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Iron Bisglycinate Chelate (Ferrochel) Supplementation and Strength of Male Powerlifters of Pakistan: An Experimental Study

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Abstract

It is recommended that athletes with iron-deficiency anemia, should be treated through oral iron suitable doses. Iron Bisglycinate Chelate (Ferrochel) is a protein chelated iron to manage Iron Deficiency with maximum absorption and safety. Role of Ferrochel is a Stable, small molecule without ionic charge, no reaction among other nutrients can be absorbed easily, Harmless and Fewer gastric distress. Powerlifting is a power sport which comprises of 3 categories at maximum power on 3 lifts in the order: squat, bench-press and deadlift. This study is helpful to powerlifting players to improve their lifting best for better performance in Powerlifting sports by managing their blood hemoglobin at optimum level. The objectives of the research are to check the change in blood hemoglobin level (g/dL) and lifting best total (Kgs) of the selected sample population of powerlifters (n=400) in experimental and control groups through Pre-test Post-test analysis. For this purpose, national-level players were selected from different cities of Pakistan in powerlifting using convenience sampling. The blood hemoglobin level (g/dL) of all players in was measured using Bio Vision Abcam® Hemoglobin Assay Kit (Colorimetric) (Kit. No. ab234046) through the colorimetric detection method. Hemoglobin Assay Kit (Colorimetric) (ab234046) provides a quick and easy method for monitoring hemoglobin levels in a wide variety of samples. Data was collected and then analyzed using SPSS version 24 and then interpreted and compared with research objectives and hypotheses. Overall results showed that that there is a markable increase in their blood hemoglobin level (g/dL) using Tab. Ferofill containing 130mg of Iron Bisglycinate Chelate (Ferrochel) for a period of 4 months in pre-assessment to post-assessment (mid-tenure) and then in post-assessment (final-tenure) in the experimental group with an increase in their best lifting record as compared to control group which concludes that Ferrochel is of great value in increase of muscle strength in male powerlifters which marks an increase in their best lifting record. So, there should be proper supplementation for powerlifting players to enhance their muscle strength and to increase their best lifting records.

Keywords: Powerlifting, Strength, Ferrochel, Iron Bisglycinate Chelate, Sports

Introduction of the Study

Iron is an unconditional necessity for nearly everyone's life, together with the human being and the majority of bacterial groups, both animals and plants utilize iron; therefore, iron is available in a broad diversity of foodstuff resources (Parmanand, 2019). Iron is vital for life because of its extraordinary elasticity to provide equally an electron acceptor and donor, the body of a human being requires iron for the transport of oxygen and that oxygen is mandatory for the making and continued existence of more or less the entire cells in an individual's body (one exception might be of mature erythrocytes, bodies of human being regularize iron assimilation and reprocessing) (Schmidt-Rohr, 2021). Iron is one of the most crucial elements of an individual's life but there is no physiologic regulatory system for the secretion of iron, nearly all people thwart iron excess exclusively by regulating the absorption of iron. People who cannot be able to control absorption adequately get turmoil of iron excess and its related syndromes, the noxiousness of iron begins overpowering the body's capability to attach and pile up (van Swelm et al., 2020).

Iron is a vital constituent of the heme molecule that connects through globulins in the bone marrow which produce hemoglobin, a sufficient amount of flowing hemoglobin is significant to carry the oxygen from the inhaled air to training muscle which is consumed in the metabolic machinery as a source of energy for oxidization of substance (predominantly fats and carbohydrates); the Fick's equation illustrates it, VO_2 (oxygen consumption) as the result of cardiac output (or blood circulation surge) and the removal of oxygen by the tangential cells (Blum et al., 2020).

Powerlifting is a power sport that comprises of 3 categories at maximum power on 3 lifts in the order of squat, bench-press and deadlift, historically Powerlifting developed from a sport recognized as Odd Lifts, its format also consisted of three attempts, but it includes a wider range of events, likewise to strongman contest, ultimately Odd Lifts turned into identical to the current three (Bakirova et al., 2019). The Pakistan Powerlifting Federation (PPLF) is the national governing body to develop and promote the sport of Powerlifting in the Country. Pakistan Powerlifting Federation was formed and in 1992 it was affiliated with the Asian and International Powerlifting Federation. Since, its formation, Pakistani powerlifters have been taking part in the Asian Championships, World Championships. The Federation is the founder member of the Commonwealth Powerlifting Federation (CPF) since 2005 and the Asian-Oceania Powerlifting Federation since 2014.

Literature Review

A vital nutrient is that nutrient that is obligatory for the routine function of the human body (Godswill, Somtochukwu, Ikechukwu & Kate, 2020). It may not be manufactured in the body by any means or cannot be produced in sufficient quantity for better health (Houghton et al., 2020). Indispensable nutrients may too be described by the combined physiological proof of their significance in nutrition (Adan et al., 2019). A few types of indispensable nutrients include vitamins, crucial fatty acids, indispensable amino acids and dietary minerals (Ghosh et al., 2021). Special groups contain very dissimilar necessary nutrients e.g. nearly all mammals produce their individual vitamin C, and as a result not believed as an important part of the diet for those groups but ascorbic acid is a vital nutrient for everybody, who needs an outer supply of vitamin C (Carr & Lykkesfeldt, 2021).

Several important nutrients in large quantities are toxic; a few may be taken in quantities greater than mandatory in an exemplary diet, without showing any side effect, for example, Vitamin B_3 (either niacin or niacinamide) has an astonishing character that minor toxicity of an essence which has such absolute physiological influence, a small nip of 5mg on daily basis, is sufficient to stay a person away from deteriorating with pellagra, however, there is no threat of toxicity even using it ten thousand times greater than normal (Trüeb, 2020).

Metals that exist in plant or animal tissue and cells are found in very small quantities which are an essential element of physiology and nutrition are called trace metals, intake of which or disclosure to them in

surplus amount is frequently lethal, though, inadequate tissue or plasma intensity of trace metals may result in pathological disarray as in the case of iron and trace metals comprise of lithium, chromium, nickel, cobalt, copper, selenium, molybdenum, vanadium, arsenic, iron, manganese, zinc, magnesium etc (Silva et al., 2019).

Iron is an unconditional necessity for nearly everyone's life, together with the human being and the majority of bacterial groups, both animals and plants utilize iron; therefore, iron is available in a broad diversity of foodstuff resources (Parmanand, 2019). Iron is vital for life because of its extraordinary elasticity to provide equally an electron acceptor and donor, the body of a human being requires iron for the transport of oxygen and that oxygen is mandatory for the making and continued existence of more or less the entire cells in an individual's body (one exception might be of mature erythrocytes, bodies of human being regularize iron assimilation and reprocessing) (Schmidt-Rohr, 2021). Iron is one of the most crucial elements of an individual's life but there is no physiologic regulatory system for the secretion of iron, nearly all people thwart iron excess exclusively by regulating the absorption of iron. People who cannot be able to control absorption adequately get turmoil of iron excess and its related syndromes, the noxiousness of iron begins overpowering the body's capability to attach and pile up (van Swelm et al., 2020).

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Even a little decrease in hemoglobin level may detrimentally influence work-out ability, a direct relationship is found between hemoglobin level and treadmill work-out time, representing a 20 percent decline in exercising time in persons with a hemoglobin concentration between 11.0g/dL to 11.9g/dL as evaluated with persons having a hemoglobin concentration of greater than 13.0g/dL (Ganz, 2019). Akin results have been found in people experiencing continuous phlebotomies to generate anemia (Blouin et al., 2021).

It is recommended that athletes with iron-deficiency anemia, should be treated through oral iron suitable doses (McCormick et al., 2020). Although there is divergence exists, most authorities recommend supplementation of iron for players who have been acknowledged to have hypoferritinemia i.e. deficiency of iron so the effect of this state on feat has not been well distinct, this commendation is carried by opinions that (a) This state influence players to clear anaemia, (b) Supplementation of iron will incite an increase in haemoglobin in those people which are in a slight amount of anaemia, and (c) Iron paucity which is showing no sign of anaemia might have a pessimistic effect on general wellbeing, together with weaken mental performance in addition to amplified vulnerability to infectivity (Griffiths et al., 2021). Yet a little decline of 1 - 2g/100ml results in a 20 percent decline in performance. That may be re-established as a result of blood transfusion. Intellectual performance may be reduced owing to a lack of haemoglobin. Muscle and hormonal dysfunction and changed resistance to infectivity have been seen because of iron scarcity (Naik & Swathanthra, 2021).

Iron is immersed in the duodenum by enterocytes of the duodenal lining, which is taken in the shape of food or supplements, similar to the majority of mineral nutrients these cells have unique molecules that permit them to travel iron into the body to help absorption, iron taken through food may be absorbed as a component of a protein for example heme protein or have to be in the form of ferrous Fe^{2+} (Alshamy, 2020). Ferric reductase on the enterocytes brush limit reduces Fe^{3+} (ferric) to Fe^{2+} (ferrous) (Azeez, 2020). DMT1 (divalent metal transporter 1) called a protein that carries all types of divalent metals in the body then moves the iron transversely to the enterocyte's cell membrane and into the cell, intestinal lining cells may subsequently either accumulate the iron as ferritin which is achieved by Fe^{3+} strapping to apoferritin

in case the iron will run off the body when the cell dies and is sloughed off into faeces, the cell may help to travel it in the body using a protein which is called ferroportin, body normalize iron concentration by regulating each of these points so for example, cells generate more DMT1, ferroportin and Dcytb in reply to iron paucity anaemia (Möller et al., 2019).

Iron assimilation is very much affected by the quantity of iron accumulated in the body, iron assimilation considerably boosts when body stocks are little and when iron stocks are up, assimilation reduces to aid in protecting alongside iron excess, iron assimilation is also affected by the kind of iron taken from food (Ramírez, 2020). Heme iron absorption is extremely efficient and not considerably influenced by the ingredients of diet, only 1 - 7% of the nonheme iron in vegetable attaches such as corn, rice, wheat, black beans, and soybeans is immersed when used as a solitary food but in vitamin C and meat proteins will perk up the absorption of nonheme iron (Wu & Zhou, 2021).

Tannins, polyphenols and calcium found in phytates and tea which are a part of plant foods such as grains, rice and legumes can lessen the assimilation of nonheme iron, a few proteins present in soybeans also restrain nonheme iron assimilation though, the majority fit persons can preserve standard iron reserves when the diet offers a large diversity of foods (Petroski & Minich, 2020).

Multifaceted detrimental effects of Iron deficiency (ID) for the organism in the context of skeletal muscles involve decreased productivity and exercise capacity, and several alterations within the muscle tissue (Barcelos et al., 2020) (Figure 4). Experimental data from in vitro and animal studies reveal that skeletal muscle energetics suffer from iron depletion at different levels, from shifts in energy substrate preferences to subcellular and molecular derangements, which result mostly in a decrement of oxidative capacity (Czaya, 2021).

There is a substantial gap in the understanding of muscle-specific iron regulation. Only recently has local iron metabolism in skeletal muscle started to be explored (Ding et al., 2020). For example, researchers examined skeletal muscle iron metabolism and confirmed the expression of several genes implicated in four pathways: iron import, export, storage, and regulation (Halon-Golabek, Borkowska, Herman-Antosiewicz & Antosiewicz, 2019). As mentioned before, little has as yet been unravelled regarding the mechanisms that control local iron regulation in skeletal muscle (Nijholt et al., 2021). Since the expression of two main regulatory peptides, namely HAMP and HJV, has been confirmed in skeletal muscle, the existence of tissue-specific translational iron regulation can be assumed (Wanga et al., 2020). Although the production of HAMP in skeletal muscle is negligible (in comparison with hepatic production), some preliminary results indicate its potential contribution to local iron regulation and immune response (Quatredeniers et al., 2021). HJV, on the other hand, is greatly expressed in skeletal muscle. Although a comprehensive study on its biogenesis has been performed, the role of muscle HJV in skeletal muscle remains undefined (Ignatieva et al., 2021). Since muscle-derived HJV accumulates in extracellular fluid, it was proposed to influence hepatic hepcidin expression, but there is a need for in-depth research to support this hypothesis (Stewart, 2020).

Justification / Rational of the Project

- This research was held on Powerlifters (male) and became the first proven information regarding the effects of Iron Bisglycinate Chelate (Ferrochel) on Powerlifting Players.
- This knowledge is helpful to reduce the risk of muscle injuries, muscle lethargy and blood hemoglobin level among Powerlifters.
- Powerlifting players having muscle injuries, muscle lethargy and low hemoglobin level should be recommended to check their blood hemoglobin levels and may be recommended for supplementation.

- Prior knowledge about Iron is of great value regarding its role in athlete's muscle health and hemoglobin so this study is the guideline for players to be selected in training camps as one of the parameters for selection.

Objectives of the Research

- To check the difference in the effect of blood hemoglobin levels of the experimental group with the control group through Pre-test Post-test analysis.
- To check the difference of improvement in lifting the best total of the experimental group with the control group of weightlifting and powerlifting players through Pre-test Post-test analysis.

Research Questions

- What is the effect of Iron Bisglycinate Chelate (Ferrochel) supplementation on blood hemoglobin level of the experimental group in comparison to the control group of Powerlifting Players?
- What is the effect of Iron Bisglycinate Chelate (Ferrochel) supplementation on lifting best total of the experimental group in comparison to the control group for Powerlifting Players?

Research Hypotheses

- **H1:** There will be an increase in the blood hemoglobin level of the experimental group in comparison to the control group of Powerlifting Players.
- **H2:** There will be an increase in the lifting best total of the experimental group in comparison to the control group for Powerlifting Players.

Research Methodology

Subject Selection

- Elite class male powerlifters (n=150) of age between 20 - 25 years and with body weights from 67 to 93kg (As the majority of Pakistani Powerlifters fall in these body weights) were selected from different weightlifting, powerlifting and bodybuilding clubs in Lahore, Gujranwala, Sialkot, Faisalabad and Quetta (As most of the powerlifting players found in these cities) using convenience sampling. All players were monitored through their native coaches and a regular weekly visit by researchers. Their consent to participate in this study was taken on consent form by giving personal data, oral intake and provision of blood sample after approval of this research protocol from the University's ethical committee.

Inclusion and Exclusion Criteria

- All National level male players (provincial and departmental level) (Hinton & Sinclair, 2007; Tseng et al., 2021) were included in the study and players less than provincial level i.e. who have not achieved any position at province level were excluded from the study due to their immature level of sports.

Research Design

- Players' information regarding their Identification Number, Age, Division, Sports and Bodyweight were recorded.

7.3.1 Blood Haemoglobin Measurement Protocol

The blood hemoglobin level (g/dL) of all players were checked using Bio Vision Abcam® Hemoglobin Assay Kit (Colorimetric) (Kit. No. ab234046) through the colorimetric detection method. Hemoglobin Assay Kit (Colorimetric) (ab234046) provides a quick and easy method for monitoring hemoglobin levels in a wide variety of samples. In this assay, the detector selectively converts heme into a stable chemical complex that absorbs maximally at 575 nm. The intensity of the colour is directly proportional to the total concentration of hemoglobin in the sample. The kit can detect as low as 0.02 g/dL hemoglobin (Wang et al., 2021).

7.3.2 Categorization / Grouping and Testing of Players

Pre-Test

- As pre-test data, lifting best total in powerlifting events (Squat + Bench-press + Deadlift) (USA Powerlifting, www.usapowerlifting.com, retrieved 2025-03-01) along with their blood hemoglobin level (g/dL) was recorded.
- Blood hemoglobin level (g/dL) of all players was measured using Bio Vision Abcam® Hemoglobin Assay Kit (Colorimetric) (Kit. No. ab234046) (Wang, Li, Zhou, Wiltse & Zand, 2021) in the pre-test protocol.
- Lifting best total (Kg) and blood hemoglobin level (g/dL) of all players was measured in the pre-test protocol.

Treatment Protocol (Mid-Term)

- All players were treated with Iron Bisglycinate Chelate / Ferrochel (Tab. Ferofill, A product manufactured by Tehseen Industries (Pvt.) Ltd.) containing 130mg of Iron Bisglycinate Chelate equal to 26mg of elemental Iron under the supervision of a registered medical practitioner, pharmacist and other paramedical staff for two months with the dosage of one tablet per day (Hinton & Sinclair, 2007).
- A separate but generalized (for all players) game-specific training program for Powerlifting was developed according to their lifting best total and applied for two months.

Post Test (Mid-Term)

- As post-test (Mid-Term) data, lifting best total of powerlifting events (Squat + Bench-press + Deadlift) (USA Powerlifting, www.usapowerlifting.com, retrieved 2025-03-01) along with their blood hemoglobin level (g/dL) was measured and recorded.
- Blood hemoglobin level (g/dL) of all players was measured using Bio Vision Abcam® Hemoglobin Assay Kit (Colorimetric) (Kit. No. ab234046) (Wang et al., 2021) in the post-test (Mid-Term) protocol.
- Lifting the best total (Kg) and blood hemoglobin level (g/dL) of all players was measured in the post-test (Mid-Term) protocol.

Treatment Protocol (Final-Term)

- All players were divided into Group A1 (75 players) and A2 (75 players) as experimental group and control group respectively where the experimental group was treated with Iron Bisglycinate Chelate / Ferrochel (Tab. Ferofill, A product manufactured by Tehseen Industries (Pvt.) Ltd.). Group A2 was treated with a placebo under the supervision of a registered medical practitioner, pharmacist and other paramedical staff for a period of two months with the dosage of one tablet per day (Hinton & Sinclair, 2007).
- A separate but generalized (for all players) game-specific training program for Powerlifting was developed according to their lifting best total and applied for two months.

Post Test (Final-Term)

- After further two months of treatment, a post-test (Final-term) of the best lifting total (Kg) of powerlifters was taken along with their blood hemoglobin level (g/dL) and recorded on data form along with a change in lifting best total, blood hemoglobin level and their percentages.
- A comparison study was done on behalf of improvement in their:
    - Change and percentage change in Lifting best total (Kg) from pre-test to post-test for powerlifters.

- Change and percentage in blood hemoglobin level (g/dL) from pre-test and post-test for powerlifters.

Data Analysis

- Statistical analysis between change in blood hemoglobin level (g/dL) and performance improvement was evaluated by using SPSS latest version of SPSS, officially named IBM SPSS statistics version 24 (Lee et al., 2020). Paired Sample t-test was used to measure the relationship from pre-test to post-test (mid-term) and then to Post-test (Final-term).

Paired Sample t-test

In group A (n=150), all powerlifter results determined that mean blood haemoglobin level (g/dL) was increased from pre-assessment to post-assessment (mid-tenure) (1.65 g/dL) ($p \leq 0.05$) after the ingestion of the dose of Tab. Ferofill (Ferrochel 130mg) one tablet each day for two months. Moreover, after the dose ingestion, the powerlifter increased their mean best lifting record (Kgs) from pre-assessment to post-assessment (mid-tenure) by 14.83 Kg ($p \leq 0.05$). In this table, results indicated a strong correlation ($r^2 = .99$) between blood haemoglobin level and best lifting record (As shown in Table 1 and Fig. 1).

Additionally, group A was divided into two groups i.e. group A1 (n=75) and A2 (n=75). Group A1 was further treated with Tab. Ferofill (Ferrochel 130mg) for a period of two months, and results revealed that group A1 had a noticeable increment in blood haemoglobin level (1.98 g/dL) ($p \leq 0.005$) from post-assessment (mid-tenure) to post-assessment (final-tenure). Group A2 was treated as a placebo for the same period, i.e. two months, as Group A1 and found a non-significant ($p \leq 0.005$) improvement in their blood haemoglobin level (results after the ingestion dose of Tab. Ferofill (Ferrochel 130mg). The results of Table 1 and Fig. 1 displayed that group A1 significantly improved ($p \leq 0.005$) their best lifting record (Kgs) from post-assessment (mid-tenure) to post-assessment (final-tenure) as 12.45 Kg and group A2 which was treated as placebo had no noticeable change in their best lifting record in post-assessment (final-tenure).

Table 1: Showing supplementation outcomes of Fe-Ron (Ferrochel 130mg) in the progressions of blood haemoglobin level (g/dL) and best lifting records (Kg) in pre-assessment, post-assessment (mid-tenure) and post-assessment (final-tenure) of powerlifters from Group A, A1 and A2. Where $P<0.05$ * and $P \leq 0.005$**

Group A Powerlifters												
Parameter → Weeks ↓	**Pre-assessment**		**Post-assessment (Mid-tenure)**		**Group A segregation after Post-assessment (Mid-tenure)**				**Post-assessment (Final term)**			
	Group A (N=150)		**Group A (N=150)**		**Group A1 (N=75)**		**Group A2 (N=75)**		**Group A1 (N=75)**		**Group A2 (N=75)**	
			Treated with Ferrochel 130 mg/week for 1st 8 weeks						**Treated with Ferrochel 130 mg/week for the next 8 weeks**		**Treated as Placebo for next 8 weeks**	
	BHL (g/dL)	**BLR (Kg)**	**BHL (g/dL)**	**BLR (Kg)**	**BHL (g/dL)**	**BLR (Kg)**	**BHL (g/dL)**	**BLR (Kg)**	**BHL (g/dL)**	**BLR (Kg)**	**BHL (g/dL)**	**BLR (Kg)**
0	10.92	647.15	-	-	-	-	-	-	-	-	-	-
8	-	-	12.57*	661.98*	12.45	655.95	12.69	668.01	-	-	-	-

16	-	-	-	-	-	-	-	-	14.43*	663.71**	13.03**	667.50**
±S.E.M.	.29	6.07	.39	5.99	.59	6.81	.24	8.59	.68	6.84	.23	8.54

Abbreviations: BHL = Blood Haemoglobin Level; BLR = Best Lifting Record; S.E.M. = Standard Error of Mean; g/dL = Gram / Deciliter; Kg = Kilograms; N = No. of Participants

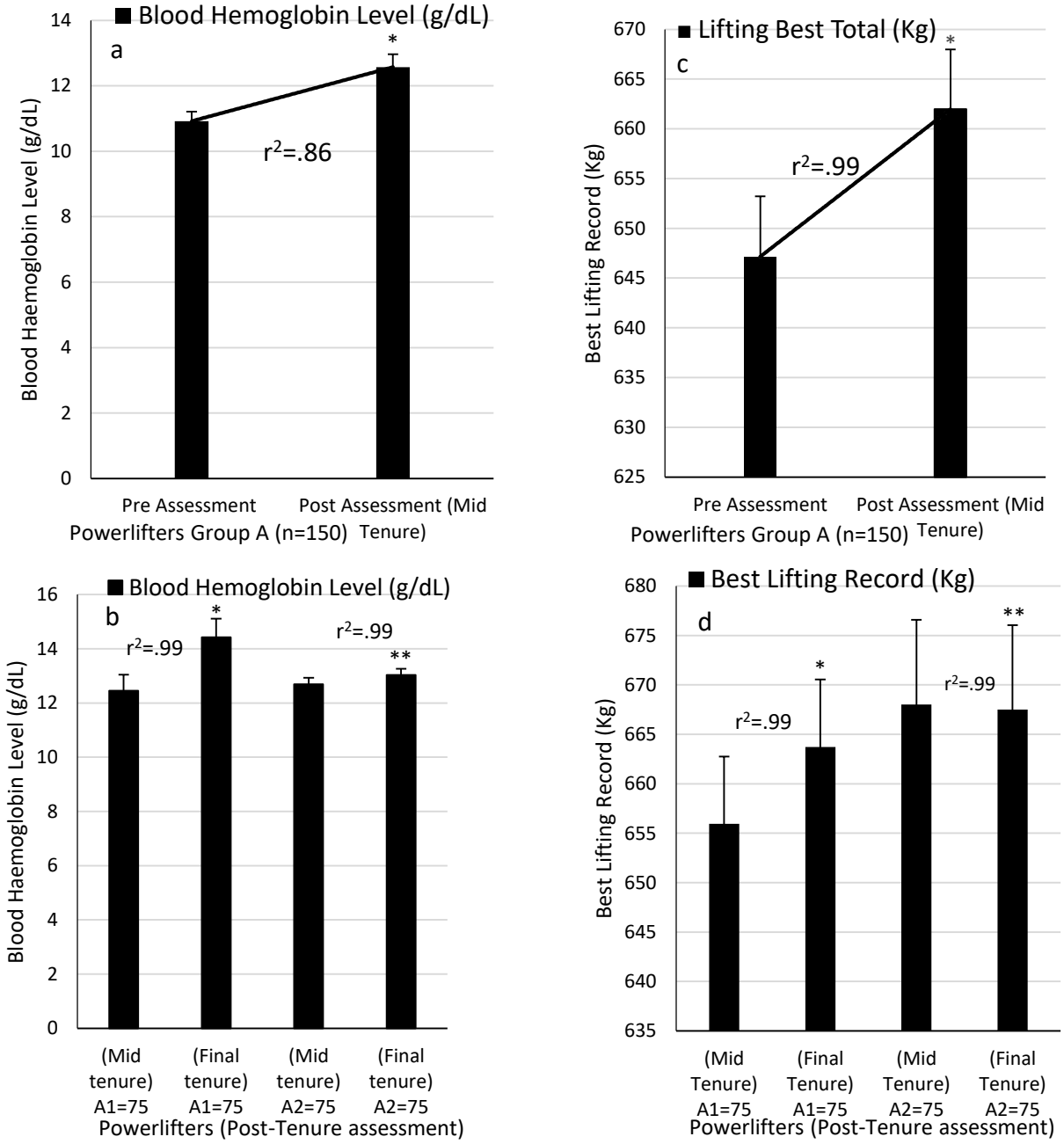

Figure 1: Showing supplementation outcomes of Fe-Ron (Ferrochel 130mg) on the mean changes of blood haemoglobin level (g/dL) and best lifting record (Kg) in pre-assessment, post-assessment (mid-tenure) and post-assessment (final-tenure) of powerlifters from Group A, A1 and A2 where P≤0.05* and P≤0.005**

Discussion

It is a matter of concern for sports professionals that sportspersons' physical, physiological, and mental wellness is fundamental for their better sports outcomes (Benjamin et al., 2023). It is generally observed in Pakistan that most of the sports masses stay iron and haemoglobin lacking because of extreme workouts, particularly strength sports like weightlifting, powerlifting and high-intensity games and marathons, which can prompt expanded iron loss through sweat, urine, and gastrointestinal blood loss (Akram et al., 2023). This elevated iron loss can add to an over-the-long run deficiency. In sports, including tedious foot strikes and pressure, a condition known as "foot strike hemolysis" can happen (Kardasis et al., 2023). This condition brings about the burst of red blood cells, delivering haemoglobin and iron into the blood circulation system, which can additionally drain iron stores (Galy et al., 2023).

The first objective of this study was to examine the difference in improvement in blood haemoglobin levels (g/dL) of the experimental group with the control group of powerlifting players through Pre-assessment and Post-assessment analysis using Ferrochel and placebo, respectively. Results showed that the experimental group of Powerlifting Sport showed significant improvement in their blood haemoglobin level (g/dL) both in the Pre-assessment to Post-assessment (mid-tenure) and then Post-assessment (final-tenure) in comparison to the placebo, which was only given in Post-assessment (final-tenure) and this was due to the high number of haemoglobin deficient players as Ferrochel is thought to have higher bioavailability compared to some other forms of iron supplements. Iron is associated with red blood cell production, and ideal haemoglobin levels are pivotal for oxygen transport to tissues (Cortese-Krott, 2023). Satisfactory iron levels can assist with relieving the effect of oxidative pressure on red blood cells and backing their legitimate capability (Brittenham et al., 2023). Players, particularly those in high-intensity games, may encounter expanded iron loss through perspiring and foot strike hemolysis (annihilation of red blood cells) (Kardasis et al., 2023). Lack of iron can lead to anaemia, which adversely influences athletic performance. Supplementation with Ferrochel might help prevent or address players' lack of iron anaemia (Stefan et al., 2023). Hence, the results and the above discussion made the first and second hypotheses, which are H1 (There will be a significant increase in the blood haemoglobin level (g/dL) of the experimental group in comparison to the control group of Powerlifting Players) as Null hypothesis.

The second objective of this study was to examine the difference of improvement in best lifting record (Kgs) of the experimental group with the control group of powerlifting players through Pre-assessment and Post-assessment analysis using Ferrochel and placebo, respectively. Results showed that the experimental group of both Powerlifting Sport showed significant improvement in their best lifting record (Kgs) both in Pre-assessment to Post-assessment (mid-tenure) and then Post-assessment (final-tenure) in comparison to the placebo, which was only given in Post-assessment (final-tenure) and this was observed due to rapid increase in blood haemoglobin level of those players which were more deficient. The improvement in strength among powerlifters because of the ascent in their blood haemoglobin levels can be credited to a few factors essentially connected with the role of haemoglobin in oxygen transport and use (Adnan et al., 2023). Haemoglobin is a protein in red platelets that dilemmas to oxygen in the lungs and transports it to the functioning muscles. Expanded haemoglobin levels mean more oxygen can be conveyed to the muscles, further developing vigorous energy creation (Lundby et al., 2024). Considering better perseverance and support performance, this upgraded oxygen supply is essential during delayed or extreme focus workouts (Coates et al., 2023). Higher haemoglobin levels increment oxygen conveyance to the muscles and upgrade the muscles' capacity to extricate and use oxygen (Wagner, 2023). This superior oxygen usage is especially useful during resistance training, as it can defer the beginning of fatigue and add to better general muscle capability (Juškevičiūtė et al., 2023). Sufficient oxygen accessibility is fundamental for creating adenosine triphosphate (ATP), the essential energy source of cells (Subramanian, 2023). Weightlifting and powerlifting require quick and severe muscle constrictions, which depend vigorously on ATP. Expanded haemoglobin levels support effective ATP creation, upgrading strength and power yield (Furrer et al., 2023). Deficient oxygen supply to the muscles can prompt hypoxia,

a condition where oxygen levels in the tissues are lower than expected. Hypoxia can hinder muscle capability and lessen exercise performance (Dennis et al., 2023). Higher haemoglobin levels assist with preventing hypoxia, guaranteeing that the muscles get the oxygen they need for ideal capability during strength exercise. Lactate is delivered during anaerobic digestion, for example, focused energy opposition preparing (Jacob et al., 2023). A sufficient oxygen supply, worked with by expanded haemoglobin levels, can assist with limiting the aggregation of lactate in the muscles (Schell et al., 2023). This is significant because unnecessary lactate development is related to muscle weakness and diminished strength. Further developed oxygen conveyance and usage can upgrade the recuperation cycle by working with the evacuation of metabolic results and lessening muscle soreness (Vollrath et al., 2023). Faster recovery permits competitors to prepare all the more reliably and at higher forces, adding to strength gains over the long run (Wittels et al., 2023). Hence, results and the above discussion made the second hypothesis, which are H2 (There will be a significant increase in the best lifting record (Kgs) of Powerlifting Players of the experimental group in comparison to the control group) as Null hypothesis.

5.3 Conclusion

The following is the conclusion of this research;

- The results showed that there is an increase in blood haemoglobin level (g/dL) of powerlifters from Pre-assessment to Post-assessment (mid-tenure) due to supplementation of Tab. Ferofill (Iron Bisglycinate Chelate / Ferrochel). Then, in Post-assessment (final-tenure) an increase in the experimental group of powerlifters is found due to supplementation of Tab. Ferofill (Iron Bisglycinate Chelate / Ferrochel) which is not seen in the control group as the control group is treated with placebo in Post-assessment (final-tenure).
- The results showed that there is an increase in the best lifting record (Kgs) of powerlifters from Pre-assessment to Post-assessment (mid-tenure) due to supplementation of Tab. Ferofill (Iron Bisglycinate Chelate / Ferrochel). Then, in Post-assessment (final-tenure), an increase in the experimental group of powerlifters is found due to supplementation of Fe-Ron (Iron Bisglycinate Chelate / Ferrochel) which is not seen in the control group as control group is treated with placebo in Post-assessment (final-tenure).

Recommendations

The following are the recommendations;

- As most of the powerlifting players in this research were found haemoglobin deficient, all the elite class players should be tested periodically for blood haemoglobin level as the parameter for their muscle health, and proper supplementation should be provided to them.
- Blood haemoglobin levels of all those powerlifting players should be based on some specific best lifting record for a more extended period. However, according to this research, they are doing appropriate training as low blood haemoglobin level (g/dL) suppresses muscle recovery and proper health, resulting in a decrease or halt on some specific best lifting records.
- There should be awareness programs by the Pakistan Powerlifting Federation regarding supplementation and care of players' blood haemoglobin levels at different sports ages for their injury-free better performance in their sporting career.
- Female players were not added to this research. Still female powerlifters should be taken into special consideration regarding supplementation and monitoring of blood haemoglobin levels. They are more vulnerable to haemoglobin deficiency and muscle injuries due to the blood loss in their mensural cycle.
- The government should launch a proper awareness program for monitoring the blood haemoglobin level of powerlifting players as the optimum level is the key to an injury-free healthy sports life.

Suggestions

The following are the suggestions;

- All powerlifters should be checked for their blood haemoglobin levels before engaging in powerlifting sports, either in their leisure or professional careers.
- A proper awareness program should be launched at the national and international levels to promote awareness of optimum blood haemoglobin levels in powerlifting players.
- Pharmaceutical industries should launch free blood haemoglobin level testing of powerlifting players through their national sports federations.
- There should be a proper blood haemoglobin maintenance awareness campaign launched by former powerlifters for young players and the general public through different media sources.
- Pharmaceutical companies should subsidise rates of Ferrochel supplements for powerlifting players at National and International levels.
- Retired players should be regularly monitored for their blood haemoglobin level to manage their optimum health related to blood haemoglobin deficiency.
- Day by day, female powerlifters are increasing in society, so pharmaceutical companies should provide free camping for female players through national sports federations.

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