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Research Paper

Effect of Aerobic and Anaerobic Exercise on Psychological Well-being of North Indian Young Adult Males

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ABSTRACT

Objective: To assess the effect of types of exercise on the psychological well-being (PWB) of North Indian young male adults. ***Method:*** The psychological well-being of the participants (n = 101, age range = 18-25 yrs.) divided into three groups, aerobic exercisers (n=35), anaerobic exercisers (n=32) and non-exercisers (n=34) was measured by Scale of Psychological Well-Being, SPWB (Ryff, 1989). ***Results:*** Exercisers (aerobic & anaerobic) experienced greater PWB than the non-exercisers, further, aerobic exercisers experienced greater PWB than the anaerobic exercisers. ***Conclusion:*** The present study has corroborated the existing research findings as it has also shown that exercisers (both aerobic and anaerobic) experienced greater PWB than the non-exercisers. However, another finding that aerobic exercisers experienced greater PWB than the anaerobic exercisers are in contrast to most of the existing research. Hence, the present study may be seen as a valuable contribution to the existing knowledge repository. Nevertheless, the research conducted so far has not established a causal relationship. Rather, it has suggested an association between the "physical exercise" and PWB. Hence, it may not be ruled out that in the present study, the PWB could be a contributory factor in the choice of exercising behavior rather than an outcome of a specific type of exercise!

Keywords: *Physical Exercise, Aerobic, Anaerobic, Psychological Well-being, SPWB*

In his famous adage, "a sound mind in a sound body", the Greek philosopher, Thales (624 BC-547 BC) not only underscored the connection between mind and body but also etched out the relationship between physical and mental health. Simply put, "a healthy mind exists in a healthy body". To acquire a healthy body, diet and "physical exercise" are important. The role of diet in acquisition of physical and mental health has been well established by the field of medicine spread over several centuries around the globe ranging from ancient medical systems like Chinese, Greek, and Indian (Ayurveda) to the modern Western medicine. We have come a long way through fads to facts, for example, one line of thinking suggested that the food item had a nutritional value for that body part, which it resembled, e.g., eating walnuts to maintain and improve brain capacities as these resemble

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the brain structure. Today, we know that such a theory may have some merit as the research in food and nutrition has established that "macronutrients" and "micronutrients" in food items are essential for the "physical" and "psychological" health. Though, the role of "physical exercise" has also been emphasized for maintenance of physical health since ancient times, however, recognition of "physical exercise" for mental health has been recent. Since the present research examines the effect of types of "physical exercise" on "psychological well-being" (PWB), hence, let us first understand these two terms. Does PWB means happiness? Is any physical activity like walking, standing, cooking, washing, shopping be considered as "physical exercise", or does it entail certain specific actions or steps?

"Psychological Well-Being (PWB) is more than happiness and encompasses psychological and social functioning. It has six components, namely, autonomy, purpose in life, self-acceptance, environmental mastery, personal growth, and positive relations with others" (Ryff, 1989).

In 2010, the World Health Organization has defined, "Physical exercise as a sub classification of physical activity that is planned, structured, repetitive, and has as a final or an intermediate objective the improvement or maintenance of one or more components of physical fitness."

Aerobic and anaerobic exercises are the two different kinds of physical exercise (Mandolesi, Polverino, Montouri, Foti, Ferraioli, Sorrentino et al., 2018). The term, "aerobic means an activity or situation that requires oxygen. Thus, aerobic exercise involves activities that increases the demand for oxygen in the body which results in increased cardiovascular activity, i.e., increased respiration and heart rate" (merriam-webster.com). Some examples of aerobic exercise are walking, jogging, skipping, swimming, running, cycling, elliptical training. During aerobic exercise, the adenosine triphosphate (ATP) is resynthesized because of increased cardiorespiratory activity that in turn maximizes the heart rate (HRmax) and oxygen consumption (Vo2max). The aerobic exercisers consume oxygen and can engage in a low to high intensity workout for a long duration (Mandolesi et al. 2018). The term anaerobic on the other hand means absence or unavailability of oxygen. Anaerobic exercise involves depletion of ATP in the muscles due to production of lactacid or alactacid which occurs because of intense "physical exercise" for a short time without the availability of oxygen (Mandolesi et al., 2018).

The importance and utility of "physical exercise" for physical health can be traced from pre-historic to modern era. Whether as gatherers and hunters of pre-historic time or as soldiers of warring modern military states, physical strength and fitness were valued. Matters ranging from family feuds to warring countries were settled with weapons and physical might. During the post-modern era, though machines and dialogues have since replaced physical labor and weapons, however, the research focus on the biological or physical aspects of "physical exercise" still prevails. Nevertheless, the research cannot be blamed for its unidirectional focus on physical benefits as rapid technological advances has driven the world toward a sedentary lifestyle. Today not only professional and household work but even leisure activities have become sedentary, resulting in various lifestyle disorders with disastrous consequences for the health of the population globally.

The WHO has reported alarming statistics about ailments and mortality due to lifestyle disorders such as obesity, cardiovascular disorders, and diabetes. Out of the fifty-six million deaths every year, 68% are due to non-communicable diseases. This percentage is expected to increase to 92% by 2030 (WHO, 2014). Thus, these lifestyle disorders caused by sedentary lifestyle and lack of "physical exercise" justified the vast research on the physical benefits of the "physical exercise". The risk factors for non-communicable and chronic diseases are effectively downsized by the "physical exercise" as it improves immunity and several body structures (e.g., bones & muscles) and bodily functions (e.g., cardiovascular system).

"Physical exercise" is a two-pronged intervention as it not only reduces blood pressure and adipose tissues but also increases muscle and bone strength and overall body fitness. Several explanations have been provided for the reformative structural and functional effects of "physical exercise". For example, Erickson, Miller, Weinstein, Akl, and Banducci (2012) have suggested that cognitive functioning improves due to "physical exercise" as it increases the blood flow in the underlying neural circuitry. However, as an alternative explanation Stern (2012) has given the concept of "cerebral reserves" which are divided into "brain reserve" and "cognitive reserve". The former pertains to neural structures (e.g., size, volume, and density of neurons), and the latter implies the functional characteristic of the brain, i.e., neural circuitry. Mandolesi and colleagues (2018) have suggested that "physical exercise" enhances both reserves and they further quoted the view of "American College of Sports Medicine", ACSM (2013), that "physical exercise has beneficial effects such as prevention of diseases, enhanced bodily systems, and increased life expectancy, and enhanced neuroplasticity". These benefits have been measured through structural changes in the brain such as white matter, brain volume, level of neurotrophins, and functional changes such as behavioral and cognitive performances (Serra, Cercignani, Petrosini, Basile, Perri, & Fadda, et al., 2011). Erickson, Voss, Prakash, Basak, Szabo, and Chaddock et al. (2011) as well as Chaddock-Heyman, Erickson, Holtrop, Voss, Pontifex, and Raine et al. (2014) have reported that the volume of gray matter increases in the frontal lobe and hippocampus through exercise. "Physical exercise" leads to increase in the levels of neurotrophic factors and blood flow (Hotting, Schickert, Kaiser, Roder, & Schmidt-Kassow, 2016; Fernandes, Arida, & Gomez-Pinilla, 2017, respectively).

There is ample evidence spread over several centuries for the importance of "physical exercise" for the healthy body. However, the importance of "physical exercise" for psychological well-being has been established relatively recently. For example, research studies in 1980s and early 1990s showed that anger, anxiety, and depression were reduced by "physical exercise", and it also leads to overall improvement in mood (Folkins & Sime, 1981, Byrne A. & Byrne D.G., 1993). Type A behaviors such as hostility which makes a person prone to coronary vascular diseases has also been reported to be reduced by "physical exercise" (Buchman, Sallis, Criqui, Dimsdale, Kapla, 1991). Rajala, Uusimaki, Keinanen-Kikukaanniemi and Kivela (1994) showed that in Finland among the 55-year-old participants, prevalence of depression was higher among those who exercised less than 2-3 times in a month. In the year 2000, yet another Finnish population study with 3403 participants who were between 25 - 64 years found that in comparison to non-frequent exercisers and non-exercisers, the frequent exercisers showed significantly lower levels of stress, anger, cynical distrust, and depression. Additionally, better perception of their health and fitness was reported by regular exercises. Further, greater feeling of social integration

and coherence was found in frequent exercisers than the less frequent or non-exercisers. Overall, the study showed that regular "physical exercise" led to significantly greater PWB. Babyak, Blumenthal, Herman, Khatri, Doraiswamy, Moore, and colleagues (2000) showed mental benefits of "physical exercise" such as reduction in stress, anger, anxiety, depression, decreased decline of mental faculties and enhancement of mood. Ekkekasis and Backhouse (2009) in their extensive review showed that physical activity is negatively correlated with anxiety and depression, and positively correlated with quality of life, cognitive functions, and self-esteem. In yet another research, Carek P., Laibstain, and Carek, S. (2011), reported that mild and moderate depression can be treated successfully by "physical exercise" without taking the antidepressants. However, for treating severe depression, aerobic exercise in conjunction with antidepressants has been found to be more effective. Hine, Wood, Barton, and Pretty (2011) have reported that green exercise can be used as a therapy for enhancing self-esteem and positive affect, and for reducing anxiety and depression.

According to Peluso and de Andrade (2005) as well as Galper, Trivedi, Barlow, Dunn and Kampert (2006) physical activity enhance emotional well-being and mood. Stress may compromise physical fitness, e.g., bone and muscle health, and cardio-respiratory fitness (Tacchi, Heggelund & Scott, 2019). Since physical exercise has been shown to reduce stress and increase resilience, hence, physical exercise can improve muscular fitness and prevent stress-related disorders (Neumann, Ahrens, Kollmann, Goldbach, Chmitorz, Weichert et al., 2022). Students have been found to cope with perceived stress by engaging in physical exercise (Garber, 2017). In an online study in UK, Lancaster and Callanghan (2022) found the mediating role of exercise in resilience shown during COVID-19 pandemic.

Azizi (2011) in a study done with university students in southeastern Iran compared the coping strategies employed by athletes and non-athletes to deal with stress. She reported that while non-athletes used "emotion-oriented coping strategies" and reported greater stress in daily life, the athletes used "problem-oriented coping strategies" and reported lesser stress in their daily life. The study concluded that exercisers tend to choose more effective coping strategies to deal with stress. A longitudinal study with Japanese elderly people during COVID-19 pandemic reported better psychological well-being in those elderly who engaged in exercising behavior during lockdown (Ejiri, Kawai, Kera, Ihara, Fujiwara, & Watanabe et al., 2021). In a study conducted with the students at University of Punjab, Lahore (Pakistan), it was reported that exercisers were more self-confident, preferred to focus on present rather than on future, were more open to new experiences and were more sociable. Overall, conclusion of the study was that exercise has a strong positive association with psychological well-being (Butt, Rashid, Rajput & Akhtar, 2016).

Donnelly and colleagues (2016) reported that academic achievement increases due to "physical exercise" in children. Chieffi, Messina G., Villano, Messina A., Valenzano, Moscatelli and colleagues (2017) found that "physical exercise" improves cognitive and executive functions, such as learning, memory, and attention. Hollamby, Davelaar, and Cadar (2017) have reported that "physical exercise" in elderly individuals prevented the decline in cognitive functions and markedly decreased risk of dementia. Huang, Fang, Li, and Chen (2016) reported that "physical exercise" modifies the neural network which leads to better cognitive functioning thereby improving quality of life (Pedrinolla, Schena, & Venturelli, 2017).

Indian studies have also shown that "physical exercise" alleviates symptoms of psychological disorders. In an extensive review of Indian research studies, Cherubal, Balasubramanian, Ramachandran & Raghavan (2019) concluded that yoga and other exercises reduced the symptoms of common and more severe psychological disorders, such as anxiety and schizophrenia, respectively. However, more exploration is required to confirm if exercise can be an intervention for mental disorders and for improving mental health. In Kolkatta (India), children aged between 12 to 18 years with mental retardation showed significant improvement in their functional well-being due to sports activities (Ghosh & Datta, 2012). Mukherjee, Safraj, Tayyab, Shivashankar, Patel, Narayanan, and Prabhakaran (2017) in a study in Delhi with 1208 participants found a negative correlation between amount of physical activity and major depression where the researchers reported that odds of major depression were highest among those participants who went to the smallest parks and lowest in those who went to the largest parks.

In a study in Pondicherry with students (n = 717, age range = 21-26 years), those with low levels of physical activity showed greater prevalence of depression (Deb, Banu, Thomas, Vardhan, Rao, & Khawaja, 2016). Ghrouz, Noohu, Dilshad, Warren, BaHammam, & Pandi-Perumal (2019) in a Delhi based study with 617 participants between age of 18 to 30 years also reported higher prevalence of depression in less active participants. Similarly, research conducted in Himachal Pradesh with 370 young adults showed that lack of physical activity led to an increased symptoms of depression (Singh, Sharma P., Raj, Sharma S., Kaushal & Raina, 2018). In Odisha, Ganesh, and Mishra (2016) took 84 participants of 22 to 43 years and showed that greater the physical activity, better was the quality of life. In Berhampur (Odisha), Nayak, Mohapatra, and Panda (2019) in research with elderly participants (n = 244) and age range between 60 and 75 years reported an inverse relationship of physical activity to anxiety, depressive disorder, and other cognitive disorders.

An exercise intervention research program was organized in Mumbai (India), and Australia by Hallam, Bilsborough, and de Courten (2018) with 1,963 participants with an age range of 16 to 74 years. The research concluded that exercise led to improvement in stress, depression, and anxiety by 8.9%, 7.6%, and 5.0%, respectively from the baseline mean scores. Well-being was also reportedly improved by 2.1% from its baseline. Another exercise intervention study in Bangalore, with an experimental and a control group showed that "Video-Assisted Structured Aerobic Exercise Program" significantly reduced mean score for depressed mood in the experimental group (Roy, Govindan, & Muralidharan, 2018).

An ancient Indian system of exercise, Yoga has also been found to be beneficial for psychological well-being. For example, in Haridwar, a fortnightly program of yoga significantly reduced the level of state anxiety and significantly improved psychological well-being in the control group (Telles, Gupta, Bhardwaj, Singh, Mishra, Pal, & Balkrishna, 2018). A ten-month long yoga intervention program by Ray, Mukhopadhyaya, Purkayastha, Asnani, Tomer, Prashad, and Selvamurthy (2001) at the Defense Institute in Lucknow with 54 participants with an age (range = 20-25 years) found the treatment group to be less anxious and depressed and with improved mental functions. A six-month intervention program of yoga and ayurveda with 69 participants in a psychiatric hospital reduced the symptom score of depression of the treatment group from a baseline of 10.6 to 8.1(Krishnamurthy & Telles, 2007).

In Haridwar, Patanjali research foundation conducted a yoga intervention program with participants (n = 140, age range = 21-46 years) and reported that treatment group attained significantly better quality of life and sleep, and showed significantly less state anxiety, stress, and breathing problems (Telles, Singh, Yadav, & Balkrishna, 2012). An intervention yoga program in Pune, which trained participants (n = 80, age range = 17-22 years) on *suryanamaskar* for 2 weeks showed high scores on physical relaxation, mental peace, feelings of refreshment, and joyfulness and low scores on physical stress, worry, sleepiness, and negative emotions for the intervention group (Godse, Shejwal, & Godse, 2015). Similarly, Ramanathan, Bhavanani, and Trakroo (2017) not only reduced the symptoms of anxiety and depression but also enhanced the self-esteem of the intervention group through a three-month yoga therapy in Pondicherry. In Bangalore, Varambally, Gangadhar, Thirthalli, Jagannathan, Kumar, Venkatasubramanian, and Nagendra (2012), conducted a sixteen-week yoga program with participants with schizophrenia (n = 120, age = 23-43 yrs.) which reduced their symptoms and improved their socio-occupational functioning.

Several research studies have compared the effect of aerobic and anaerobic exercise on PWB, such as, Cohen and Shamus (2009) reported in a review study that moderate aerobic exercise leads to the maximum psychological benefits in comparison to vigorous aerobic exercise or anaerobic exercise. They also suggested that the individuals should avoid stressful, competitive, and aggressive exercises and sports which increases stress, anger, and anxiety. Heidary, Emami, Eskandaripour, Saiah, Hasanlu, and Shahbazi (2011) randomly assigned the 60 high school students with high levels of anxiety to aerobic, anaerobic, and no exercise regimen and reported that anxiety decreased significantly in both aerobic and anaerobic exercisers as compared to the non-exercisers. Tolbert (2015) in a pre-post design study, examined the difference between the effects of aerobic and anaerobic exercise on the college students with high "anxiety sensitivity" (AS, a precursor for the development and maintenance of anxiety disorders). The results indicated that over time, AS significantly decreased from baseline in anaerobic exercisers as compared to the aerobic exercisers. Another pre-post experimental study by Kianian, Kermansaravi, Saber, and Aghamohamadi (2018) in Iran, showed that both aerobic as well as anaerobic exercise resulted in significant decrease in stress and anxiety among the non-athlete students. Yet another pre-post experimental study by Corey (2005) examined the effect of anaerobic exercise (yoga) and aerobic exercise (cycling and cardio-kickboxing) on mood of 73 participants. The findings indicated no significant difference between the anaerobic and aerobic exercisers on positive mood changes. Wilson and Yilla (2022) compared the effect of maximal aerobic and anaerobic exercise on mood of college students (n = 55) by using "Profile of Mood States" (POMS) and concluded that irrespective of type, intensity, and duration, any "physical exercise" benefits the "physical" and "psychological" health if it is carried out consistently.

Feller L., Nemutandani, Feller G., Jose, Lemmer, & Khammissa (2021) have reasoned that "physical exercise bring neurochemical and neurostructural changes to the Hypothalamus-Pituitary-Adrenal Axis (HPA) and sympathetic nervous system" thereby improving their functional activity. This improved functional activity improves overall psychological well-being (PWB) through better sleep quality, better cognitive functions and mood, high level of mental energy, and reduced negative emotional perceptions. They also reported greater benefits of moderate to vigorous aerobic exercise on several cognitive domains. However, the researchers concluded that the role of other factors such as age, consistent adherence to aerobic exercise during adolescence and young adulthood should be investigated.

The existing research has clearly established a positive link between "physical exercise" and psychological well-being across gender and age. However, no unequivocal results have been found regarding the effect of types of exercise on PWB. While some studies have shown greater benefits of aerobic exercise on PWB, others have shown the positive effects of anaerobic exercise, and yet others have reported no significant difference between the effect of aerobic and anaerobic exercises on PWB. An expansive review of Indian studies about the effects of "physical exercise" on PWB also reflects the same picture. In India, though many researchers have studied the beneficial effects of "physical exercise" as well as Yoga on well-being, but no research has examined the effects that different types of exercise may have on PWB. Therefore, the first objective of the present study is to corroborate the research evidence gathered till date about the positive effects of "physical exercise" on PWB. The second objective is to examine as to whether aerobic and anaerobic exercises have different effect on the PWB. Following these objectives the study has two hypotheses, 1) Both aerobic and anaerobic exercisers will have greater PWB than the non-exercisers; 2) A significant difference will be found between aerobic and anaerobic exercisers on PWB.

METHODOLOGY

Design

A cross-sectional online survey prepared by Google forms was used in the present study.

Participants

Through the snowball technique, young adult males (age range = 18-25 yrs.) were contacted online through various channels, like, WhatsApp and Instagram. Initially, 114 individuals consented to participate in the study, however, six did not respond to the informed consent form whereas seven did not meet the inclusion criteria. The inclusion criteria were gender (male), age (between 18 to 25 years), functional knowledge of English, education at least up to senior secondary school, medium to high socioeconomic status for all the participants; engagement in exercise (aerobic/anaerobic) for 1 hour for 3-5 times a week for last six months for exerciser groups, and no engagement in exercise or any sports for the non-exercisers. The exclusion criteria were presence of clinically diagnosed health (physical or mental) related problems or disorders like cardiovascular diseases, diabetes, depression, anxiety disorders etc. for all the participants. Based on the inclusion and exclusion criteria, the final sample consisted of 101 young male adults (age range= 18-25 years) from northern region of India, such as Delhi, Noida, Gurgaon (Haryana), Punjab, Uttarakhand, Himachal Pradesh, Uttar Pradesh, and Rajasthan. (Aerobic, anaerobic, and no exercise) divided into three groups, namely, aerobic exercisers (n=35), anaerobic exercisers (n=32) and non-exercisers (n=34).

Questionnaires

The online survey consisted of a brief description of the present study, informed consent form, and demographic details form with questions pertaining to age, gender, education, socioeconomic status, contact details, general health condition and the "Scale of Psychological Well-Being" by Carol Ryff (1989).

"Scale of Psychological Well-Being" (Ryff, 1989): It is a self-report measure with 42 items that are divided into six subscales which measure different aspects of well-being and happiness, namely, "autonomy, purpose in life, self-acceptance, environment mastery, personal growth, and positive relations with others". This scale is reliable (internal consistency ranging between 0.86 and 0.93; test-retest reliability ranging between 0.81 and

0.88) and has high convergent validity with other measures of psychological well-being. Each item is rated on a 7-point scale ranging from 1 = strongly agree to 7 = strongly disagree. The scale gives six subscale scores and a total score for "Psychological Well-being."

Procedure

Indian young adult males were approached online through snowballing technique for data collection. Since COVID-19 protocols were enforced in India, hence only online mode was used for data collection by devising Google Forms. A brief description of the study along with the request to participate and an informed consent form were circulated on various online platforms, such as WhatsApp and Instagram. After receiving the informed consent, the form with demographic details and the "Scale of Psychological Well-Being" (Ryff, 1989) with clear instructions were sent to the participants. After the participants submitted the forms, they were thanked, and their queries were answered personally.

RESULTS

The study examined the exercising behaviour among the Indian young male adults and classified them into three groups, namely aerobic exercisers, anaerobic exercisers, and non-exercisers based on their self-reported exercising behaviour. Further, the differences among the aerobic exercisers, anaerobic exercisers and non-exercisers on the psychological well-being were examined by using "Scale of Psychological Well-Being", SPWB (Ryff, 1989). MANOVA was performed using group as a between-subject variable on the mean scores obtained by the three groups in the six domains of SPWB, namely, "autonomy, purpose in life, self-acceptance, environmental mastery, personal growth, positive relations with others", and total score of PWB. Since, MANOVA revealed an overall significant main effect of group, $F(14, 182) = 10.26$, $p < .001$, hence the simple main effects for all the subscales and the total score for the three groups were analysed separately by using one-way analyses of variance (ANOVAs). Further, wherever ANOVA revealed significant simple main effect, post hoc analyses using test of Least Significant difference (LSD) were done. All the results were analysed using Statistical Product and service Solutions (SPSS) v.21.0.

It is evident from Table 1, that simple main effect of group was significant for "autonomy", $F (2, 98) = 9.90$, $p<0.01$; "purpose in life", $F (2, 98) = 35.78$, $p<0.01$; "personal growth", $F (2, 98) = 9.97$, $p<0.01$, and "positive relations with others", $F (2, 98) = 3.20$, $p<0.05$. Post hoc analysis revealed that on "autonomy", aerobic and anaerobic exercisers did not differ significantly from each other, but both the groups had significantly higher scores than the non-exercisers. On "purpose in life", the post-hoc analysis revealed a significant difference among aerobic exercisers, anaerobic exercisers, and non-exercisers. That is, among the three groups, aerobic exercisers showed significantly highest scores, followed by the non-exercisers, who in turn showed significantly higher scores than the anaerobic exercisers. Thus, while aerobic exercisers showed highest score, the anaerobic exercisers showed the lowest score on the "purpose in life". While no significant difference was found between aerobic and anaerobic exercisers on "personal growth", however, both aerobic as well as anaerobic exercisers showed significantly greater "personal growth" than the non-exercisers. On "positive relations with others", there was no significant difference between aerobic and anaerobic exercisers as well as between anaerobic and non-exercisers. However, aerobic exercisers had significantly greater "positive relations with others" than the non-exercisers. Further, no significant main effect of group was found for "self-acceptance" and "environmental mastery". Lastly, on overall psychological well-being, the simple main

effect of group was significant, $F(2,98) = 37.61$, $p<0.01$ where the post hoc analysis revealed significant differences among the three groups. That is, among the three groups, aerobic exercisers showed significantly highest scores, followed by the anaerobic exercisers, who in turn showed significantly higher scores than the non-exercisers.

Table No.1. Mean and standard deviation, ANOVA values and effect size obtained on the Scale of Psychological Well-Being (SPWB) for the three groups

Measures	Aerobic Exercisers (n = 35) Mean (S.D.)	Anaerobic Exercisers (n = 32) Mean (S.D.)	Non-Exercisers (n = 34) Mean (S.D.)	F(2, 98)	Effect Size
Subscales of SPWB					
1)Autonomy	37.86^{cd} (3.48)	36.97^{bd} (2.66)	33.91^{a} (4.98)	9.91**	.17
2)Purpose in Life	37.69^{c} (3.80)	29.56^{a} (3.32)	31.77^{b} (4.94)	35.78**	.42
3)Self-Acceptance	33.80^{cd} (4.90)	33.53^{bd} (3.53)	32.91^{ad} (4.52)	0.37 (ns)	.01
4)Environment Mastery	32.89^{bd} (3.56)	33.13^{cd} (4.45)	32.03^{ad} (4.04)	0.69 (ns)	.01
5)Personal Growth	38.66^{cd} (3.73)	38.19^{bd} (3.32)	34.71^{a} (4.75)	9.97**	.17
6)Positive Relations with others	36.40^{cd} (5.01)	35.06^{bde} (3.59)	33.79^{ae} (4.05)	3.20*	.05
Total Score on SPWB	217.29^{c} (7.50)	203.59^{b} (7.56)	199.12^{a} (11.51)	37.61**	.44

**p<.05, **p<.01 Note. "Superscript letters indicate significant differences: if means within a row are labelled with different superscripts, they are significantly different and if they share superscripts they do not differ".*

It can be summarized that aerobic and anaerobic exercisers did not differ significantly on most of the domains of PWB. However, in comparison to the non-exercisers, while the aerobic exercisers scored significantly higher on several domains of PWB, the anaerobic exercisers scored significantly higher only on two domains of PWB. Further, not only both aerobic and anaerobic exercisers showed significantly greater overall PWB than the non-exercisers, but aerobic exercisers showed the significantly highest overall psychological well-being among the three groups.

DISCUSSION

The present study examined the exercising behaviour among the young male adults of northern India and its effect on their psychological well-being (PWB). In our study, based on their self-report, approximately 66% engaged in exercise whereas 34% were non-exercisers who did not engage in any type of exercising behaviour. Out of those who engaged in exercising behaviour, 52% were aerobic exercisers and 48% were anaerobic exercisers. So, we compared the PWB of the three groups, that is, aerobic exercisers, anaerobic exercisers, and non-exercisers by using "Scale of Psychological Well-Being" (Ryff, 1989) which along with a total score for PWB, also gives scores for its six domains, namely, "autonomy, purpose in life, self-acceptance, environmental mastery, personal growth, and positive relations with others".

The present findings showed that while both aerobic and anaerobic exercisers experienced higher level of PWB than the non-exercisers, however, the level of PWB was highest in aerobic exercisers. In comparison to the anaerobic exercisers, the aerobic exercisers had significantly higher score only on one domain, i.e., "purpose in life", whereas on the other five domains, no significant differences were found. The aerobic exercisers showed significantly higher scores on "autonomy, purpose in life, personal growth, and positive relations with others" as compared to the non-exercisers. On the other hand, the anaerobic

exercisers showed significantly lower scores for "purpose in life" and significantly higher scores on "autonomy and personal growth" in comparison to the non-exercisers. The discussion focuses around the two present findings, one, exercisers (aerobic & anaerobic) experienced greater PWB than the non-exercisers; second, aerobic exercisers experienced greater PWB than the anaerobic exercisers.

The present finding that "physical exercise" is associated with greater PWB is consistent with several existing studies, such as, Zubala, MacGillivray, Frost, Kroll, Skelton, and Gavine et al. (2017) showed the benefits of "physical exercise" on PWB for people of different age groups. Windle, Hughes, Linck, Russell, and Woods (2010) reported an improvement in quality of life due to "physical exercise". Children who exercised physically were found to have significantly greater self-efficacy, perceived competence, and orientation toward goal (Biddle, Atkin, Cavill, & Foster, 2011). A review by Kumar (2017) also concluded that "physical exercise" has a positive effect on PWB.

Since PWB can be studied through outcome measures such as, self-esteem, depression, anxiety, and emotional distress (Janssen & LeBlanc, 2010), hence, several researchers have examined the relationship between "physical exercise" and PWB by measuring such outcomes, e.g., Opdenacker, Delecluse, and Boen (2009) in a longitudinal study reported that "physical exercise" improved the self-esteem and body perception in older adults. In another study, Sepahmansour, Memar, and Azmodeh (2012) found that "physical exercise" improves self-esteem. "Physical exercise" has been found to improve mood and self-concept in young adults (e.g., Berger & Motl, 2001; Penedo & Dahn, 2005) and helps the older adults to maintain their independence thereby improving their social relations and mental health ((Stessman, Hammerman-Rozenberg, Cohen, Ein-Mor, & Jacobs 2009). "Physical exercise" can be used as an intervention for depression and anxiety (Carek, Laibstain, & Carek, 2011). The finding by De Moor, Beem, Stubbe, Boomsma, and De Geus (2006) that anxiety and depression reduce with regular exercise has been supported by others such as DeBoer, Powers, Utschig, Otto, & Smits (2012), Mammen & Faulkner (2013).

According to Knapen, Sommerijns, Vancampfort, Sienaert, Pieters, Haake, et al., (2009), "physical exercise", especially, aerobic exercise can bring positive changes in mood. This observation was supported by Craft and Perna (2004) who showed significant reduction in symptoms of major depressive disorder in patients through an intervention program of 16 weeks of aerobic exercise. Contrarily, the anaerobic exercise has also been found to alleviate clinical depression (Martinsen, 1990). Scully, Kremer, Meade, Graham, and Dudgeon (1998) have reported that any type of "physical exercise" reduces anxiety. Thus, the present finding of significantly greater PWB for aerobic and anaerobic exercisers than the non-exercisers is supported by the current research evidence.

Nevertheless, the present study has also reported that aerobic exercisers had a significantly higher score on PWB than the anaerobic exercisers. Yet another interesting result was that anaerobic exercisers showed significantly lowest score on 'purpose in life' among the three groups. These results can be interpreted in the light of the research on the interaction between biological and psychological mechanisms underlying "physical exercise" (Penedo & Dahn, 2005). On the one hand, biological mechanisms such as increased cerebral blood flow (e.g., Dietrich & McDaniel, 2004), maximum consumption of oxygen, increased supply of oxygen to the cerebral tissues (Querido & Sheel, 2007), reduced muscle tension (Ferreira-Vieira, Bastos, Pereira, Moreira, & Massensini, 2014) and neuroplastic changes such as

increased secretion of some neurotransmitters, e.g., serotonin and endorphins (Korb, Bonetti, Da Silva, Marcuzzo, Ilha, & Bertagnolli et al., 2010; Fuss, Steinle, Bindila, Auer, Kirchherr, & Lutz, et al., 2015) enhance the feeling of well-being. On the other hand, "physical exercise" has affirmative effects on psychological mechanisms, for example, on sense of self-control; self-competency and efficacy as suggested by Weinberg and Gould (2015) and Rodgers, Markland, Selzler, Murray, and Wilson (2014), respectively. Further, Fox (2000) and Sani, Fathirezaie, Brand, Puhse, Holsboer-Trachsler, Gerber, and Talepasand (2016) showed that other psychological aspects like self-concept and self-esteem also get enhanced. According to Bartlett, Close, MacLaren, Gregson, Drust, and Morton (2011), such psychological enhancement leads to greater positive social relations which provide opportunities for enjoyment thereby increasing the feelings of PWB (Mandolesi et al., 2018).

In the present study, perhaps, the maximal oxygen consumption by the aerobic exercisers and its subsequent positive effects on the body and secretion of serotonin and endorphins can be associated with an enhanced PWB in comparison to the anaerobic exercisers. Similarly, enhanced self-concept, self-esteem, self-competency, and self-efficacy may have also contributed to the overall high PWB in the aerobic exercisers. Lastly, low score on purpose in life in case of anaerobic exercisers can be an indication of their dissatisfaction with their selves as usually people with a desire for a well-built body choose anaerobic exercises as they compare and compete with others for a stronger and muscular body. Cohen and Shamus (2009) have suggested that the individuals should avoid stressful, competitive, and aggressive exercises and sports which increases stress, anger, and anxiety. These researchers concluded that moderate aerobic exercises lead to greater psychological well-being than the vigorous aerobic exercise or anaerobic exercise. Perhaps, the anaerobic exercisers in the present study might be competing with others and feeling dissatisfied for not having achieved the desired body proportions, thereby leading to significantly lower PWB than the aerobic exercisers.

Limitations and Strength

A cautious interpretation of the present findings is warranted for several reasons: first, the results are based on a small group size where all the participants were males; second, the results are based solely on the self-reports; third, since it is a cross-sectional study, hence there is a risk of effect of confounding variables on the results and interpretations, for example, is PWB better due to exercising behaviour or is it because of existence of some other qualities in the exercisers and non-exercisers? Hence, rather than establishing a causal relationship, the present study points toward an association between exercising behaviour and PWB. Many studies conducted so far are also indicative of a link between "physical exercise" and mental health, for example, Cohen and Shamus (2009), Kumar (2017), Mandolesi et al. (2018), Cherubal et al. (2019) have unanimously associated "physical exercise" with better well-being. However, intensive review of literature has shown that fewer studies have compared the effects of aerobic and anaerobic exercises on PWB globally as well as in India. Further, no unequivocal results have been found about the difference in the effect of aerobic and anaerobic exercises on the PWB. Hence, the present study may be seen as a valuable contribution to the existing knowledge repository.

CONCLUSION

The present study has corroborated the existing research findings as it has also shown that exercisers (both aerobic and anaerobic) experienced greater PWB than the non-exercisers.

Further, the present study also reported that aerobic exercisers experienced greater PWB than the anaerobic exercisers. This is contrary to the existing research where either no significant difference was reported between the effects of aerobic and anaerobic exercise on PWB or significantly greater positive effect of the anaerobic exercise on psychological well-being was reported. Nevertheless, one cannot ignore the fact that the research conducted so far has not established a causal relationship. Rather, it has suggested an association between the "physical exercise" and PWB. Hence, it may not be ruled out that in the present study, the PWB could be a contributory factor in the choice of exercising behavior rather than an outcome of a specific type of exercise!

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Conflict of Interest

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