

Impact of Nocturnal Push-Up on Morning Values of Peripheral Oxygen Saturation and Cardiovascular Indices in Young Males

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<p>Abstract: A typical physical exercise is characterized by intensity, frequency, duration and rhythmicity. The study investigated the effect of nocturnal push-up on morning values of peripheral oxygen saturation (SPO₂) and cardiovascular indices in apparently healthy males who have neither participated in pushup nor any programmed physical activities in the past three months. 15 apparently healthy young males averaging 16 years executed pushup work-out (44reps/min) between 7pm and 9 pm for a period of 2 weeks. SPO₂, blood pressure and pulse rate were measured early in the morning between 6am and 8am 1 week before commencement of workout, two weeks of workout and a week after cessation of workout. Morning values of blood pressure and pulse rate were not significantly affected by either two week of pushup or cessation. However, morning value of SPO₂ was significantly increased following 2 weeks of nocturnal pushup. 1week following cessation, SPO₂ was not significantly altered. The finding of the study showed the beneficial effect of nocturnal pushup on peripheral oxygen saturations in young males.</p> <p>Keywords: Nocturnal pushup, pulse rate, workout, SPO₂, blood pressure, cardiovascular indices.</p> <p>Copyright © 2024 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.</p>	<p>Research Paper</p>
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	<p>How to cite this paper: Mayowa Jeremiah Adeniyi & Anna Chika Idaguko (2024). Impact of Nocturnal Push-Up on Morning Values of Peripheral Oxygen Saturation and Cardiovascular Indices in Young Males. <i>Middle East Res J. Med. Sci.</i> 4(1): 12-17.</p> <p>Article History: Submit: 11.12.2023 Accepted: 12.01.2024 Published: 01.02.2024 </p>

INTRODUCTION

Physiological processes and mechanisms fluctuate in distinct rhythmical patterns (Awosika *et al.*, 2023; Adeniyi and Agoreyo, 2017). While some require more than 24 hours, others are achieved either in less than 24 hours or at an approximation of 24 hours (Adeniyi *et al.*, 2021; Adeniyi *et al.*, 2020; Awosika *et al.*, 2023). Fluctuations in physiological processes and mechanisms requiring 24 hours approximation are known as circadian rhythms (Adeniyi *et al.*, 2023). Circadian fluctuations in blood pressure, pulse rate and peripheral oxygen saturation evolved for energy optimization. Typically, blood pressure, heart rate and pulse rate are known to exist at basal level after awakening justifiable by low metabolic demand. Without any stress, morning values of systolic and diastolic blood pressure are in the range of 90 to 120 mmHg and 60-80 mmHg respectively, pulse rate and peripheral oxygen saturation are expected to be between 60 and 100 BPM and 95-100% respectively. Non-exertion-related increase in heart rate in the morning indicates a heart struggling hard to meet body metabolic demand at rest. Morning rise in blood pressure is a

predictor of cardiovascular diseases (Hering *et al.*, 2011; Oni and Adeniyi, 2017; Adeniyi *et al.*, 2023). Insufficient blood oxygenation and impaired blood flow are reflected by low peripheral oxygen saturation (Adeniyi *et al.*, 2023; Adeniyi and Awosika, 2023; Awosika *et al.*, 2022).

In a study by Akbay *et al.*, (2022), recovery systolic blood pressure, maximum systolic blood pressure and diastolic blood pressure were correlative with morning surge in blood pressure but an independent relationship was observed between recovery systolic blood pressure and morning surge in blood pressure. Lambert *et al.*, (2014) found no association between morning blood pressure surge and cold pressor test induced muscle sympathetic nerve activity, an index of autonomic vascular function (Adeniyi *et al.*, 2022). In hypertensive individuals, rate of morning surge in blood pressure was found to be greater in normotensive subjects (Luo *et al.*, (2013); rate of the morning surge in blood pressure was reportedly associated with cardiovascular and stroke events.

Morning values of blood pressure, pulse rate and peripheral oxygen saturation rise under physical exertion and stress (Adeniyi, 2022; Adeniyi *et al.*, 2023; Adeniyi *et al.*, 2023). Although physical activity is known to alter blood pressure, pulse rate and peripheral oxygen saturation, not much is known about the impact on morning values of cardiovascular indices. A study by Yi *et al.*, (2022) indicated that night active population exhibited increased mortality from cardiovascular diseases than day active population. Night physical activity was reported to modulate autonomic heart rate control in the first sleeping hours without altering sleep quality (Myllymaki *et al.*, 2011). Morning exercise was shown to enhance parasympathetic activity evidenced by low heart rate variability while nighttime exercise orchestrated increased sympathetic activity and high heart rate variability (Yujiro *et al.*, 2015). There is insufficient information about the effect of nighttime pushup on morning values of blood pressure, pulse rate and peripheral oxygen saturation. Therefore the aim of the study was to determine the impact of nocturnal pushup on morning values of peripheral oxygen saturation, blood pressure and pulse rate.

METHODOLOGY

Study Design

The study was conducted in Iyamho, a town situated in Etsako West Local Government Area of Edo State, Nigeria.

Subjects

15 apparently healthy young males averaging 16 years old were recruited for the study out of a pool of 20 participants through respondent driven sampling. Written consent was obtained from each subject and a well-structured questionnaire was administered to rule out those with medical history of musculoskeletal, respiratory, cardiovascular, kidney, hepatic and metabolic diseases or anatomical deformities as well as to participation in school game. History of smoking, alcoholism and caffeine and any form of medication was also taken.

Subjects who have neither participated in pushup nor any conventional exercise were ruled out.

Experimental Protocol

The study was a residence-based investigation, carried out in Iyamho. Participants were acquainted

with procedures in executing pushup workout on the first day of the study. Pushup workout was conducted in the night between 8pm and 10pm at 44reps/min.

Pushup workout was done for two consecutive weeks.

Morning values of SPO₂, Blood pressure and pulse rate were measured between 6am to 8am using Pulse Oximeter, Sphygmomanometer and Stop Watch respectively.

Measurements were obtained a week (in the morning) prior to the pushup a day after the two week pushup (in the morning) and 1 week after cessation of pushup (in the morning).

Measurement of Blood Pressure

Blood pressure was measured from the arm, an inch above the elbow using Omron BP7000 Evolve Wireless Upper Arm Sphygmomanometer (Iris Global Care, China). Baseline readings were taken at sitting position as previously reported (Okeke *et al.*, 2023; Adeniyi *et al.*, 2021). Blood pressure measurements were also obtained for each of the legs at the first perception of exertion.

Pulse pressure was determined by subtracting diastolic blood pressure from systolic blood pressure.

Mean arterial blood pressure was obtained using; diastolic blood pressure +1/3 of pulse pressure.

Determination of Peripheral Oxygen Saturation

Peripheral oxygen saturation was measured using digital Pulse Oximeter MD300C25, Columbia, SC 29223.

Statistical Analysis

Statistical analysis was conducted using Statistical Package for Social Science Students (SPSS) 23. Statistical test was done using Analysis of Variance (ANOVA) and student t test. Statistically significant difference was accepted at P<0.05.

RESULTS

Figure 1 shows that night pushup increased morning value of peripheral oxygen saturation when compared to baseline. Morning values of peripheral oxygen saturation did not significantly vary from baseline 1 week after cessation of push up.

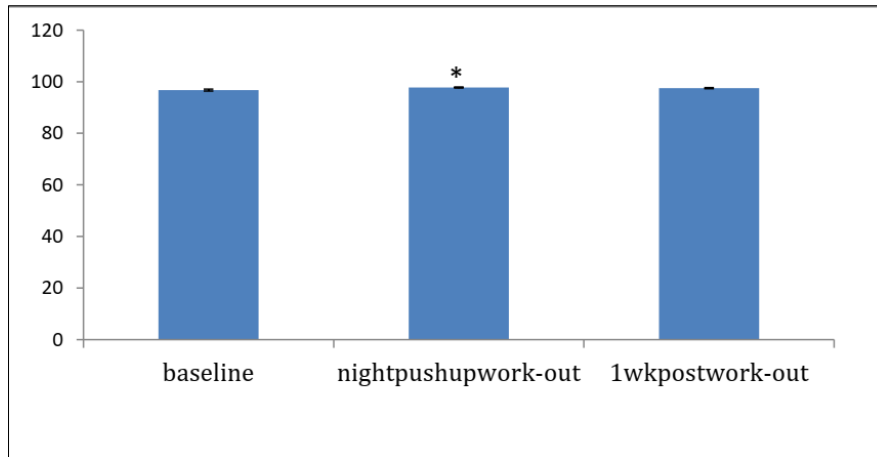


Figure 1: Impact of nocturnal push-up on morning values of peripheral oxygen saturation in young males. *Significant difference from baseline

Figure 2 showed that night pushup had no significant effects on systolic blood pressure when compared to baseline. Morning values of systolic blood

pressure did not significantly vary from baseline 1 week after cessation of push up.

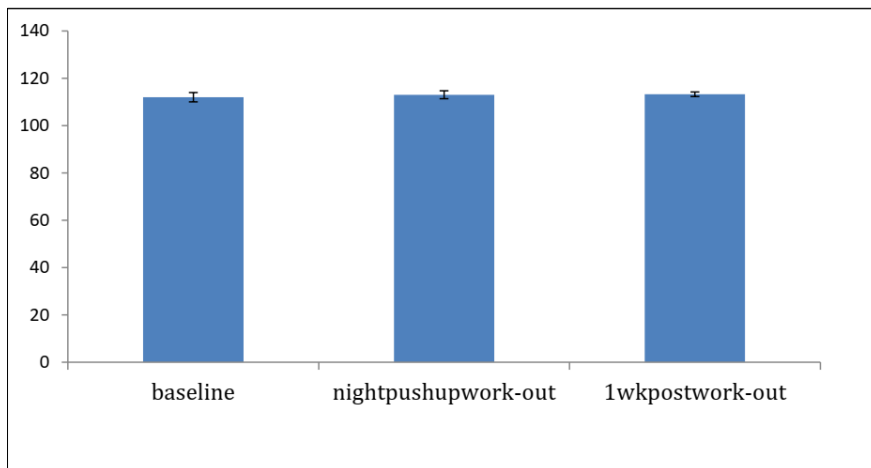


Figure 2: Impact of nocturnal push-up on morning values of systolic blood pressure in young males

Figure 3 showed that night pushup had no significant effects on diastolic blood pressure when compared to baseline. Morning values of diastolic blood

pressure did not significantly vary from baseline 1 week after cessation of push up.

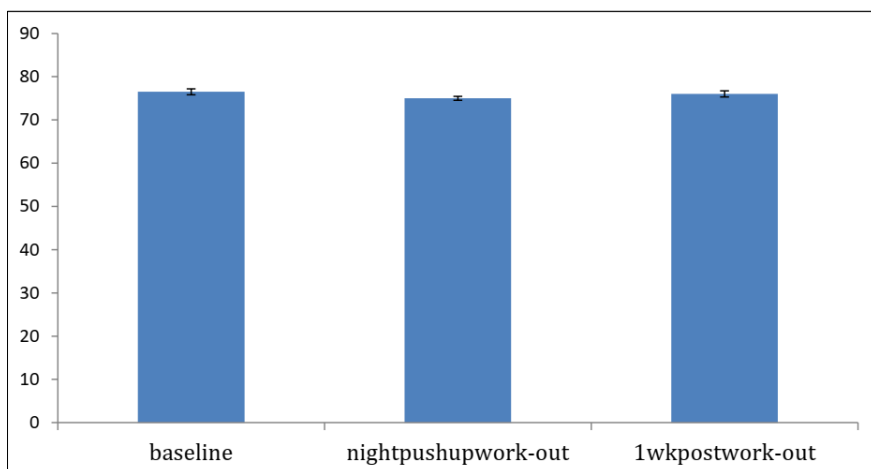


Figure 3: Impact of nocturnal push-up on morning values of diastolic blood pressure in young males

Pulse Rate

Figure 4 showed that night pushup had no significant effects on pulse rate when compared to

baseline. Morning values of pulse rate did not significantly vary from baseline 1 week after cessation of push up.

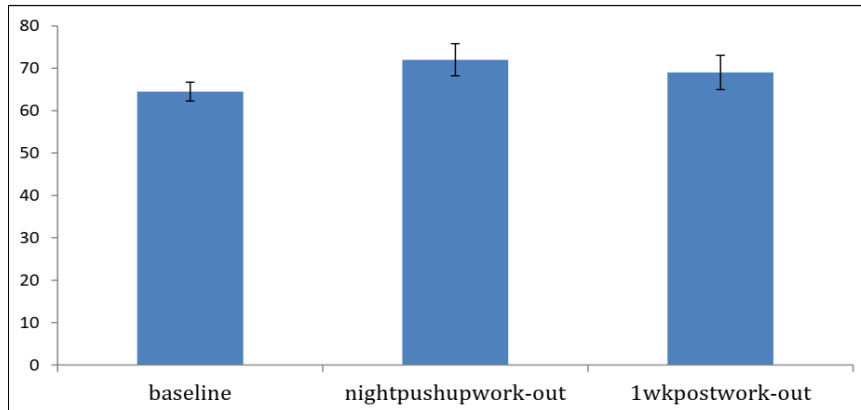


Figure 4: Impact of nocturnal push-up on morning values of pulse rate in young males

Figure 5 showed that night pushup had no significant effects on pulse pressure when compared to baseline. Morning values of pulse pressure did not

significantly vary from baseline 1 week after cessation of push up.

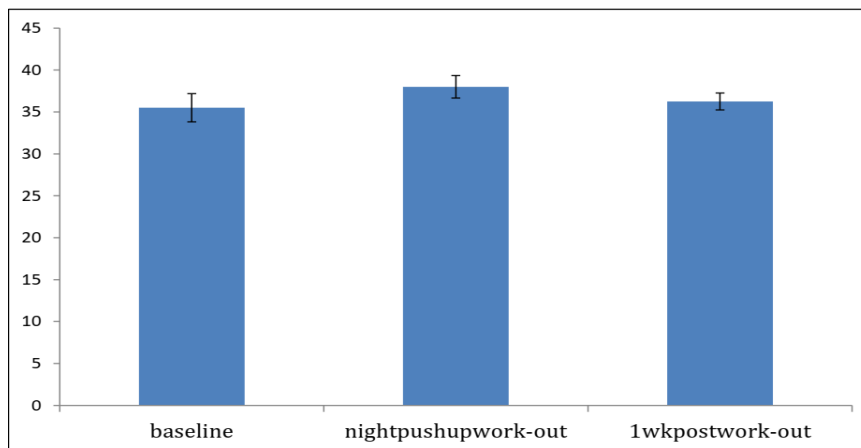


Figure 5: Impact of nocturnal push-up on morning values of pulse pressure in young males

Figure 6 showed that night pushup had no significant effects on pulse pressure when compared to baseline. Morning values of pulse pressure did not

significantly vary from baseline 1 week after cessation of push up.

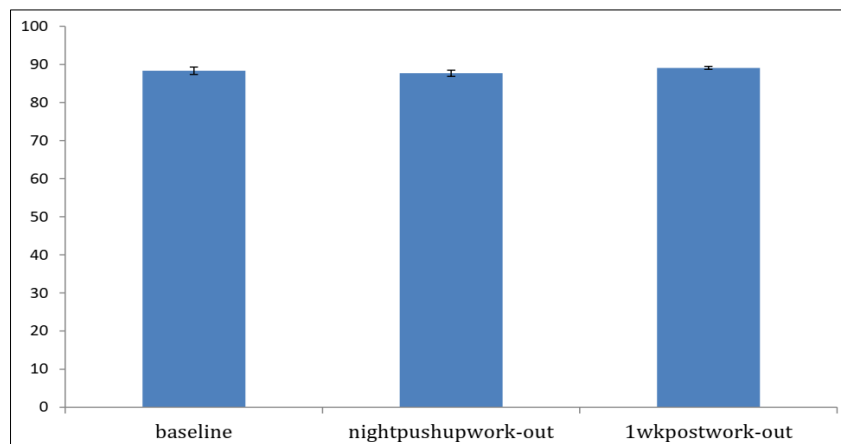


Figure 6: Impact of nocturnal push-up on morning values of mean arterial blood pressure

Figure 7 showed that night pushup had no significant effects on shock index when compared to baseline. Morning values of shock index did not

significantly vary from baseline 1 week after cessation of push up.

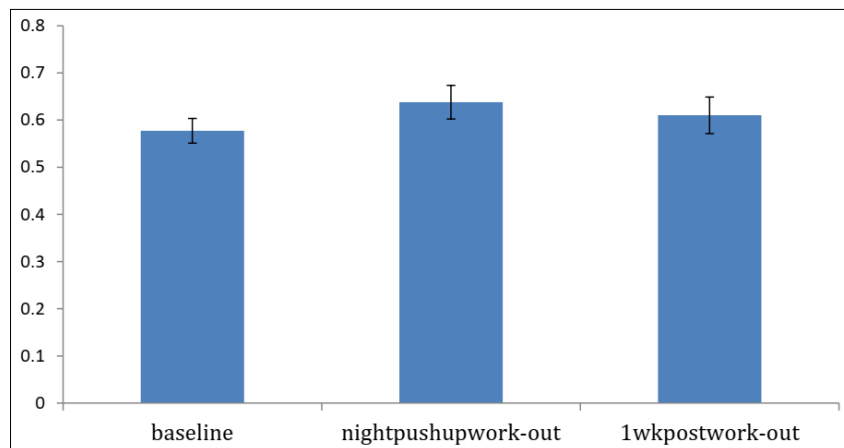


Figure 7: Impact of nocturnal push-up on morning values of shock index

DISCUSSION AND CONCLUSION

Not only does exercise play important role in maintenance of health wellness, it prevents disease development and progression (Awosika *et al.*, 2022; Uzochukwu *et al.*, 2023). Many studies that reported the roles of exercise in healthy and diseased subjects were conducted in the daytime. Moreover, among exercise-related studies which were majorly conducted in the daytime, very few specifically examined changes in morning values of indices of cardiovascular and respiratory function. The study evaluated morning values of peripheral oxygen saturation, blood pressure and pulse rate occasioned by nocturnal pushup work and whether these values return to baseline one week after cessation of the workout.

The major finding of the study was that two-week nocturnal pushup workout increased peripheral oxygen saturation significantly. Morning value of peripheral oxygen saturation has conventional been used to evaluate the extent of oxygenated hemoglobin reaching peripheral capillaries (Adeniyi *et al.*, 2020). Improvements in capillary densities and networks and increase in cardiac output, mitochondria and oxidative enzymes are established effects of exercise (Pickard *et al.*, 2019). Whether exercise could affect morning values of indices of cardiorespiratory function has not been thoroughly clarified. Interestingly, the participants recruited for the study were youngsters and had not been exposed to the workout prior to the study. A week after cessation of the workout, morning value of peripheral oxygen saturation was not significantly different from the baseline measurement.

Increase in blood pressure and pulse rate are expected to occur following exercise including nocturnal pushup workout. Nighttime physical activity was reported by (Yi *et al.*, 2022) to increase mortality risk. In another investigation, night physical activity was shown to modulate autonomic heart rate control in

the first sleeping hours without interfering with sleep quality (Myllymaki *et al.*, 2011). Yujiro *et al.*, (2015) reported that exercise conducted at nighttime orchestrated increased sympathetic activity and high heart rate variability. In all of these studies, morning values of cardiovascular indices were not put into consideration. In the present study morning values of systolic and diastolic blood pressure, pulse pressure, mean arterial blood pressure and pulse rate were measured and did not differ significantly from the baseline values.

As calls for precautionary and preventive measures against development of metabolic diseases increase, the present study provides vivid evidence in support of the health-wise contribution of a single bout of nocturnal pushup workout on peripheral oxygen saturation without adverse alteration of indices of cardiovascular function.

In conclusion, the finding of the study showed the beneficial effect of nocturnal pushup on peripheral oxygen saturations in young males.

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