fertility

The impact of age on fertility is observed in Tables (1 and 2). Chi-square analysis showed significant differences between different groups of ages and a high prevalence of regular menstrual cycles was recorded with age groups (21-39 years), while a low prevalence of regular menstrual cycles was observed with ages (15-20 years and ≥40 years), Table 1. Significant differences in the regular menstrual cycle and amenorrhea appeared between age groups ≥40 years with ages 15-20 years, and 21-39 years, and a high prevalence of amenorrhea were recorded with ages ≥40 years, Table 2.

Table 1. Chi-square analysis for comparison of regular and irregular menstrual cycles among different group ages of women.

	Regular menstrual cycle	**Irregular menstrual cycle**
Group1: 15-20 years	33 (82.5%)	7 (17.5%)
Group2: 21-29 years	36 (90.0%)	4 (10%)
Group3: ≥40 years	26 (65.0%)	8 (20%)

Pearson chi-square = 135.12 p- value = 0.001

Table 2. Chi-square analysis for comparison of regular menstrual cycles and amenorrhea among different group ages of women.

	Regular menstrual cycle	**Amenorrhea**
Group1: 15-20 years	31 (100%)	0.0 (0.0%)
Group2: 21-29 years	36 (100%)	0.0 (0.0%)
Group3: ≥40 years	26 (65.0%)	6 (15.0%)

Pearson chi-square = 8.98 p- value = 0.001

Fertility declines with age. Female fertility is at its peak between the ages of 18 and 24 years (Agboola, 2004), while, it begins to decline after age 27 and drops at a somewhat greater rate after age 35. In terms of ovarian reserve, a typical woman has 12% of her reserve at age 30 and only 3% at age 40. 81% of the variation in ovarian reserve is due to age alone (Wallace and Kelsey, 2010), making age the most important factor in female infertility.

The main function of the corpus luteum is to produce progesterone, which is necessary for the establishment and maintenance of pregnancy. Women's menstrual cycles naturally alter as a result of natural fluctuations in their hormone levels as they age. length of the menstrual cycle, Younger women typically have menstrual cycles that are more regular and have a constant length of 28 days. But as women get older, their periods would get longer or shorter, and irregularities would happen more frequently. menstrual flow, As people age, their menstrual cycle's duration and blood volume may also alter. Older women can have lighter or heavier periods than they did in the past. Symptoms associated with menstruation, As one ages, symptoms including bloating, cramps, and mood swings may also alter. As they age, some women might find a decrease in symptoms, while others might observe a worsening of their symptoms. The menstrual cycle undergoes its most major alteration during menopause, which usually strikes women between the ages of 45 and 55. Hormone levels drastically drop during menopause, resulting in the end of menstruation and decreased fertility (Shirasuna and Iwata, 2017).

3.2. Age and body mass index

As shown in Table 3, ≥ 40 years have significantly ($p \leq 0.01$) higher BMI (25.26 ± 0.65) when compared with 15-20 (21.56 ± 0.87) and 21-29 years women (22.35 ± 0.91). Gaining Weight When they get older, especially after menopause, many women tend to gain weight. Having too much weight, particularly around the waist, can raise blood pressure. Decreased Exercise, A decline in physical activity levels is frequently associated with aging. Several things can influence a woman's BMI as she ages. The process of metabolism Women's metabolisms typically slow down with age. This implies that if individuals don't modify their food and exercise routines, they can burn fewer calories while at rest and find it easier to put on weight. hormonal shifts, A woman's weight and body composition might also be impacted by hormonal changes that occur during menopause. A greater BMI may result from an increase in belly fat brought on by a decrease in estrogen levels (Wahyuni et al., 2022).

Table 3. BMI among different age groups of women (means ± standard errors).

Groups	**BMI**
Group 1: 15-20 years	21.56 ± 0.87 [b]
Group 2: 21-29 years	22.35 ± 0.91 [b]
Group 3: ≥ 40 **years**	25.26 ± 0.65 [a]
p-value	0.01

P-value ≤ 0.05 is considered significant.

Tukey's post-hoc test. No differences between groups with the same letter.

3.3. Age-related to blood pressure and heart rate

Table 4 shows the heart rate, and systolic and diastolic blood pressure among different groups of ages, the results observed significantly lower heart rate ($p \leq 0.05$) and higher systolic ($p \leq 0.01$) and diastolic blood pressure ($p \leq 0.05$) in group 3 (≥40 years) when compared with the other 2 age groups. No significant changes were recorded between groups 1 and 2. Heart rate variability (HRV) is the physiological variation in the duration of the cardiac cycle. With age resting heart rate tends to decline. HRV is mainly controlled by the autonomic nervous system (ANS) through the interplay of sympathetic and parasympathetic neural activity especially at the sinus node. The autonomic nervous system interacts with receptors on the sinoatrial node (SAN) and the relative contributions of the ANS and SAN to HRV have been elucidated (Garavaglia et al., 2021). Many studies have shown that the maximal exercise heart rate declines with age (Sheffield et al., 1978). A common problem in studying the effect of age on the heart is the difficulty in separating the true effects of aging from those due to deconditioning or unrecognized diseases. Deconditioning due to a sedentary lifestyle is a common accompaniment of aging, and undetected significant coronary artery disease may be present in more than one-fourth of persons older than 45 years of age (Weisfeldt, 1980). One cause that leads to a decrease in the heart rate with increasing age may be a decline in the capacity of the sinus node to increase the heart rate. Aging is associated with changes in pacemaker tissue, a decrease in the responsiveness of autonomic cardiovascular reflexes, a decline in the intrinsic heart rate, and decreased adrenergic receptor sensitivity (Ericsson and Lundholm, 1975). Decreased responsiveness of the sinus node to catecholamines may also explain the lower nighttime maximal heart rate of older subjects despite increased plasma norepinephrine levels at night and higher levels of wakefulness and insomnia (Bixler et al., 1979).

Table 4. Heart rate and systolic and diastolic blood pressure of different groups of women (means ± standard errors).

Groups	Heart rate (beat/minute)	Systolic blood pressure (mm Hg)	Diastolic blood pressure (mm Hg)
Group1: 15-20 years	80.34 ± 2.60 [a]	110.54 ± 5.32 [b]	68.32 ± 6.75 [b]
Group2: 21-29 years	81.45 ± 2.54 [a]	112.43 ± 6.43 [b]	74.25± 8.76 [b]
Group4: **≥40 years**	75.35 ± 1.26 [b]	130.22 ± 7.56 [a]	88.67 ± 7.36 [a]
p-value	0.05	0.01	0.05

P-value ≤ 0.05 is considered significant.

Tukey's post-hoc test. No differences between groups with the same letter

The increased blood pressure seen with aging is most likely related to arterial changes, as aging results in the narrowing of the vessel lumen and stiffening of the vessel walls through a process known as atherosclerosis. Atherosclerosis leads to structural alterations, including increased vascular calcification, causing earlier reflected pressure waves during blood pressure wave propagation. The pressure wave arrives back from the aortic root during systole and contributes to the increase in systolic blood pressure. Diastolic blood pressure tends to increase up to 50 years of age due to the rise in arteriolar resistance. The large artery stiffening occurring later in life contributes to wider pulse pressure, including decreased diastolic blood pressure. The increase in arteriolar resistance, in combination with large artery stiffening, leads to a significant increase in systolic blood pressure, pulse pressure, and mean arterial pressure (Pinto, 2007).

The decreased ability to appropriately respond to abrupt hemodynamic changes is rooted in many pathophysiological factors, including a change in heart structure and function and a decrease in the autonomic regulation of blood pressure. Left ventricular hypertrophy and a decrease in left ventricle compliance correlate with a reduction in cardiac performance and in the ability to increase systolic blood pressure in response to stress. The autonomic system plays a key role in maintaining blood pressure through physiologic responses to standing, volume depletion, and increased cardiac output during stress. With a decrease in the autonomic regulation of blood pressure, there is a significant impact on physiologic adaption. One example includes the high prevalence of orthostatic hypotension among the elderly population (Zhu et al., 2016).

Stiffening of the arteries is one of the hallmarks of aging. In younger individuals, the peripheral arterial system is more rigid than the central arterial system. With time, this finding reverses, and older individuals have greater central artery stiffness compared to peripheral arteries. This reversal and increased stiffening of the larger central arteries is multifactorial in etiology. Changes in structural components, increased reactive oxygen species, inflammatory changes, and endothelial dysfunction are among the causes of the changes in arterial structure and function seen with aging. The ratio of collagen to elastin increases with age leading to an increase in arterial stiffness. This change may also be present in ventricular smooth muscle cells. In the ventricular wall, a decrease in elastin results in a less compliant heart wall, leading to an increase in diastolic filling pressure. There are many hypotheses for why this change occurs in older populations, including material fatigue and various signaling pathways leading to the destruction of elastin and increased collagen deposition. Recent studies have shown that angiotensin II, along with the activation of TGF-B1 and matrix metalloproteinases are some of the signaling molecules that may be involved (Xu et al., 2017).

An increase in the levels of inflammatory mediators seen with aging leads to the production of reactive oxygen species, which may lead to endothelial damage predisposing the vascular system to atherosclerosis. Atherosclerosis presents with endothelial injury or dysfunction. It is a slow process by which large-to-medium-sized arteries (e.g., abdominal aorta, popliteal artery, carotid artery, coronary artery) undergo thickening of the intimal layer of blood vessel walls, leading to less compliant arteries. This process initiates endothelial damage, permitting lipid transport through the innermost layer of arteries, the intima, into the lumen of the vessels. These lipids are then oxidized and consumed by macrophages, resulting in the formation of foam cells and fatty streaks. Subsequently, an inflammatory and healing process ensues. An increase in various growth factors allows for the recruitment and proliferation of smooth muscle cells, which form a fibrous cap with a lipid core (Dai et al., 2015).

Other pathophysiologic factors contributing to increased blood pressure with aging include decreased baroreceptor sensitivity, increased responsiveness to SNS stimuli, altered renal and sodium metabolism, and altered renin-aldosterone relationship (Weber et al., 1989).

3.5. Age-related to vital capacity

Age-related vital capacities are presented in Table 5. The results found significantly (≤ 0.01) lower vital capacity in age $\geq$ 40 years women when compared with 15-20 and 21-29 years old. No significant differences were observed between groups 1 and 2.

Table 5. Vital capacity among different age groups of women (means ± standard errors).

Groups	Vital capacity (ml)
Group 1: 15-20 years	1780.00 ± 60.58 [a]
Group 2: 21-29 years	1890.35 ± 70.34 [a]
Group 3: ≥ 40 years	1500.35 ± 46.89 [b]
p-value	0.01

P-value ≤ 0.05 is considered significant.

Tukey's post-hoc test. No differences between groups with the same letter.

Lung vital capacity is the maximum volume of air in the lungs at the time of entry and out of the lungs during the breathing cycle, namely at the time of maximal inspiration and maximal expiration. Lung vital capacity development describes the ability of the lungs and chest cavity. Lung vital capacity lungs ability to hold oxygen in the measurement can be done by way of ofinspiration and expiration as possible. Kapasital vital lung capacity greater than the oxygen will also be more and more. Lung capacity can be divided into two: 1) the total capacity is the amount of air to fill the lungs at the time of maximal inspiration, and 2) Vital capacity is the amount of air that can be issued after maximal respiration. Several factors can affect the measurement of the vital capacity of the lungs in humans' posture, age, gender, physical, pregnancy, and physical training (Badri et al., 2021).

Changes in pulmonary elastic and resistive properties, and maximum expiratory flow with increasing age, were first described 40 years ago, admittedly by small cross-sectional studies of young adults versus elderly subjects. These studies established that the maximum size of the lungs (total lung capacity) did not change with age, but functional residual capacity (FRC) and residual volume (RV) both increased so that inspiratory capacity and vital capacity (VC) both declined (Cohn and Donoso, 1963).

4. Conclusions

The current study concluded that women with ages ≥ 40 years have a lower regular menstrual cycle and higher irregular menstrual cycle and amenorrhea when compared with ages 15-20 and 21-39 years. Higher BMI and blood pressure and lower heart rate and vital capacity were recorded in women aged ≥ 40 years as compared with ages 15-20 and 21-39 years.

Conflict of Interest

The authors declare no conflict of interest

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