

Estimation Of Intensity Of Suryanamaskar In Children Age 12-17 Years

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Abstract

Physical inactivity is becoming an urgent health issue. The WHO reported 81% of adolescent age 11-17 years worldwide have insufficient level of Physical activity. To obtain the adequate level of Physical fitness the ACSM guidelines recommends to engage in least 60 minutes per day of moderate to vigorous intensity, physical activity which includes vigorous intensity of resistance exercise on at least 3 days per week. To attain the optimal level of Health related components of Physical fitness the different intensities including mild, moderate and vigorous intensity of aerobic exercise has to be defined. So this study is planned to estimate the intensity of Suryanamaskar based on different speeds at which they are performed children aged 12-17 years.

Keywords: Physical fitness, Suryanamaskar, Children, Intensity .

INTRODUCTION

A fit and healthy person will live longer, be more productive at work and school, and generally contribute more to the country's growth and development. With an increasing prevalence of heart and other cardiovascular diseases as well as a wide range of health concerns, the importance of leading healthy lives that include a well-balanced diet and an adequate fitness regime that embodies healthy lifestyle habits is imperative. As per The World Health Statistics-2012 report released by WHO, one in three adults worldwide, has raised blood pressure and one in 10 adults has diabetes. Also 12% of the total populations are obese. A startling observation of WHO Report-2001 is that major sections of youth (below 25 years) in India are vulnerable to these deadly diseases. In the same Report, WHO also makes a prediction that one out of every three Indians will either be a coronary patient or a diabetic by 2030. This projected population at risk about two decades from now will necessarily be the presently school going children. Given the fact that, majority of our population are in the youth category below the age of 35 years, WHO's prediction for 2030 has to be addressed at the national level urgently (1)

As per Report of Working Group on Disease Burden for 12th Five Year Plan WG-3 : Non Communicable Diseases - Among non-communicable diseases (NCD), Cardio-Vascular Diseases (CVD) account for 52% of mortality. The potentially productive years of life lost (PPYL) due to CVDs in the age group of 35-64 was 9.2 million in 2000 and is expected to rise 17.9 million in 2030 - again comprising of that segment of the population that is in the school going age bracket currently. (1)

Physical fitness initially was needed for survival purposes as "survival of the fittest" was the dictum. Today physical fitness is the underline paradigm for social as well as economic wellbeing of the country. Physical fitness is all the more important now in view of the technological advancements which have reduced physical activities being performed by individuals to a bare minimum. A stage has now come when adults as well as children are facing diseases which were unheard of by human beings a few years ago. Blood pressure, diabetes, hypertension, heart disease etc. are prevalent in children of the country.

It is seen that the School Health Programme is more about general health rather than at improving physical fitness levels of the school going children. Accordingly, there is a need to prepare and formulate a scientific programme and criteria to first motivate and encourage school going children of both sexes to be physically fit and concurrently evaluate their fitness.

The physical fitness came into prime focus amongst Indians since past decades In the year 1959, the government of India launched a scheme called the "National Physical Fitness Programme" which became popular throughout the country over the year and had developed a test battery "National Physical Efficiency Drive" (NPED) for inculcating awareness of Physical fitness among the people. However, the programme was discontinued as it was based on inappropriate and inaccurate assessment of physical fitness norms. In the year 2008-2009 to tackle this Social problem in the state of Kerala, Govt of Kerala launched the Total Physical Fitness Program (TPFP) in November 2008. To tackle the Serious Health issue "Khelo India" was launched in 2018 followed by "The Fit

India movement “launched on 29th August 2019 with the vision of making India a fit and healthy Nation. The mission of the movement is to bring about behavioural change and move towards a more physically active lifestyle. As defined by U.S. Centers for Disease Control and Prevention “Physical fitness is a set of attributes that people have or achieve that relates to the ability to perform physical activity.” ACSM defines Physical Fitness as Physical fitness is the ability to perform moderate to vigorous levels of physical activity without undue fatigue and the capability of maintaining such ability throughout life.” (2)

These days Physical fitness amongst children and adolescents is the prime determinant of the health status. In India, a survey of 78,000 school aged children conducted across 68 cities and 17 states of India, showed that fitness levels in Indian children are —alarmingly low in all age groups and regions (3). Recently in 2022 there was a study conducted to assess Physical fitness levels and Physical activities in school going children This study results suggest that, among physical fitness profile in Pune School children for both the boys and girls, authors found that overall physical fitness profile for both boys and girls were on lower levels when compared to the normal standards set by fitness gram programmed for these age group (28) Possible reason for poor physical fitness amongst Indian Students could be that have been found to spend an average of 8 to 9 hr per week in additional study in tuitions or coaching classes as the Indian society emphasizes more focus on Educational literacy rather than Physical Literacy. It is assumed that time spent in playing could be well utilized in studying. As per fitness 365 survey of 1, 25,000 children over a period of 7 years, only 32% Children have the right fitness level, 25% children are overweight. 40% of Primary School Children are underweight. Only 1% Children are Athletic/Sports Fit children. (34) The current education system lays more emphasis on academic performance that encourages rote learning and prepares students for jobs of yesterday. Even though Indian Education System has given priority to academics over physical education, we are not doing too well in our academic achievement.

With the onset of Covid 19 pandemic along with the direct impact on the affected patients ,the preventive measures like social distancing and home confinement has caused impact on the Physical and mental health of the non-affected as well. To cope up with the loss of education online mode was newly introduced in the field of child education right from the kinder gardens to the higher education which as potential impact on the health and cardiovascular fitness of the children due to limited opportunities in terms of regular physical activity ,recreational sports and competitive athletics . While adults are often accustomed to independent exercise, the majority of children receive their main exposure to exercise through school and recreational activities, as well as important social activities such as summer camps during school breaks All of these activities have been extremely restricted during the COVID19 pandemic. In a Canadian study, it was found that only 4.8% of children are meeting the movement behaviors guidelines during the COVID-19 pandemic (4). As estimated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) on March 26, 2020, school closures have affected 87% of the world's students (i.e., more than 1.5 billion children and young people in 165 countries) by restricting access to education (United Nations Educational, Scientific and Cultural Organization, 2020)., school closure may also cause disruptions in the physical activity ,social interaction and mental health of children .Fear of being infected is one risk factor for depressive symptoms in primary school students and anxiety symptoms in children and adolescents during the COVID19 pandemic (6) Along with that if we talk in terms of technological advancement Play Time vs Gadget Time: TV, Computers, video games, mobiles are moving in swiftly to take the available time for recreation.

So the need of the hour is to understand Physical Activity and Education are symbiotic. Exercise in the form of structured Physical Activity is the best means to improve aerobic fitness Exercise directly affects synaptic structure, potentiates synaptic strength, and strengthens the underlying systems that support synaptic plasticity such as neurogenesis, metabolism, and vascular function. Over time, these changes increase synaptic plasticity. If synaptic function is improved, nerve impulses can travel quicker to the brain. This allows for enhanced brain function. Exercise also affects neurotransmitter and protein activity. For example, exercise elevates levels of brain derived neurotrophic factor (BDNF). BDNF is a protein that plays a major role in cognitive function by affecting the mechanisms governing memory formation and storage dynamics. Aerobic training has shown to increase the volume of gray matter in the lateral prefrontal anterior cingulate and lateral temporal cortices and to increase volume of anterior white matter. Exercise also increases the size of the hippocampus, a part of the brain associated with long-term memory (7, 8,9)

Indian literatures on ancient exercise science are available. More than one hundred and twenty slokas (aphorism) on exercise (vyayama) are discovered from Charaka Samhita. This Samhita clearly suggested vyayama (exercise) for the body and yoga for mind and soul. The exercises are mentioned in terms of Yogasanas. The practice of yoga has been thought to date back to pre Vedic Indian traditions ,possibly in the Indus valley civilization around

300 BC. Surya Namaskar, is a practice of yoga as exercise incorporating a flow sequence of twelve gracefully linked asanas. With the requirement of minimum space and not gadgets it can be an excellent aerobic exercise /physical activity option for children to develop their physical fitness. The components of yoga which are very commonly applied for health benefits are asanas (physical postures), pranayama (regulated breathing) and meditation. In the context of asanas, yoga resembles more of a Physical exercise, which may lead to the perception that yoga, is another kind of

Physical exercise (10) The benefits of a suryanamaskar practice are so many that for example, in the late 1940's, Shrimant Bhavanrao Pant Pratinidhi (1868- 1951; Raja of Aundh 1909-1947) made suryanamaskar a compulsory part of the physical training program in his kingdom's schools. He helped to popularize suryanamaskar as a simple physical exercise for the all-round development of an individual (11)

Suryanamaskar or Sunsalutation is an Indian form of aerobic exercise. It is sequence of poses that involves attainment of a series of yogic postures in succession, coordinating with breathing.. Suryanamaskar is slow sustained repetitive activity utilizing both the aerobic and the anaerobic system. It includes closed chain activities even of the upper limbs which is optimal for osteogenesis . Effectiveness of suryanamaskar has been observed in children in regards to their ability to help improve the musculoskeletal & cardiorespiratory functioning & thus in safe process to be introduced in adolescent children (13)

Suryanamaskar induces increase in pulse pressure . Pulse pressure represents the stroke volume. Muscle contraction and deep breathing during suryanamaskar promotes blood flow and venous return to heart. As a result of increased blood flow to the heart, there is increase in its output (stroke volume), resulting in increase in pulse pressure. This relationship between ventricular filling and stroke volume is explained by the —Starling's law of heart. An insignificant increase in heart rate immediately after the suryanamaskar indicates that suryanamaskar is not a straining exercise, but a heart-healthy exercise (12)

Devotion of significant time to Surya Namaskar and the inclusion of standing and balancing poses that involve isometric contractions with jump transitions between asanas would be expected to increase overall energy cost and intensity of a suryanamaskar session . As ACSM guidelines classifies every aerobic exercise into mild ,moderate and vigorous according to the intensity at which it is done so, With the increasing popularity of Suryamanskar , it is important to understand the intensity of suryanamaskar within the context of the public health and exercise prescription guidelines recommended by the American College of Sports Medicine (ACSM) . To promote and maintain health and reduce disease risk, the ACSM/AHA guidelines encourage 30 min of moderate-intensity aerobic physical activity 5 d/wk or vigorous intensity aerobic activity for a minimum of 20 min 3 d/wk(13) Even the ASCC framework by Govt of India has advocated Mandatory 60 Minutes of Physical Activities/day for all Age Groups(36)

According to Bihar school of yoga, Surya namaskar style can be followed with variations in speed . The same count is followed for fast surya namaskar ,medium pace suryanamaskar and slow surya namaskar practice. (17,18) that SN at different speeds provides different benefits. The Study concluded that : Fast suryanamaskar produced a significant increase in systolic pressure, pulse pressure and rate pressure product. On the other hand, slow suryanamaskar produced a significant decrease in diastolic pressure but there was no significant change in systolic pressure or rate-pressure product. Thus it was evident that the cardiovascular response to suryanamaskar

The outcome measures to access different intensities of Suryanamaskar Rate of perceived exertion and HR

Aim: To Estimate intensity of Suryanamaskar in children age 12-17 years.

OBJECTIVES:

- 1. To assess effect of mild intensity suryanamaskar on HR and RPE in Children age 12-17 years at the end of 12 weeks .
- 2. To assess effect of Moderate intensity suryanamaskar on HR and RPE in Children age 12-17 years at the end of 12 weeks .
- 3. To assess effect of Vigorous intensity suryanamaskar on HR and RPE in Children age 12-17 years at the end of 12 weeks .
- 4. To Compare the effect of intensity mild, moderate ,vigorous suryanamaskar on HR and RPE in Children age 12-17 years at the end of 12 weeks .
- 5. To find out the Correlation between HRR method and RPE method for estimating the intensity of Exercise

HYPOTHESIS:

- Null hypothesis: There is no difference in effect of mild intensity, Moderate intensity, Vigorous intensity Suryanamaskar on HR and RPE in Children age 12-17 years at the end of 12 weeks.
- Hypothesis(H1): There is difference in effect of mild intensity, Moderate intensity, Vigorous intensity Suryanamaskar on HR and RPE in Children age 12-17 years at the end of 12 weeks.

METHODOLOGY:

- Study design: Single blinded, randomised controlled trial. It is three (group) by two (time) repeated, measures factorial design
- Sample size: 136 (with effect size 0.25 and power .80)
- Sample population: 12-17 Children
- Duration of study: 1 year
- Duration of Intervention: 12 weeks
- Type of sampling: Cluster Sampling
- Place of study: Schools/ Junior colleges in and around the City
- **Inclusion criteria:**
- 12-17 years of school/ junior college going children
- Children willing to participate

Exclusion criteria

- Trained /athlete /hyperactive child.
- Children on medications for any diagnosed medical condition. Children having any previous episode of acute and/or chronic cardiorespiratory illness as reported by parents or school authorities
- Children with any neurological, cognitive disorders or hearing difficulties as reported by parents or school authorities
- Children having musculoskeletal disorders.
- Children having neuromuscular disorders like CHD and anemia

Materials Used:

1. Weighing machine.
2. Measuring tape.
3. Pre and post Test Evaluation score-sheets
4. Chair.
5. Pen.
6. Stopwatch.
7. Yoga Mats
8. Smart watches with HR calibration
9. Borg's Scale chart

Outcome Measures:

1. HR using smart watch
2. RPE using Borg's Scale

METHOD: The Study was presented in front of the Research Advisory Committee. On Approval from the Ethical Committee the study began as follows. Adolescent urban school / Junior college children from 12 to 17 years of age were randomly selected for the study using multistage cluster sampling. The city was divided into four zones namely central, north, south and west. A list of SSC/ CBSE board, English/Marathi medium co-education schools/ Junior colleges was drawn and one school from Central zone will be chosen randomly. Students of Std. 7th, to 12th were included from school, / Junior college according to the age and gender criteria. The children were randomly selected according to their roll numbers. Every odd roll number were selected from the 7th, 8th and 9th standard and every even roll number were selected from the 10th, 11th and 12th. If a child whose roll number was randomly selected if absent at the day of the selection, he/she was be skipped and the next odd/even roll number was selected accordingly.

Consent was obtained from the participants' teachers and an assent letter from the parents / guardians of the students for the study. Every School/ Junior College conducts the parent teacher meeting at the month end so the same day and date was chosen to obtain the assent from parents and explain them about the participant information sheet. The ethical issues were also be discussed with them .The pre interventional HR and RPE were assessed using the smart watch and RPE was assessed using Borg's scale. BMI was also assessed

The subjects will be randomly divided into four groups

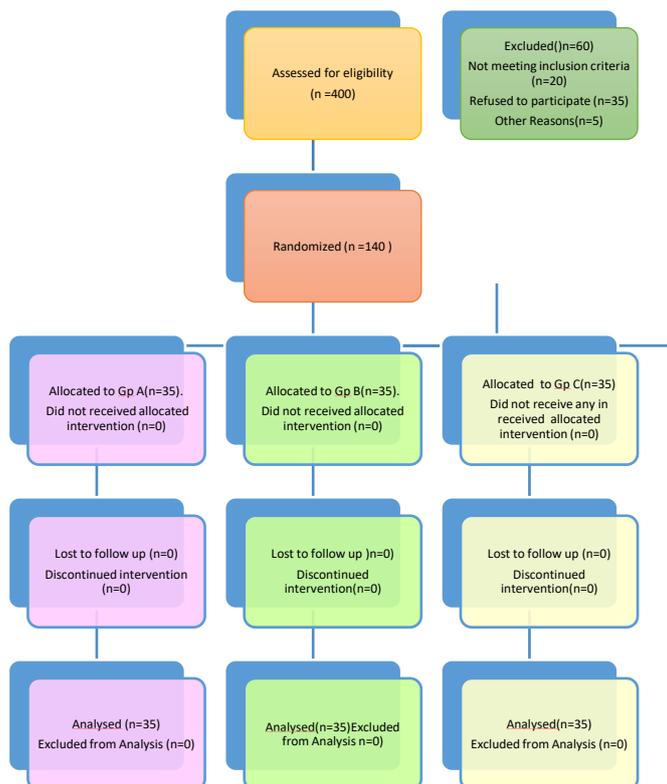
Group A: The subjects were trained to perform SN with Mild intensity postures each posture was held for 30 seconds. Each round of 12 postures took 6 minutes to complete and three -four rounds performed in 20 minutes

Group B: The subjects were trained to perform SN with Moderate intensity so that all 12 postures completed in 3 minutes. Six -Seven rounds were performed in 20 minutes

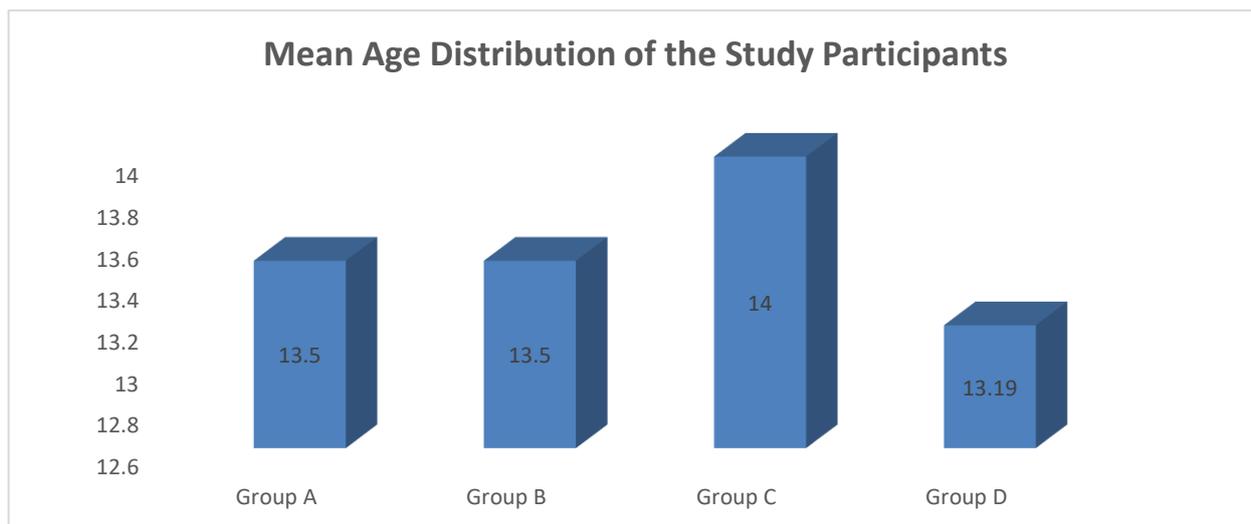
Group C: The subjects were trained to perform SN with vigorous intensity so that all 12 postures were complete in 2 minute. Ten rounds were performed in 20 minutes

Group D: Control Group performed routine activities at school/ Junior College

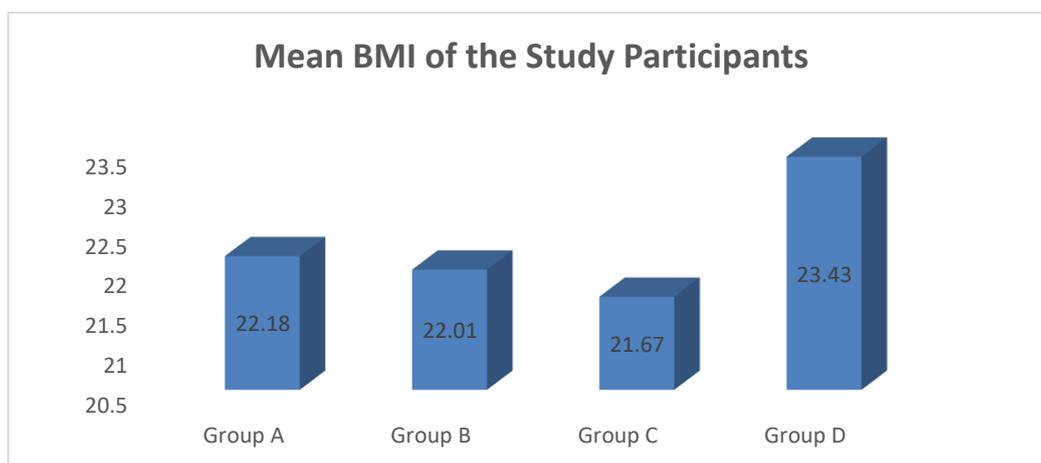
Each Group did 5 minutes of warm up session which included spot marching and 5 Minutes of cool down which also include 5 minutes of spot marching.



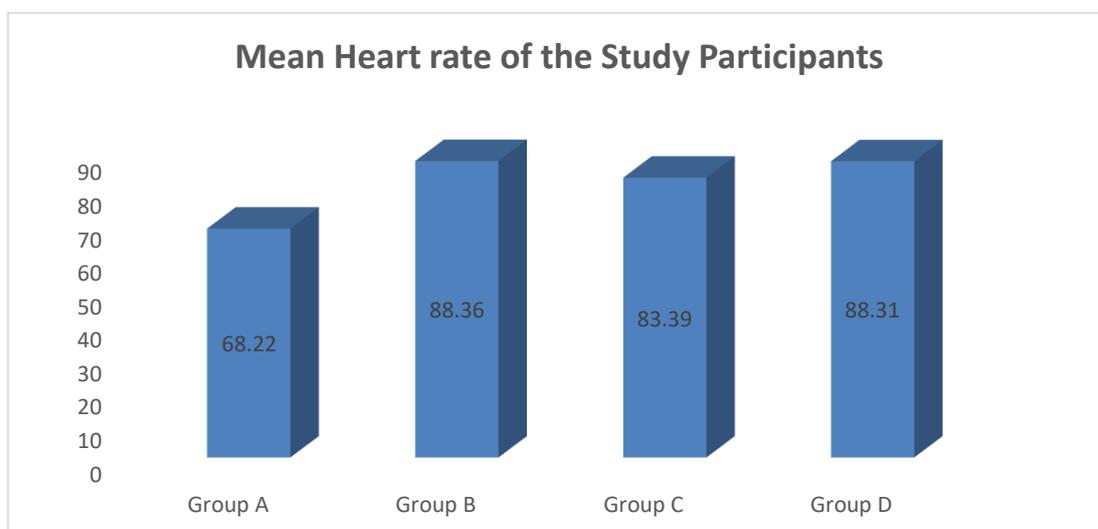
Data Analysis



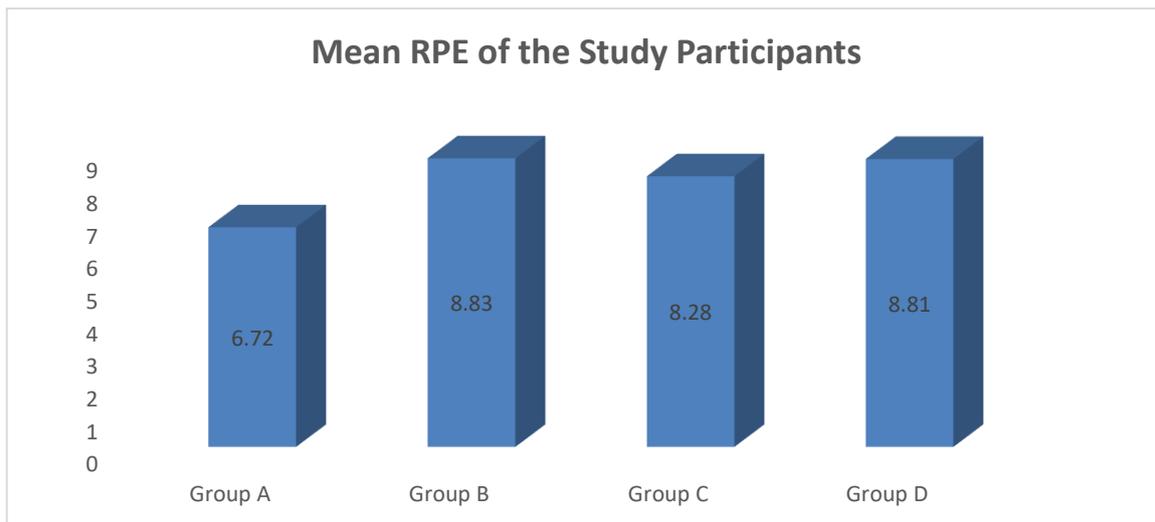
The Mean Age Distribution of the Study Participants depicted that in Group A, B, C and D the Mean Age was 13.50 ± 1.80 , 13.50 ± 1.80 , 14.00 ± 0.00 and 13.19 ± 1.85 respectively.



The Mean BMI of the Study Participants in Group A, B, C and D was 22.18 ± 3.74 , 22.01 ± 2.73 , 21.67 ± 4.16 and 23.43 ± 4.37 respectively.



The Mean Heart rate of the Study Participants in Group A, B, C and D was 68.22 ± 6.70 , 88.36 ± 5.45 , 83.39 ± 7.60 and 88.31 ± 5.44 respectively.



The Mean RPE of the Study Participants in Group A, B, C and D was 6.72 ± 0.74 , 8.83 ± 0.61 , 8.28 ± 0.85 and 8.81 ± 0.62 .

Comparison of the BMI between Groups

Groups	N	Minimum	Maximum	Mean	Std. Deviation	F	P Value
Group A	36	14.20	30.30	22.18	3.74	1.481	.222
Group B	36	16.40	28.30	22.01	2.73		
Group C	36	13.20	28.70	21.67	4.16		
Group D	36	16.30	34.90	23.43	4.37		

When Comparison of the BMI was done between Groups it was observed that the difference in Mean was not statistically significant ($p > 0.05$)

Comparison of the Heart Rate between Groups

Groups	N	Minimum	Maximum	Mean	Std. Deviation	F	P Value
Group A	36	60.00	88.00	68.22	6.70	80.656	.000
Group B	36	73.00	99.00	88.36	5.45		
Group C	36	64.00	95.00	83.39	7.60		
Group D	36	73.00	99.00	88.31	5.44		

When Comparison of the Heart Rate was done between Groups it was observed that the difference in Mean was statistically significant between Groups ($p < 0.05$).

Pairwise Comparison of the Heart Rate between Groups

Multiple Comparisons						
Dependent Variable: Heart rate						
Tukey HSD						
(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	P Value	95% Confidence Interval	
					Lower Bound	Upper Bound
Group A	Group B	-20.13889	1.49930	.000	-24.0373	-16.2405
	Group C	-15.16667	1.49930	.000	-19.0651	-11.2682
	Group D	-20.08333	1.49930	.000	-23.9818	-16.1849
Group B	Group C	4.97222	1.49930	.006	1.0738	8.8706
	Group D	.05556	1.49930	1.000	-3.8429	3.9540
Group C	Group D	-4.91667	1.49930	.007	-8.8151	-1.0182

When Pairwise comparison was done for Heart Rate between Group A – Group B, Group A – Group C, Group A – Group D, Group B – Group C, Group B – Group D and Group C – Group D the difference in Mean was statistically significant ($p < 0.05$) between all groups except Group B – Group D ($p > 0.05$).

Comparison of the RPE between Groups

Groups	N	Minimum	Maximum	Mean	Std. Deviation	F	P Value
Group A	36	6.00	8.00	6.72	.74	69.749	.000
Group B	36	7.00	10.00	8.83	.61		
Group C	36	6.00	10.00	8.28	.85		
Group D	36	7.00	10.00	8.81	.62		

When Comparison of the RPE was done between Groups it was observed that the difference in Mean was statistically significant between Groups ($p < 0.05$).

Pairwise Comparison of the RPE between Groups

Multiple Comparisons						
Dependent Variable: RPE						
Tukey HSD						
(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	P Value	95% Confidence Interval	
					Lower Bound	Upper Bound
Group A	Group B	-2.11111	.16795	.000	-2.5478	-1.6744
	Group C	-1.55556	.16795	.000	-1.9923	-1.1189
	Group D	-2.08333	.16795	.000	-2.5200	-1.6466
Group B	Group C	.55556	.16795	.006	.1189	.9923
	Group D	.02778	.16795	.998	-.4089	.4645
Group C	Group D	-.52778	.16795	.011	-.9645	-.0911

When Pairwise comparison was done for RPE between Group A – Group B, Group A – Group C, Group A – Group D, Group B – Group C, Group B – Group D and Group C – Group D the difference in Mean was statistically significant ($p < 0.05$) between all groups except Group B – Group D ($p > 0.05$).

RESULT: When Comparison of the BMI was done between Groups it was observed that the difference in Mean was not statistically significant ($p > 0.05$)

When Comparison of the Heart Rate was done between Groups it was observed that the difference in Mean was statistically significant between Groups ($p < 0.05$).

When Pairwise comparison was done for Heart Rate between Group A – Group B, Group A – Group C, Group A – Group D, Group B – Group C, Group B – Group D and Group C – Group D the difference in Mean was statistically significant ($p < 0.05$) between all groups except Group B – Group D ($p > 0.05$).

When Comparison of the RPE was done between Groups it was observed that the difference in Mean was statistically significant between Groups ($p < 0.05$).

When Pairwise comparison was done for RPE between Group A – Group B, Group A – Group C, Group A – Group D, Group B – Group C, Group B – Group D and Group C – Group D the difference in Mean was statistically significant ($p < 0.05$) between all groups except Group B – Group D ($p > 0.05$).

CONCLUSION:

The mean BMI across groups ranged from 21.67 (Group C) to 23.43 (Group D). Group D had the highest variability ($SD = 4.37$), which could imply a wider range of body compositions. The ANOVA results ($F = 1.481$, $p = .222$) indicated no statistically significant differences in BMI between groups, suggesting that BMI was relatively consistent across the sample.

Heart rate varied significantly among groups ($F = 80.656$, $p < .001$). Group A had the lowest mean heart rate (68.22 bpm), while Groups B and D had the highest (88.36 bpm and 88.31 bpm, respectively). Pairwise comparisons revealed

Group A differed significantly from Groups B, C, and D ($p < .001$), likely due to lower physical exertion or baseline differences. • Groups B and D were nearly identical, while Group C was intermediate (83.39 bpm). These differences may reflect varying exercise intensities or physiological responses among groups.

RPE scores showed significant differences ($F = 69.749$, $p < .001$). Group A reported the lowest RPE (6.72), while Groups B and D reported the highest (8.83 and 8.81, respectively). Pairwise comparisons indicated: • Group A differed significantly from all other groups ($p < .001$), suggesting lower perceived exertion. • Groups B and D were similar, while Group C was slightly lower (8.28). This aligns with heart rate findings, as higher RPE correlates with higher heart rates.

DISCUSSION: The Study proves that Moderate to Vigorous intensity has effect on RPE and HR. Mild intensity has HR between 40-60, Moderate intensity has 60-80 and vigorous intensity has 80-100 which correlates with RPE of the normative value and this goes with intensity guidelines as defined by ACSM. SN meets nearly all the criteria of the American College of Sports Medicine's current guidelines in terms of Table type of exercise (viz., aerobic, resistance, flexibility, and proprioceptive and neuromotor exercise) with purposive frequency, intensity, time, and volume. SN could be performed in multiple sessions of ≥ 10 min or could be slowed down by holding a static stretch for 10-30 s also recommended for most adults. Practicing SN at 51%-60% VO_2 max (i.e., at 7 METS) for $\geq 25-50$ min/day on $\geq 3-5$ day/week reaches the weekly goal of ACSM's criteria (i.e., 150 min/week of total exercise volume and energy expenditure of $\geq 500-1000$ MET. min/week or ~ 1400 kcal/week) for cardiorespiratory fitness in adults.. The Findings of our study correlataes with study conducted by Mody BS etal, The variability of MET intensities for Surya Namaskar (sun salutations), which ranged from 2.9 METs (light intensity) to 7.4 METs (vigorous intensity) As ACSM guidelines classifies every aerobic exercise into mild ,moderate and vigorous according to the intensity at which it is done

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