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Research Article

Physiotherapy for Better Pain Management

Impact of Aerobic Exercise and Yoga Asanas along with Diet Supplements on Haemoglobin Level among Female Collegiate

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Abstract: Haemoglobin is a conjugate iron containing protein molecule in red blood cells that carries oxygen from the lungs to the body tissues and returns carbon dioxide from the tissues back to the lungs during all body functions. In India, anaemia is a widespread condition, due to lack of haemoglobin in children, non-pregnant women, and pregnant women. Anaemia increases the risk of death during pregnancy and leads to fatigue, poor motor and mental performance in adolescent girls. Recent literature also suggests an independent association of chronic anaemia with increased mortality in a variety of conditions including chronic kidney disease, heart failure, acute coronary syndromes and acute stroke. Hence, it is necessary to prevent the occurrence and progression of anaemia from mild to a severe form in young girls. Although the current medical management is effective in improving the Hb level, researches have found few adverse effects due to the high dose usage of such medications. Thus, this study intended to investigate the effects of aerobic exercise versus yoga along with diet supplement on the haemoglobin level. 20 female collegiate between 17 to 22 years with a BMI range of 20-25 kg/m^2 and haemoglobin level from 8 to 11.5g/dl participated in this study. 10 subjects in Group A performed moderate intensity aerobic exercise and 10 subjects in Group B performed yoga asanas for 1 hour in the morning for 2 months after taking 5 grams jaggery and raisins. The result of this study suggested that both aerobic activity and yoga asanas along with raisins and jaggery helped to speed up the Hb synthesis and reduce mental and physical fatigue.

Keywords: Aerobic exercise, Yoga, Raisin, Jaggery, Haemoglobin, Aneamia

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1. INTRODUCTION

The haemoglobin molecule is the functional unit and the complex protein structure inside the red blood cells. Erythropoietin, a molecule secreted by kidney, promotes the formation of red blood cells in the bone marrow[1]. Haemoglobin (Hb) level is the most reliable indicator of anaemia among all individuals[2]. The primary role of red blood cells is to transport respiratory gases. In the lungs, oxygen (O_2) diffuses across the alveolar barrier from inspired air into blood, where it is bound to haemoglobin (Hb) to form oxy-Hb, by oxygenation process. Hb is present in the red blood cells, which, when circulated by the cardiovascular system, gives O_2 to the periphery where it is released from its Hb-bond to diffuse into the cells[3]. Anaemia is a condition that develops due to reduced haemoglobin, which in turn declines the oxygen carrying capacity of blood, thereby causing tissue hypoxia and paves way for multi-organ damage[4].The symptoms of anaemia are fatigue, general malaise, poor concentration, dyspnoea, cold intolerance[5]. Anaemia is classified based on the haemoglobin levels as -Severe with Hb less than 7g/dl, Moderate with Hb level 7-9.9g/dl and Mild with Hb level 10-11g/dl[6]. Low concentrations of haemoglobin, adversely affect cognitive and motor development and cause fatigue and low productivity. Lower haemoglobin level during pregnancy can be associated with an increased risk of maternal and perinatal mortality and size or weight of new-born. Maternal and neonatal deaths are a major cause of mortality in developing countries, and together cause between 2·5 million and 3·4 million deaths worldwide[7]. Over the world, roughly one out of three non-pregnant women of reproductive age are anaemic with low- level of haemoglobin. Although there are several causes for anaemia, it often results from sustained iron deficiency. The standard practice to prevent or treat anaemia in women has been daily iron supplementation (sometimes combined with folic acid and other vitamins and minerals) for three months. However, researchers have found that high dose usage of such medications is frequently associated with adverse effects such as nausea or constipation. Intermittent supplementation has been proposed as an effective and safer alternative to daily supplementation[8]. Hence, this study intended to analyse the effects of non-expensive therapies with nil side-effects for improving the haemoglobin level in females. Anaemia occurs due to inadequate intake of iron rich products, chronic blood loss, or a combination of both. The primary sources of heme iron are haemoglobin and myoglobin, commonly derived from ingestion of meat, poultry, fish, whereas non-heme iron is derived from cereals, pulses, legumes, jaggery, fruits and vegetables. The most sustainable strategy for preventing micronutrient deficiency anaemia is dietary improvement. Jaggery and raisins apart from iron also contain ascorbic acid (vitamin c) which is an iron absorption enhancer. Combination of jaggery with raisins is an analytically proved natural supplement to overcome Iron deficiency anaemia. The advantage of this preparation is that it does not have any significant adverse effects as observed with oral and parenteral iron preparations[6]. Aerobic exercise is a type of low to moderate intensity physical activity in the presence of oxygen. It can change the number of red blood cells and haemoglobin levels in several ways[9]. Aerobic exercise training (AET) is associated with improved hemorheology and can increase blood volume by improving plasma volume and RBC mass[10]. Regular participation in aerobic exercise has been reported to improve cardiorespiratory fitness, increase physical activity levels, and diminish the severity of fatigue in patients with severe illness[11]. Prolonged training at moderate aerobic intensities results in physiological adaptations, including increased blood volume, capillary density, mitochondrial size and density, improved fat mobilization, and thermoregulation. Collectively these adaptations represent improved cardio-respiratory fitness[12]. Physical activities, especially aerobic activities, increase blood circulation and increase the need of muscles for oxygen, so that oxygen consumption in the muscles is 100 times more than resting time[13]. Yogic practice can influence the body from the cell level and causes improvement in haematological boundaries with least expenditure. The improvement in thalamic GABA levels found after yoga practice clarifies the improvement in anxiety disorders, depression and multiple sclerosis where lower GABA levels is found. Yoga is a powerful strategy for diminishing stress and thus can achieve clinical improvement in those procedures where biopsychosocial stressors of extraordinary intensity are included. The improvement in haemoglobin esteems after normal yoga practice may likewise include another alternative therapeutic concentration in those clinical circumstances where a debt of this blood parameter is present[14]. Recent research suggests that improvement in haematological parameters caused by yoga can benefit anaemic patients[15]. Due to the dearth of literature on the effects of aerobic exercise and yoga practice along with the diet supplement on haemoglobin level, this study is an attempt to compare and analyse the effects of aerobic exercise and yoga asanas along with diet supplement on female collegiate on Hb laboratory test and FACIT-Fatigue scale. The findings of which can be an useful inexpensive method in preventing anaemia in children and adolescent girls and further reduce the progression of mild anaemia into severe anaemia thereby reducing the risk and mortality rate of pregnant women during delivery without any side-effects.

2. MATERIALS AND METHODS

This experimental study was conducted in the Faculty of physiotherapy at Dr.M.G.R Educational and Research Institute, Chennai for a period of two-months after obtaining the ethical clearance from Institutional Review Board (A-42/PHYSIO/IRB/2018-2019).After obtaining the informed consent from all the participants by explaining the procedure and need of the study, 20 female collegiate between 17 to 22 years with a BMI range of 20-25 kg/m^2 and Haemoglobin level from 8 to 11.5g/dl were included in the study. Female collegiate with diabetes, Cardiopulmonary disease, Kidney disorder, Peptic ulcer, Parasitic infection, any acute illness for more than 2 weeks and under any medications or exercise program were excluded from the study. The selected subjects were divided into two groups, Group A and Group B with 10 subjects in each group. The fatigue level of each subject was assessed using FACIT-fatigue scale (a collection of health-related quality of life questionnaires) and Hb level was taken at laboratory in pre and post intervention period. Both groups were instructed to take 5grams raisins with jaggery in the morning, one hour before the breakfast[5].

2.1 Group-A (Aerobic Exercise)

10 subjects in Group A performed moderate intensity aerobic exercise (at the level of 60-70 percent of heart rate maximum) for 1 hour, 3 sessions per week, for 2 months[9]. The exercise was performed using bicycle ergometer as mentioned below:

- ***First Stage (Warming Up)***

10 minutes of warming up in the form of pedalling at a speed of 60 rpm (revolutions per minute).

- ***Second Stage (Active Stage)***

At this stage, the workload was increased until reaching the desired intensity of 60% of maximal heart rate which was calculated by the following equation: (Maximal heart rate =220-age in year). With 40 minutes of pedalling at a speed of 60 rpm.

- ***Third Stage (Cooling Down)***

10 minutes of cooling down in the form of pedalling at speed of 60 rpm.

2.2 *Group-B (Yoga)*

10 subjects in Group B performed Asana of Trikona and its variations for 10 minutes, Sarvanga asana for 10 minutes, Suryanamaskara for 30 minutes and yoga mudras for 10 minutes every day 1 hour in morning for 2 months[15].

3. STATISTICAL ANALYSIS

The collected data were tabulated and analysed using both descriptive and inferential statistics. All the parameters were assessed using statistical package for social science (SPSS) version 24. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to find statistical difference between the groups.

4. RESULT

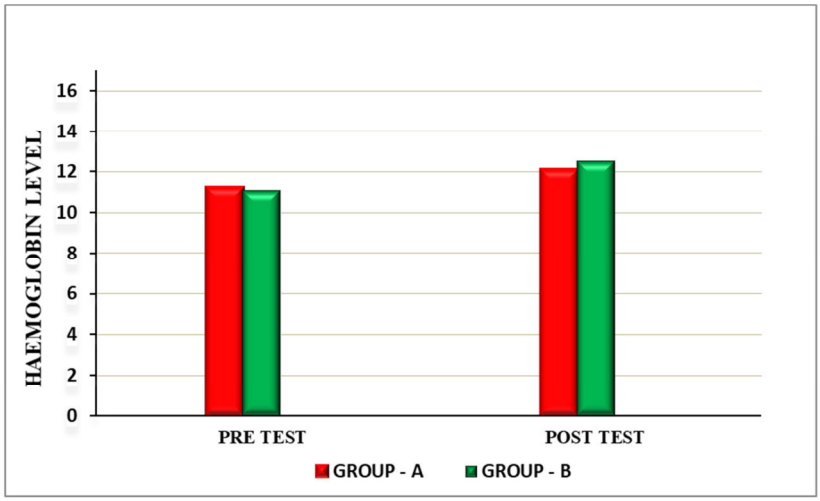
4.1 *Comparison of Haemoglobin Level Between Group – A and Group - B in Pre And Post Test*

On comparing the Mean values of Group, A & Group B on Haemoglobin Level, there was an increase in the post test Mean values in both groups, Group B (Yoga) had a higher mean value of 12.53 when compared to Group A (Aerobic Exercises) with a mean value of 12.12. However, statistically there was no significant difference in post-test values between Group A & Group B at P ≥ 0.05.

Table 1. *Comparison of Haemoglobin Level Between Group – A and Group - B in Pre And Post Test*

Hb	GROUP - A		#GROUP - B		t - TEST		
	MEAN	S. D	MEAN	S. D		df	SIGNIFICANCE
PRE-TEST	11.24	.957	11.12	1.32	.232	18	.819*
POST TEST	12.12	.906	12.53	.982	-.970	18	.345*

(* P > 0.05)



Graph 1. Effects of Aerobic Exercise and Yoga on Hb Level

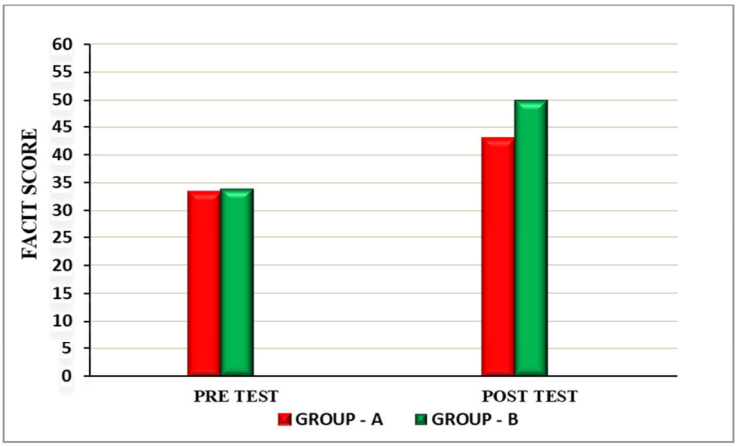
4.2 *Comparison of Facit Fatigue Scale between Group – A and Group - B in Pre and Post Test*

On comparing the Mean values of Group A & Group B on FACIT Fatigue Scale Score, there was a significant increase in the post test Mean values, Group B (Yoga) had the higher mean value of 50.00 and was more effective than Group A (Aerobic Exercises) which had a mean value of 42.90 at P ≤ 0.05.

Table-2. *Comparison of Facit Fatigue Scale between Group – A and Group - B in Pre and Post Test*

FACIT	GROUP - A		GROUP - B		t - TEST		
	MEAN	S. D	MEAN	S. D		df	SIGNIFICANCE
PRE-TEST	33.30	7.83	33.90	3.28	-.223	18	.826*
POST-TEST	42.90	6.55	50.00	3.68	-2.98	18	.008**

(* - P > 0.05), (- P ≤ 0.05), On comparing Pre-test and Post-test within Group A & Group B on Haemoglobin Level, FACIT Fatigue Scale score showed a highly significant difference in Mean values at P ≤ 0.001.**



Graph 2. Effect of aerobic exercise and yoga on fatigue level

5. DISCUSSION

Haemoglobin is the protein molecule in red blood cells that carries oxygen from the lungs to the body's tissues and returns carbon dioxide from the tissues back to the lungs. Haemoglobin is composed of four protein molecules (globulin chains) that are connected together. The normal adult haemoglobin (Hb) molecule contains two alpha-globulin chains and two beta-globulin chains. The iron present in haemoglobin is also responsible for the red colour of blood. It plays an important role in maintaining the shape of the red blood cells[15]. Thus, the present study was conducted to investigate if aerobic exercise and yoga asanas when done along with diet supplements had any impact on haemoglobin synthesis. In this study, about 20 female collegiate were selected with Hb ranging from 8.5 to 11.5g/dl and grouped into Group A and Group B. Group A followed aerobic exercise and Group B followed yoga. Jaggery is very rich in important minerals, vitamins, and proteins. Similarly, jaggery and raisins apart from iron also contain ascorbic acid (Vitamin C) which enhances iron absorption as reported by M. Sakthibalan et.al[6]. The combination of aerobic exercise and yoga along with diet supplement facilitates Hb synthesis and reduces fatigue. Subjects who participated in this study, reported general malaise, stress, resistance of tissues being stretched before doing yoga or aerobic exercises. After following 2 months of aerobic exercise or yoga the subjects reported that they had increased flexibility of muscles, decreased level of fatigue and stress, and added that they have a positive outlook on life. However, in the present study, we also noticed an improvement in the Hb level and decrease in fatigue with 8 weeks of yoga and aerobic exercise along with 5 grams of jaggery and raisins. The statistical reports revealed that there was no significant difference in pre and post-test values between Group A and Group B. On comparing the Hb values between two groups, there was a slight increase in the post-test value in both groups as seen in Table-1, but statistically no difference was obtained. There is a highly significant increase in mean post-test values in Group B (yoga) on the facit fatigue scale as seen in Table-2. This is because exercise training can increase the total haemoglobin and red blood cells, which results in enhancing the oxygen carrying capacity of blood. Bone marrow stimulated erythropoiesis with hyperplasia of hematopoietic bone marrow and improvement of hematopoietic microenvironment are possible in underlying conditions as reported by Engy.M.et.al[8]. The need to increase oxygen during exercise can provoke hematopoietic cells to produce more oxygen carriers. Since 92 percent of the oxygen in the blood is carried by haemoglobin, there is high correlation between oxygen carrying capacity and range of haemoglobin density. In addition, as haemoglobin contains 33.5% of internal compounds of red blood cells, it is obvious that an increase in red blood cells is followed by increased haemoglobin as reported by Kratz.A et.al[16]. Mohammad Reza Ramezanpour et.al also reported that inactivity reduces plasma volume and total volume of red blood cells, leading to reduced circulating blood volume and reduced performance of the body and the number of red blood cells in active tissues increases while performing physical activity. This phenomenon is created due to increased blood flow associated with an increase in the number of red blood cells and slight increase in haemoglobin and haematocrit immediately after exercise[17]. In this study, subjects who performed yoga exercises showed better results than to the subjects who performed aerobic exercise. Evidence from various studies stated that the reason for increased red blood cells by yoga can be explained by two different mechanisms. It may be due to hypoxia that releases more erythropoietin during yoga practices, other is yoga practices increases the release of iron stores from reticuloendothelial cells, and splenic contractions enhance the release of reserved red blood cells as proposed by B. Ramanath et.al[18]. Gabriela Carranque et.al[13] proposed that an increase in Hb values after regular yoga practice might add a new focus in treating underlying clinical conditions. There was a significant difference in the mean values of FACIT fatigue scale after 8 weeks of yoga practice. This could be because leucocytes count increases only when there is stress and allergy but the effect of yogic asanas decreases total leucocytes count indicating anti-stress and allergy mechanisms of the body whether it is physical, physiological or psychological. Asanas and exercise also increase the myoglobin pigment, which is helpful to supply more oxygen. Yogic asanas minimize all types of stress of the body as reported by Verma Rahul.et.al[16]. Thus, while comparing the results of both Group A and Group B, the study revealed that yoga showed better reduction in fatigue when compared to aerobic exercises, but both aerobics and yoga showed a beneficial effect on Hb level. To have a better understanding on the effects of aerobic exercise and yoga practice on Hb level, further studies should be conducted with larger sample size including all age groups and by considering Serum ferritin level in the investigation part.

6. CONCLUSION

Thus, by considering all our observations, we state that performing yoga or aerobic exercises has a potential to increase the haemoglobin level and reduce the fatigability of the persons with low levels of Hb. Hence, regular yoga asanas or aerobic exercises along with iron rich diet supplement like jaggery and raisin should be practised by young and adolescent girls with mild forms of anaemia to prevent its progression from mild to severe forms. In future aerobic exercises or yoga asanas can be prescribed along with good diet supplements for young females with anaemia to reduce the side-effects of oral iron supplements or any other medical supplements.

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8. AUTHORS CONTRIBUTION STATEMENT

Tharani.G and G. Preethi conceptualized and gathered the data with regard to this work. K. Kamatchi and G. Yuvarani analysed these data and necessary inputs were given towards designing the manuscript. G. Vaishnavi and S. Jenifer Augustina analysed the main conceptual ideas and proof outline. All authors discussed the methodology and results and commented on the manuscript. Tharani.G drafted the final manuscript.

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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