ORIGINAL ARTICLE

CONTENTS

Sex- and qualification-dependent differences in heart rate and blood pressure among swimmers

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ABSTRACT

Aim: To comparatively analyze heart rate and blood pressure in swimmers of varying skill levels and genders, utilizing contemporary scientific data alongside our own observations.

Materials and Methods: A total of 411 swimmers (270 men, 141 women) competing in 100–200 m distances were examined at the beginning of the preparatory training phase. Participants were divided into three groups: beginners, intermediate level, and high-class athletes. Blood pressure was measured using the Korotkoff method with an aneroid sphygmomanometer, and heart rate was recorded by auscultation after 5 minutes of rest.

Results: High-class athletes had lower HR and higher systolic BP compared to beginners. Male swimmers exhibited lower HR and higher BP than females, with significant sex differences in systolic BP across all qualification levels. Findings highlight the influence of sports proficiency and sex on cardiovascular parameters in swimmers.

Conclusions: Male swimmers exhibited bradycardia and hypertension more frequently, while female swimmers had higher rates of tachycardia and hypotension. Higher sports qualification in males was associated with lower heart rates and increased blood pressure, whereas female swimmers showed no HR differences across levels but had higher BP at advanced levels. Gender differences were most pronounced in high and intermediate level qualification groups, with males showing lower HR and higher BP than females.

KEY WORDS: heart rate, blood pressure, tachycardia, hypotension, hypertension, swimmers

Wiad Lek. 2026;79(4):763-770. doi: 10.36740/WLek/216925 DOI

INTRODUCTION

The prevailing view suggests that proper training enhances cardiovascular function, typically manifesting as bradycardia and hypotension. However, empirical data and studies show these parameters don't always indicate positive adaptation; bradycardia can result from overtraining or insufficient training [1-5]. Resting heart rate (HR) is influenced by cardiac function, sinoatrial node excitability, and autonomic regulation, with non-athletic females typically having a 7–8 bpm higher HR than males [1]. HR in the general population varies with metabolic rate and activity [5]. In athletes, HR fluctuations depend on age, sex, body composition, sport, training experience, competitive level, and training phase, with lowest HR during peak conditioning [3-10]. Bradycardia in athletes often accompanies increased cardiac volume, reduced blood pressure (BP), and decreased cardiac output, suggesting efficient resting heart function [5]. Lower HR may protect against myocardial wear [3], induced by increased vagal tone from training. However, endurance athletes might not always show bradycardia due to training intensity, leading to incomplete HR recovery from fatigue. Tachycardia can result from overtraining, detraining [10], incomplete recovery, heart failure, or intoxication [5, 7].

BP in non-athletes is affected by age, sex, weight, activity, and hormones [11]. Accurate BP assessment in athletes is crucial for training eligibility and managing hypo- and hypertension [12]. Despite research, definitive conclusions on sports' effects on BP are lacking due to the diverse nature of athletic activities influencing functional state. Most athletes have normal BP [3, 13]. For speed and power athletes, systolic BP is 112.0±5.9 mmHg and diastolic BP (DBP) is 68.5±9.2 mmHg [13].

In 13-14 year old swimmers (3rd-2nd class), systolic BP is 113.9±1.87 mmHg and DBP is 68.93±2.63 mmHg [13]. BP in most athletes remains stable even at peak performance [14], though some show deviations [3, 6]. During primary training, 70.8% of athletes have normal BP, 10.1% elevated, and 19.1% hypotension [3, 6].

Hypotension prevalence is similar in athletes and non-athletes, with Lang observing a ~20 mmHg BP decrease in 63% of athletes [4]. Sports-related hypotension can be physiological or pathological, requiring exclusion of pathological causes first. Many consider sports hypotension an adaptation to exertion, influenced by age, athletic level, sport, training phase, and less so by experience and profession, being common in young, skilled athletes during main training, increasing with sports years. Hypotension incidence varies by qualification: Masters of Sport (21%), first-class (14.7%), second-class (14.9%), third-class (3.0%), and beginners (2.5%) [12]. Gender also affects prevalence [4, 6, 8], with female athletes experiencing it twice as often as non-athletes [12], and Levin reporting 26.0% in females vs. 12.8% in males [8], though Zharikov found it 1.5 times more common in men [6]. Deshin et al. [1] noted hypotension isn't always a good training marker, potentially indicating impaired circulation, overtraining, or neurocirculatory hypotension. Initially considered a hallmark of high-level training [3, 12], later analysis showed only 33.2% of hypotensive athletes exhibit it physiologically, with others possibly having infections or fatigue. Volnov [15] found SBP decreased in ~1/3 and DBP in 1/2 of athletes with increased training, generally by 10–15 mmHg. Hypotension prevalence in athletes ranges from 10% to 16% [5, 8], but some studies report higher rates (24% [16], 45-50% in highly trained athletes, including 50% in swimmers [17]). Despite this, BP below 95-100/60 mmHg is uncommon in elite athletes [5, 11]. Levin [8] found highest hypotension in gymnasts (30.0%), then track and field (25.6%), swimmers (13.0%), and soccer players (7.5%), suggesting sport-specific activity influences BP regulation.

Training regimen also affects elevated BP prevalence [18]. Serkin [19] reported 2%, Shakhlina [4] 11-14%, Volnov [15] 11.7%, and Ryzhkova [20] 17.8%. Among elite athletes, elevated BP prevalence was 5.3% [7], with highest incidence in weightlifters (21.2%), then soccer (16.6%), volleyball (15.6%), track and field (10.6%), and swimmers (9.1%) [15]; Zharikov [6] reported 6% in swimmers. Karpman [3] attributed elevated BP in athletes to multifactorial causes, including early hypertension stages, underlying diseases, or improper training leading to fatigue and overstrain. Hypertension in athletes and the general population is influenced by gender and age, being three times more common in men [12] and increasing with age [15]. Isolated BP elevations warrant attention as they may indicate vascular hyperreactivity and potential for persistent hypertension under stress [6].

Therefore, generalized HR and BP data in athletes, without considering specific factors, has limited value. Focused data on pathological hypo- and hypertension in specific groups, like 100-200m swimmers, considering skill, gender, and training phase, is needed and incorporated in our study.

AIM

The aim of this study is to comparatively analyze heart rate and blood pressure in swimmers of varying skill levels and genders, utilizing contemporary scientific data alongside our own observations.

MATERIALS AND METHODS

PARTICIPANTS

The study was conducted from 2018 to 2022 at the Zaporizhzhya Regional Medical and Physical Culture Dispensary, Zaporizhzhya, Ukraine. At the beginning of the preparatory phase of the training process, 411 athletes (270 men and 141 women), all swimmers in the 100–200 meter distance, were examined. The participants included beginners, intermediate-level, and high-class athletes (Table 1). All participants had no history of cardiovascular diseases. Informed consent was obtained from all participants (or their legal representatives) prior to their involvement in the study.

METHODS OF RESEARCH

Blood pressure was measured using the Korotkoff method with an aneroid sphygmomanometer (Romed, Netherlands) while the participant was seated. A standard cuff, appropriate for the circumference of the subject's upper arm, was used to measure blood pressure. The cuff was positioned on the upper arm of the right arm, 2–3 cm above the antecubital fossa. The diaphragm of the stethoscope was placed over the brachial artery in the antecubital fossa. The cuff was inflated rapidly to a pressure 20–30 mmHg higher than the expected systolic blood pressure (SBP), after which the pressure was decreased gradually at a rate of 2–3 mmHg per second. SBP was recorded when the first Korotkoff sounds were heard, and diastolic blood pressure (DBP) was recorded when the sounds disappeared. Measurements were repeated three times, with a 5-minute interval between each, and the lowest reading was used for analysis.

Table 1. General Characteristics of Swimmers Competing at 100-200 Meters (Mean ± SE)

Group (by sports qualification)	Subgroup (by sex)	Age, years
Beginners (3rd – 2nd class athletes)	males – 101	18.4±0.22
	females – 44	18.0±0.36
Intermediate level (1st class – Candidate for Masters of Sports)	males – 148	16.0±0.14
	females – 90	14.8±0.18
High-class (Masters of Sports – Masters of Sports, International Class)	males – 21	13.7±0.27
	females – 7	13.0±0.69

Source: compiled by the authors of this study

Heart rate was measured by auscultation in a seated position after 5 minutes of rest. The diaphragm of the stethoscope was placed at the apex of the heart. Heart sounds were auscultated for 1 minute, and the number of beats counted was recorded as the heart rate in beats per minute.

STATISTICAL ANALYSIS

Data were analyzed using the Statistica 6.0 software. The Shapiro-Wilk test was applied to assess the normality of the data distribution. Results are presented as the mean (M) ± standard error of the mean (SE). A two-sided independent t-test was used to compare differences between groups. The chi-square test was used to assess differences in categorical data. Differences were considered statistically significant at a p-value of < 0.05.

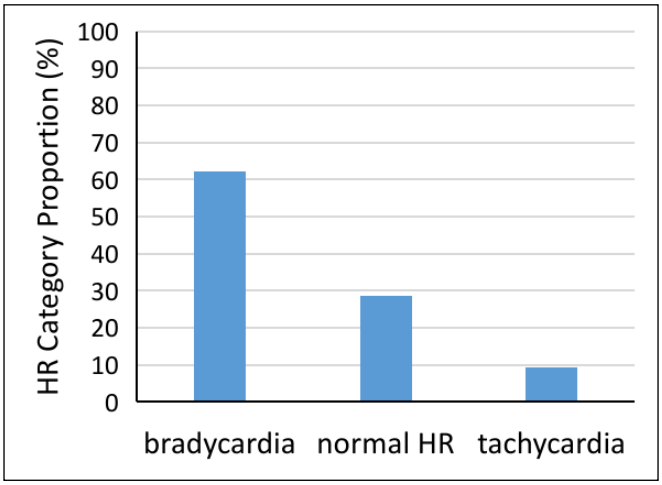

Fig. 1. Percentage ratio of male swimmers with bradycardia, normal heart rate, and tachycardia
Picture taken by the authors

ETHICS

This work complies with the principles of the Declaration of Helsinki.

RESULTS

CHARACTERISTICS OF THE STUDIED POPULATION OF MALE SWIMMERS

A total of 270 male swimmers with varying levels of sports qualifications participated in the study. The mean age of the athletes was 16.7 ± 0.14 years. The mean resting HR was 68.7 ± 0.57 bpm, the mean SBP was 118.7 ± 0.84 mmHg, and the mean DBP was 74.3 ± 0.61 mmHg.

Heart rate analysis showed that 62.2% of athletes had HR within the normal range, 28.5% had bradycardia, and 9.3% had tachycardia (Fig.1). The results of blood pressure measurements revealed that 60.4% of athletes had SBP within the normal range, 14.1% had hypotension, and 25.5% had hypertension. Regarding DBP, 72.2% of athletes had normal values, 16.3% had hypotension, and 11.5% had hypertension.

COMPARATIVE ANALYSIS OF MALE SWIMMERS BY SPORTS QUALIFICATION

Analysis of the studied indices across different qualification levels (Table 2) revealed statistically significant differences in age between all groups ($p < 0.001$). HR was significantly lower in high-class swimmers compared to intermediate level swimmers (66.4 ± 0.90 vs. 69.6 ± 0.74 bpm, $p = 0.006$), as well as compared to beginners (66.4 ± 0.90 vs. 74.0 ± 2.20 bpm, $p = 0.003$). SBP did not differ significantly between high-class and intermediate level swimmers (120.2 ± 1.11 vs. 119.3 ± 1.22 mmHg, $p = 0.546$), but was significantly higher in high-class swimmers compared to beginners (120.2 ± 1.11 vs. 107.9 ± 2.84 mmHg, $p < 0.001$). Similarly, DBP was significantly higher in high-class swimmers compared to beginners (74.8 ± 0.96 vs. 69.8 ± 1.84 mmHg, $p = 0.022$), but there were no significant differences between high-class and intermediate level swimmers ($p = 0.902$).

In the group of high-class swimmers, the highest proportion of athletes with bradycardia (36.63%) was observed compared to intermediate level (25.0%) and beginner (14.28%) swimmers. However, the differences in bradycardia prevalence between the groups were not statistically significant ($p > 0.05$, Table 1).

Table 2. Distribution of male athletes by heart rate, systolic and diastolic blood pressure depending on sports qualification (Mean ± SE)

Parameter	High-class n=101	Intermediate level n=148	Beginner n=21
Heart rate			
normal HR (61-79 bpm)	n=57 (56.4%)	n=97 (65.5%)	n=14 (66.7%)
bradycardia (≤60 bpm)	n=37 (36.7%)	n=37 (25.0%)	n=3 (14.3%)
tachycardia (≥80 bpm)	n=7 (6.9%)	n=14 (9.5%)	n=4 (19.0%)
Systolic blood pressure			
normal (101-129 mm Hg)	n=71 (70.3%)	n=82 (55.4%)	n=10 (47.6%)
hypotensive (≤ 100 mm Hg)	n=6 (5.9%)	n=24 (16.2%)	n=8 (38.1%)
hypertensive (≥130 mm Hg)	n=24 (23.8%)	n=42 (28.4%)	n=3 (14.3%)
Diastolic blood pressure			
normal (61-89 mm Hg)	n=73 (72.2%)	n=108 72.0%)	n=14 (66.7%)
hypotensive (≤ 60 mm Hg)	n=14 (13.9%)	n=23(15.5%)	n=7 (33.3%)
hypertensive (≥ 90 mm Hg)	n=14 (13.9%)	n=17(11.5%)	n=0 (0%)

Source: compiled by the authors of this study

Normal SBP values were significantly more frequent in high-class athletes (70.3%) compared to intermediate level athletes (55.4%, p = 0.05). Hypotension of SBP was more common in beginner athletes (38.1%) compared to intermediate level (16.2%) and high-class (5.94%) athletes, though these differences did not reach statistical significance (p > 0.05). No significant intergroup differences were found for DBP (p > 0.05).

CHARACTERIZATION OF THE STUDIED POPULATION OF FEMALE SWIMMERS

A total of 141 female athletes with varying sports qualifications participated in the study. The mean age of the participants was 15.7 ± 0.21 years. The mean resting HR was 69.9 ± 0.78 bpm, the mean SBP was 108.3 ± 1.07 mmHg, and the mean DBP was 71.6 ± 0.76 mmHg. HR analysis indicated that 66.7% of the athletes exhibited normal HR, 19.8% had bradycardia, and 13.5% had tachycardia (Fig. 2). Blood pressure measurements showed that 61.0% of the athletes had SBP within the normal range, 31.9% exhibited hypotension, and 7.1% had hypertension. Regarding DBP, 61.7% of the female athletes were normotensive, 32.6% had hypotension, and 5.7% had hypertension.

COMPARATIVE ANALYSIS OF INDICATORS IN FEMALE SWIMMERS BY SPORTS QUALIFICATION

Statistically significant differences in age were observed between the groups of female athletes (p < 0.05 for all comparisons). However, no significant differences in HR were detected between the groups (Table 3).

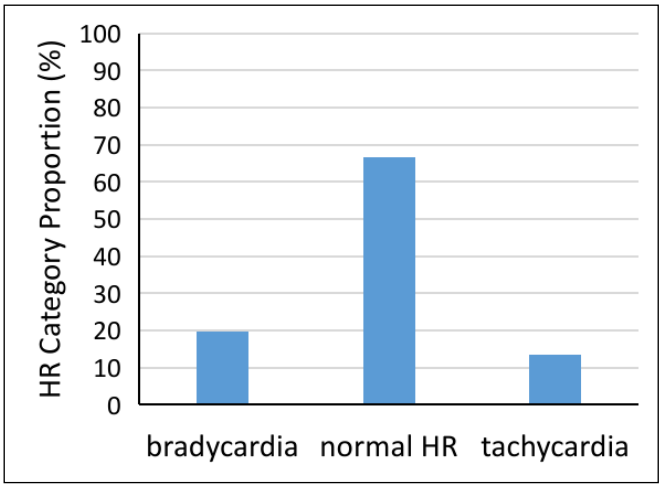

Fig. 2. Percentage ratio of female swimmers with bradycardia, normal heart rate, and tachycardia
Picture taken by the authors

There were no differences in SBP between high-class and intermediate level swimmers (p = 0.258); however, beginner swimmers had significantly lower SBP values compared to both high-class (p = 0.012) and intermediate level swimmers (p = 0.026). In terms of DBP, high-class female swimmers had significantly higher values than intermediate level swimmers (p = 0.046), while no significant differences were found when comparing high-class and beginner swimmers (p > 0.05).

Normal HR values were most frequently observed in intermediate level female athletes (67.8%), while bradycardia was more prevalent among high-class female athletes (27.3%), and tachycardia was predominantly found in beginner female athletes (42.9%). However, no statistically significant differences were identified between the groups (p > 0.05) (Table 3).

Table 3. Distribution of female athletes by heart rate, systolic and diastolic blood pressure depending on sports qualification (Mean ± SE)

Indicator	High-class n=44	Intermediate level n=90	Beginner n=7
Heart rate			
normal HR (61-79 bpm)	n=29 (65.9%)	n=61 (67.8%)	n=4 (57.1%)
bradycardia (≤60 bpm)	n=12 (27.3%)	n=16 (17.8%)	n=0 (0%)
tachycardia (≥80 bpm)	n=3 (6.8%)	13 (14.4%)	n=3 (42.9%)
Systolic blood pressure			
normal (101-129 mm Hg)	n=28 (63.6%)	n=56 (62.2%)	n=2 (28.6%)
hypotensive (≤100 mm Hg)	n=12 (27.3%)	n=28 (31.1%)	n=5 (71.4%)
hypertensive (≥130 mm Hg)	n=4 (9.1%)	n=6 (6.7%)	n=0 (0%)
Diastolic blood pressure			
normal (61-89 mm Hg)	n=32 (72.7%)	n=2 (57.8%)	n=3 (42.9%)
hypotensive (≤60 mm Hg)	n=9 (20.5%)	n=34 (37.8%)	n=3 (42.9%)
hypertensive (≥90 mm Hg)	n=3 (6.8%)	n=4 (4.4%)	n=1 (14.2%)

Source: compiled by the authors of this study

Normal SBP values were most frequently observed in high-class female athletes (63.6%). A hypotensive state of SBP was predominant in beginner female athletes (71.4%), whereas hypertensive state of SBP was absent in this group but was observed more frequently among high-class female athletes (9.1%). However, no statistically significant differences were found between the groups ($p > 0.05$).

Regarding DBP, normal values were more common in high-class female athletes (72.7%), whereas a hypotensive state was more frequently recorded in intermediate level (37.8%) and beginner (42.9%) female athletes. No statistically significant differences were observed between the groups ($p > 0.05$).

COMPARATIVE ANALYSIS OF INDICATORS IN MALE AND FEMALE SWIMMERS

HIGH-CLASS SWIMMERS

There were no significant differences in age between high-class male and female swimmers (18.4±0.22 vs. 18.0±0.36 years, p=0.340). However, male swimmers had a statistically significantly lower resting HR compared to females (66.4±0.90 vs. 70.1±1.38 bpm, p=0.026).

The proportion of athletes with bradycardia was higher in males (36.6% vs. 27.3% in females), but this difference did not reach statistical significance (p=0.552). The incidence of tachycardia was almost identical between males and females (6.9% vs. 6.8%, p=0.999).

SBP was significantly higher in male swimmers compared to females (120.2±1.11 vs. 110.7±1.76 mm Hg, p<0.001). There were no significant differences in DBP between the two groups (74.8±0.96 vs. 72.2±1.32 mm Hg, p=0.117).

INTERMEDIATE LEVEL SWIMMERS

In the group of intermediate level swimmers, males were older than females (16.0±0.14 vs. 14.8±0.18 years, p<0.001) and had statistically significantly lower resting HR (69.6±0.74 vs. 71.9±0.92 bpm, p=0.05). Intermediate level male swimmers had significantly higher SBP (119.3±1.22 vs. 108.2±1.34 mm Hg, p<0.001) and DBP (74.6±0.85 vs. 68.8±0.97 mm Hg, p<0.001) compared to female swimmers. The hypotensive state of DBP was observed in 37.8% of female swimmers and 15.5% of male swimmers (p=0.068).

BEGINNER SWIMMERS

In the group of beginner swimmers, there were no statistically significant differences in age (13.7±0.27 years in males vs. 13.0±0.69 years in females, p=0.395) or HR (74.0±2.20 vs. 78.0±3.93 bpm, p=0.395). However, SBP was significantly higher in male swimmers (107.9±2.84 vs. 95.0±4.50 mm Hg, p=0.034). There were no differences in DBP between the groups (69.8±1.84 vs. 70.0±4.36 mm Hg, p=0.961).

DISCUSSION

Early sports medicine research (1960s) on athletes' bradycardia, tachycardia, hypotension, and hypertension often lacked consideration for sport, training period, qualification, and gender. This study presents new HR data for soccer players across qualifications (3rd class to MSIC), including healthy athletes and those with bradycardia/tachycardia, alongside BP and hypo-/hypertension data [21, 22]. It also investigates HR and BP in swimmers based on qualification and distance, comparing male and female athletes.

Prior research indicates exercise lowers HR, most significantly in endurance athletes (36-66 bpm, often <50 bpm). Speed athletes show less HR reduction (48-72 bpm), as do those in static/dynamic sports (50-70 bpm in speed/strength athletes; 52.6±4.8 bpm in highly skilled speed/strength athletes [5, 7, 13]). Our study of 693 soccer players (mean age 19.9±0.18 years, 3rd class to MSIC) showed a mean HR of 67.8±0.38 bpm, with 34.49% bradycardia and 10.24% tachycardia [21]. Limited data exists on young athletes' HR [23].

In male swimmers, bradycardia was more common in high-class swimmers (36.63%) than intermediate (25.0%, p=0.048) and beginner (14.28%, p=0.047). Hypotensive systolic BP (SBP) was more frequent in beginner males (38.10%) vs. intermediate (16.22%, p=0.016) and high-class (5.94%, p<0.001). A similar trend was seen for diastolic BP (DBP) hypotension: beginner (33.3%) > intermediate (15.5%, p=0.045) > high-class (13.9%, p=0.031). No significant differences in tachycardia or hypo-/hypertensive SBP/DBP were found between male qualifications. Thus, as male swimmers' qualification increases, bradycardia becomes more frequent, while hypotensive SBP/DBP decreases.

In female swimmers, bradycardia was absent in beginners. Tachycardia was more frequent in beginner females vs. intermediate (42.9% vs. 14.4%, p=0.05) and high-class (42.9% vs. 6.8%, p=0.006). Hypotensive SBP was more prevalent in beginner females vs. intermediate (71.4% vs. 32.1%, p=0.035) and high-class (71.4% vs. 27.3%, p=0.021). Hypotensive DBP was more frequent in intermediate females than high-class (37.8% vs. 20.5%, p=0.043). No significant differences in hypertensive SBP/DBP were found in females, and hypertensive SBP was absent in beginners.

Bradycardia/tachycardia frequencies didn't significantly differ between female swimmer qualifications, except for bradycardia absence in beginners (present in 14.3% of beginner males). This suggests qualification minimally impacts HR in females. High-class females had more hypotensive SBP than high-class males (27.3% vs. 5.9%, p<0.001) and intermediate males (32.1% vs. 16.2%, p=0.004). Conversely, high-class and intermediate males had more hypertensive SBP. Intermediate females had more hypotensive DBP than intermediate males (37.8% vs. 15.5%, p<0.001). Beginner males and females showed no significant differences in hypotensive SBP/DBP, but hypertensive SBP was seen in male beginners (14.3%) only, while hypertensive DBP was seen in female beginners (14.3%) only. No significant differences in hypo-/hypertensive DBP were found in high-class males, but hypertensive DBP was seen in intermediate males.

Significant changes in training, competition, and recovery methods over the last 50-60 years necessitate considering sport, qualification, age, and gender in research. Older studies lacking these considerations provide historical context. Limited, small-sample HR studies exist for swimmers [24]. Our intermediate male swimmers (similar qualification and age to a Ukrainian group [25, 26]) showed similar HR. However, elite French male swimmers (100-400m) had lower HR than Belotserkovsky's high-class swimmers [23, 27] and our high-class male swimmers (likely due to no 400m specialists in our group). A 2006 study of elite male swimmers (50-100m) showed HR closer to the French group [25, 26]. Elite French female swimmers also had lower HR than our high-class females and those in a 2006 study (50-100m) [25-27]. These discrepancies may be due to body position during measurement (seated vs. supine) and training period phase.

Bradycardia frequency was 28.5% in our male swimmers and 19.9% in females. Tachycardia was 9.7% in males and 13.5% in females. Bradycardia was more frequent in high-class male swimmers vs. intermediate and beginner males. No significant tachycardia differences were found in male qualifications. In females, bradycardia was higher in high-class vs. intermediate (non-significant) and absent in beginners. Tachycardia was higher in beginner females vs. high-class and intermediate females. Soccer player data [22] showed more bradycardia and less tachycardia with increasing qualification. Our data suggests increasing qualification and training positively impacts the cardiovascular system in swimmers, increasing bradycardia and decreasing tachycardia.

Regarding BP, normal SBP was seen in ~60% of both genders. Hypotension was 2.27 times more frequent in females (32.6%) than males (14.1%), aligning with other findings [8, 28]. Hypertension was 3.6 times more common in males (25.6%) than females (7.1%, non-significant), also consistent with existing data [28]. Small, varied methodology BP studies in swimmers make direct comparison difficult [29-31].

Hypotension in athletes can be physiological or pathological [3, 4, 32, 33], with physiological cases being a minority [2, 8]. Our data showed statistically more frequent hypotension in female swimmers overall (31.9% vs. 14.1%, p=0.05). However, no significant gender differences in hypotension prevalence were found within qualification groups. Similarly, no significant differences in hypertension prevalence were found across male or female qualification groups, nor overall between genders (males 25.6%, females 7.1%, p=0.196).

CONCLUSIONS

1. Overall, male swimmers exhibited bradycardia 2.8 times more frequently and hypertensive states 3.6

times more frequently than female swimmers. Conversely, female swimmers experienced tachycardia 1.5 times more often ($p>0.05$) and hypotensive blood pressure states 2.3 times more often ($p=0.05$) than male swimmers.

2. Among male swimmers, those of high-class level showed lower heart rates, a higher incidence of bradycardia, and elevated systolic and diastolic blood pressure compared to male swimmers of intermediate and beginner levels. Beginner male swimmers more commonly experienced decreased systolic and diastolic blood pressure.
3. Heart rates did not differ among female swimmers of varying qualifications. High and intermediate level female swimmers had higher systolic and diastolic blood pressure and experienced diastolic hypotension more frequently than beginner female swimmers. Beginner female swimmers more often presented with tachycardia and decreased systolic blood pressure.
4. High and intermediate level male swimmers had significantly lower heart rates and higher systolic blood pressure (with intermediate level male swimmers also showing higher diastolic blood pressure), but less frequently experienced systolic hypo- and hypertension compared to female swimmers of similar qualifications. Intermediate level male swimmers had a lower incidence of diastolic hypotension than female swimmers. There were no gender differences among beginner male and female swimmers, except for systolic blood pressure, which was higher in males.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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RECEIVED: 11.04.2025
ACCEPTED: 13.01.2026