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Impact of Iron Intake on Intelligence Level and Academic Achievement Among Pre-Adolescents

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Abstract

To examine the impact of Iron Intake on Intelligence Level and Academic Achievement among pre-adolescents. The "Wechsler Intelligence Scale for Children (Revised)" testing tool was used to collect data from a government school in the district of Sargodha. 30 iron-deficient respondents of age 11-13 years were targeted, both boys and girls from the government institute. Mostly, the students were in the age group 11, were in 7th grade, and 12-13 were in 8th grade. The Wechsler Intelligence Scale for Children (Revised WISC-R) was applied, and the scales were applied before and after the provision of iron supplementation. The academic achievement record was obtained from their school records. With the support of SPSS version 26, the data was analyzed. The interpretation of the data was based on descriptive statistics and T-tests. A small increase in IQ after iron supplementation was observed, and no significant relationship between IQ and academic achievement was found. There was quite a small increase in the amount of IQ after the provision of iron supplementation. There was no significant relationship between iron, IQ and academic achievements.

Keywords: Iron deficiency, intelligence level, academic achievements, pre-adolescents, Wechsler Intelligence Scale for Children, Iron supplementation.

1 Introduction

Iron deficiency (ID) is a common disorder, affecting more than 1 billion people worldwide (Grosbois et al., 2005). It may reduce work capacity in adults (Haas et al., 2001) and reduce mental development in children Iron deficiency is the most prevalent hematologic disorder in childhood.

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Infants from 9 to 24 months of age may develop dietary iron deficiency as bone marrow stores of iron are depleted during a period of accelerated growth. Adolescent girls also are susceptible to dietary iron deficiency because of poor dietary intake in conjunction with high iron requirements related to rapid growth and menstrual blood loss (Halterman et al., 2001). Iron deficiency is a systemic condition with many consequences including anemia, impaired exercise capacity, and functional alterations of the small bowel (McCann & Ames, 2007). One of the most concerning consequences of iron deficiency in children is the alteration of behavior and cognitive performance. The association of iron deficiency anemia with lower mental and motor developmental test scores in early childhood is well described and has recently been reviewed (Black et al., 2013). There are fewer published data, however, on cognitive achievement in iron-deficient school-aged children and adolescents; thus, the relationship between iron status and cognitive functioning for older children is less clear (Beard & Connor 2003). The majority of studies evaluating cognitive performance and iron deficiency have focused on individuals who have iron deficiency anemia. There is little evidence to implicate iron deficiency without anemia in causing developmental problems (Aggett et al., 2002). However, central nervous system iron decreases before restriction of red cell production, and, therefore, the cognitive effects of iron deficiency may precede the hematologic manifestations of anemia (Haacke et al., 2005). Furthermore, the prevalence of iron deficiency without anemia is much greater than the prevalence of iron deficiency with anemia, (Lopez et al. 2016) suggesting the potential fora greater public health impact. Although current screening guidelines recommend evaluation for anemia among certain children, there are no screening guidelines for evaluation for iron deficiency without anemia (Andriastuti et al., 2019). Iron is required for the development of myelin because it is a cofactor for lipid biosynthesis. As a consequence, myelin deficiencies and slower processing via the auditory and visual systems have been attributed to IDA (Al Mamun et al., 2017). This is an unfixable concept that continues beyond the use of iron supplementation in IDA therapy. Finally, iron tends to be essential in monoamine synthesis, which involves dopamine and other neurotransmitters and neuromodulators (Algarín et al., 2003). It's important to note that iron favor's red blood cells over all supplementary organs, together with the mind (Denis & Denis, 2005). Iron status does not play a major role in educational performance and intelligence of school going adolescents. Several factors affect educational performance and intelligence (Dissanayake et al. 2009). The impact of iron intake on intelligence level and academic achievement among pre-adolescent who are at highest risk for iron deficiency, requires clarification regarding iron deficiency symptoms, intelligence and academic achievements. The objective of this study was to evaluate the relationship between iron intake, intelligence level and academic achievement among Pre-Adolescent.

2 Materials and Methods

Area of study: This research was conducted in the District of Sargodha, Punjab Pakistan (2020). There were no gender preferences, and both boys and girls were given similar chances. The information was gathered from a government school in District of Sargodha.

Sample size and sampling technique: Sample size of 30 students as respondents was equally selected from each school. After giving proper instruction of WISC-R 10 iron-deficient students were chosen by analyzing symptoms of iron deficiency from each school. Afterword the test was applied on them.

Targeted population: 30 iron deficient respondents of age 11-13 years was targeted, both boys and girls from the government institute. 7thclass to 8th class was filled with this age group. Mostly the students between the age group 11 were in 7th grade and 12-13 in 8 grades. All these students were in their late adolescent age which is also called pre-adolescent age (Schoenthaler et al., 2000).

Gender of respondents: Present research consist of both genders' girls and boys. They were equal in number; data was randomly selected on the basis of their school records.

2.1 Instrumentation

Research tool: The "Wechsler Intelligence Scale for Children (Revised)" testing tool was used to collect data and its standardized scoring was used to obtain this study's statistical solution. In 1949 after the first Wechsler – Bellevue Adult Intelligence Scale was published by David Wechsler (Wechsler, 2012). David Wechsler created the Wechsler Child Intelligence Scale (WISC-R), tests child intelligence (Konold & Canivez, 2010) for the first time. This test allows the measurement of a wide spectrum of childhood intelligence (WISC-R) calculation. In these scales there were a total of 9 subtests.

2.2 Methodology

The Wechsler Intelligence Scale for Children (Revised WISC-R) was applied, the scales were applied before the provision of iron supplementation. Iron supplementation was recommended through child specialist, which was provided to the respondents. After the provision of iron supplementation, the WISC-R was applied yet again on the respondents to analyze the difference in their intelligence level of pre-adolescents. Academic achievement records were obtained from their school records which were provided by their teachers.

Data collection: The data was collected by the "Wechsler Intelligence Scale for Children (Revised WISC-R)" scale.

Apply the Wechsler Intelligence Scale for Children (WISC-R) on respondents: Wechsler Intelligence Scale for Children (WISC-R) consists of 6 verbal tests and 6 performance tests. Verbal tests are Information, Similarities, Arithmetic, Vocabulary, Comprehension, Digit Span and Performance tests are Picture completion, Picture Arrangement, Block Design, Object Assembly, Coding, and Mazes. It will take at least 45 minutes to conduct a single test.

Information: Precisely read each statement as mentioned. It is permissible to say if the answer is not obvious, explain what you mean or tell me more about it, but do not ask extended questions or spell the word.

Data analysis: The standardized scoring method of analysis tools collected numerical results and the statistical criteria evaluated data to interpret the results. With the support of SPSS version 26, the data was analyzed. The interpretation of the data was based on descriptive statistics and T-tests. In order to explore the influence of iron on the level of intelligence and academic achievements of pre-adolescents, the paired sample t-test was used to assess discrepancies in pre-iron or post-iron respondents.

3 Results and Discussion

RESULTS

After data collection, findings were utilized with the SPSS (Version 26). For the data analysis t-test was applied and this chapter represents the pretest and posttest on the respondents. **Demographic profile**

Table 1. Demographic Characteristics of the participants (N=30)

Demographic	Characteristics	F	%
Gender	Male	15	50
	Female	15	50
	Total	30	100.0
Age	11	10	33.3
	12-13	20	66.6
	Total	30	100.0
Class of Participants	7^{th}	10	33.3

8th	20	66.6
Total	30	100.0

Based on the results of the findings, the results highlighted that this research study involved a total of 30 respondents. 50% of the respondents were male and 50% were female. The age of the participant was also reported and 66.6% of the age range of respondents was dropped in 12-13 according to the findings and 33.3 % of the age range of respondents was dropped in 11. Finally, respondent groups often measured as a demographic and the outcome of the above table indicates that 33.3% of respondents from the 7th class to 8th class, 66% of respondents.

3.1 Descriptive analysis of demographic variables

Based on the results of the findings, the results highlighted that this research study involved a total of 30 respondents. 50% of the respondents were male and 50% were female. The age of the participant was also reported and 66.6% of the age range of respondents was dropped in 12-13 according to the findings and 33.3 % of the age range of respondents was dropped in 11. Finally, respondent groups often measure as a demographic and the outcome of the above table indicates that 33.3 percent of respondents from the 7th class to 8th class, 66 percent of respondents. Similarly, Dissanayake et al. (2009) presented a report on the relationship between iron status and teenage educational achievement and intellect. The aim was to find a connection between iron status and adolescent academic achievement and intelligence. A longitudinal cross-sectional analysis of adolescents aged 13 to 15 years was taken as sample. Each iron-deficient student was matched with another iron-deficient student of the same gender, age, and grade. Hemoglobin and serum ferritin levels were used to assess iron status. Educational achievement was evaluated using grades in mathematics, astronomy, Sinhala language, and social science. Raven's Norm progressive matrices were used to measure intelligence. Both possible confounders and impact changes were taken into account. The accuracy of the findings was checked with a sub-sample of home visits. Pongcharoen et al. (2011) also focused iron and zinc supplements during childhood had a enduring consequence on intellectual function at 9 years of age. Iron and zinc intake in childhood may have an impact on long-term cognitive development and school success, although this hasn't been tested. During childhood, the effects of iron or zinc intake, or both, on cognitive output were studied eight years later. Continuation study was conducted on 560 children aged 9 years, or 92 percent of those who took part in a randomized clinical trial featuring 4 classes receiving daily iron, zinc, iron + zinc, or placebo for 6 months at 4 to 6 months of age.

Table 2: Present the descriptive statistics of the pre-test and post-test academic achievement (N=30)

	N	Minimum	Maximum	Mean		Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
Pre semester Academic performance	30	280	633	452.23	17.66	96.76	.12	.42
Post semester Academic performance	30	283	650	455.23	18.04	98.83	.12	.42

The results presented in table displayed the descriptive statistics of pre-test and post-test academic achievement (mean and standard deviation). The mean aggregate value for the pre-test was (M=452.23 and S. D=96.76) and the mean aggregate value for the post-test was (M=455.23, S. D=98.83). The post-test has a positive relationship with profitability compared to the pre-test, as per the findings.

3.2 Descriptive Analysis of the Pre-test and Post-test Academic Achievement

Based on the results of the findings the descriptive statistics of pre-test and post-test academic achievement shows. The mean aggregate value for the pre-test was (M=452.23 and S. D=96.76) and the mean aggregate value for the post-test was (M=455.23, S. D=98.83). The post-test has a positive relationship with profitability compared to the pre-test, as per the findings. Similarly, Sullivan et al. (2009) argued that the relationship with cognitive transformations had so far-off solitary remain verified in two very exploratory experiments for a few unique cognitive tasks. This survey specified that, after providing iron supplementation, there was very limited increase in the intelligence level vales as well as in academic achievements. It was therefore concluded that the Intelligence Level and Academic Achievement Association through Iron Intake among teenagers was insignificant. Beard, (2001) concludes that, despite the provision of iron supplementation, there was a precise improvement in the rate of intelligence and educational achievement. It was therefore concluded that the Intelligence Level and Academic Achievement Connection, through Iron Intake among Teenagers, was unimportant.

Table 3: Descriptive statistics of the full score pre and post IQ Test scale (N=30)

	N	Minimum	Maximum	Mean		Std. Deviation	Skewness	
	Statistic	**Statistic**	**Statistic**	**Statistic**	**Std. Error**	**Statistic**	**Statistic**	**Std. Error**
Pre full scale score IQ test	30	69	95	83.43	1.230	6.73	-.04	.42
Post full scale score IQ test	30	70	99	84.80	1.257	6.88	.069	.42

The results of above table showed the descriptive statistics (Mean and Standard Deviation) of the full score pre and post IQ Test scale. The full pre-test mean score was (M=83.43, S. D=6.73) and the full post-test score was (M=84.80, S. D=6.88). The mean score was (M=84.80, S. D=6.88). The post-test has a marginally higher mean score compared to the pre-test, according to the findings.

3.3 Descriptive analysis of full score pre and post IQ test scale

The full pre-test mean score was (M=83.43, S. D=6.73) and the full post-test score was (M=84.80, S. D=6.88). The mean score was (M=84.80, S. D=6.88). The post-test has a marginally higher mean score compared to the pre-test, according to the findings. Similarly, with Chaudhari et al. (2004) argued that student success should be evaluated as well. A total of 188 infants weighing less than 2,000 grams were measured at birth, with a further ninety children being looked after. The average IQ of the sample group was normal, though marginally lower than that of the controls. The average IQ of kids with Pre-Term SGA was the lowest. In the 78 VLBW children, 12 were mentally ill, compared to just three in the controls. In the VLBW group, there were only 3 'healthy' girls associated to 20 in the controller group. It was concluded that children weighing less than 2,000 grams had substantially lower intelligence and academic performance than controls, but within normal limits. They had poor visual-brain coordination, brain fatigue, impaired reading and learning math. The lowest cognitive skills were in preterm SGA and VLBW children. This study concluded that there was a precise enhancement in the rate of intelligence and educational achievement, despite the availability of iron supplementation. It was therefore concluded that the level of intelligence and the relation between academic achievements through iron intake among teenagers was unimportant.

Schoenthaler et al. (2000) also concluded that this research indicated that foliate-minerals supplementation moderately improved the nonverbal intelligence. This research concluded that the rate of intelligence and educational achievement had increased limitedly despite the provision of iron supplementations. The conclusion was thus that, through iron intake among adolescents, the Intelligence level and the academic achievement connectivity were not significant

Table 4: Represent the Descriptive statistics of the per-performance IQ scale and post-performance IQ scale (N=30)

	N	Minimum	Maximum	Mean		Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
Pre performance IQ testing	30	48	71	56.90	1.05	5.73	.28	.42
Post-performance IQ testing	30	50	73	58.90	1.04	5.75	.08	.42

The results of above table displayed the descriptive statistics of the per-performance IQ scale and post-performance IQ scale (mean and standard deviation). The mean average score for the pre-test performance was (M=56.90, S. D=5.73) and the mean average score was (M=58.90, S. D=5.75) for the post-test performance. The post-test performance has a higher mean score relative to the pre-test, according to the findings.

3.4 Descriptive analysis of the per-performance IQ scale and post-performance IQ scale

The results display the descriptive statistics of the per-performance IQ scale and post-performance IQ scale (mean and standard deviation). The mean average score for the pre-test performance was (M=56.90, S. D=5.73) and the mean average score was (M=58.90, S. D=5.75) for the post-test performance. The post-test performance has a higher mean score relative to the pre-test, according to the findings. Similarly, Ghazi et al. (2012) worked on review of nutrition and children's intelligence quotient (IQ) Child nutrition was vital particularly during the early years for the development of the region body and the particular mentally. Malnutrition prevalence among Iraqi children was 12.1 per cent. Infant intelligence was significantly correlated with Nutritional status, eating habits, and breakfast consumption are also factors to consider. Child malnutrition remained a public health concern in Iraq, affecting children's cognitive function and academic achievement at school. The mechanism by which the diet had influence the Intelligence remained uncertain. The goal of this analysis was to recognize the children's latest nutrition and IQ studies performed over the last 5 years. This research concluded that the rate of intelligence and educational achievement had increased in small amount despite the provision of iron supplementations. The conclusion was thus that, through iron intake among adolescents, the Intelligence level and the academic achievement connectivity were not significant. Low et al. (2013) also worked on the impact of daily iron supplementation on older children in primary school. According to this article, anemia had become a major public health and clinical concern. Observation was based on researchers in children with many adverse consequences associated with iron deficiency and anemia, including impeded cognitive development, negative effects were associated with iron supplementation, a commonly used preventive and therapeutic technique. Children of primary school age were at a critical period in academic growth and improving their cognitive function. The advantages and risks of daily iron supplementation in primary-school-aged children were reviewed. Daily iron supplementation was required in randomized and quasi-randomized clinical trials of children aged 5 to 12 years.

Table 5: Represent the Descriptive statistics of the per-verbal IQ scale and post-verbal IQ scale (N=30)

	N	Minimum	Maximum	Mean		Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
Pre verbal IQ testing	30	58	125	90.20	2.48	13.60	.20	.42
Post verbal IQ testing	30	60	124	94.33	2.67	14.62	-.11	.42
Valid N (list wise)	30							

The results of above table showed the descriptive statistics of pre verbal IQ testing and post verbal IQ testing (mean and standard deviation). The mean average score for pre verbal IQ testing was (M=90.20, S. D=13.60) and the mean average score was (M=94.33, S. D=14.62) for post verbal IQ testing. The post-test has a higher mean score compared to the pre-test, according to the findings.

3.5 Descriptive analysis of the per-verbal IQ scale and post-verbal IQ scale

The results indicated the descriptive statistics of pre verbal IQ testing and post verbal IQ testing (mean and standard deviation). The mean average score for pre verbal IQ testing was (M=90.20, S. D=13.60) and the mean average score was (M=94.33, S. D=14.62) for post verbal IQ testing. The post-test has a higher mean score compared to the pre-test, according to the findings. Similarly, Rico et al. (2006) stated that the negative impact of lead poisoning on children's cognitive abilities have been well-documented in recent decades. A lack of behavioral signature is caused by a variety of susceptibilities and responses in children. Fortunately, with one of the most regular and reliable findings of performance deficits on global function assessments such as IQ, adverse impacts had also been identified in many cognitive domains. School success in visual-spatial abilities and consideration of cognitive processes in literacy and numeracy had also shown negative associations with levels of blood lead concentration. Yao et al. (2009) also argued that, after providing iron supplementation, there was very limited proliferation in the intelligence level vales as well as in academic achievements. It was therefore concluded that the intelligence level and academic achievement association through iron intake among teenagers was not significant but according to that, according to detailed histopathology, these mineral deposits were closely linked to small blood vessels and displayed primarily iron staining properties, though a small proportion of calcium may be present.

Table 6: Represent the Descriptive statistics of the respondent's demographic (N=30)

Demographics	N	Mean	Std. Deviation
Age of participant	30	1.47	.50
Gender of participant	30	1.67	.47
Classes of participant	30	2.47	.81

The descriptive statistics of the population of the respondent were emphasized in the above table. The findings show that the mean score for age was (M=1.47, S. D=.50), the mean score for gender was (M=1.67, S. D=.47) and the mean score for participant groups (M=2.47, S. D= .81)

3.6 Descriptive analysis of the respondent's demographic

The descriptive statistics of the population of the respondent were emphasized. The findings show that the mean score for age was (M=1.47, S. D=.50), the mean score for gender was (M=1.67, S. D=.47) and the mean score for participant groups (M=2.47, S. D= .81) similarly Pongcharoen et al. (2011) focused iron and zinc supplements during childhood had an enduring consequence on intellectual function at 9 years of age. Iron and zinc intake in childhood may have an impact on long-term cognitive development and school success, although this hasn't been tested. During childhood, the effects of iron or zinc intake, or both, on cognitive output were studied eight years later. Continuation study was conducted on 560 children aged 9 years, or 92 percent of those who took part in a randomized clinical trial featuring 4 classes receiving daily iron, zinc, iron + zinc, or placebo for 6 months at 4 to 6 months of age. Penke et al. (2012) also worked 143 non-demented participants from the comparatively healthy Lothian birth population had their general cognitive capacity (intelligence) assessed, and new magnetic resonance imaging (MRI) scans focused on multispectral image fusion were used to measure iron deposits in the basal ganglia and micro bleeds. At 11, 70, and 72 years of age, having more iron deposits was substantially correlated with poorer general cognitive capacity at 72 years of age, accounting for 4 to 9% of the difference.

Hypothesis testing

H1: There would likely be a significant difference in the mean verbal score between pre and post test

Table 7: Descriptive Statistics and t-test statistics for difference in the mean verbal score between pre and posttest (N=30)

Variable	Groups	N	M	S. D	T	Df	Correlation	P
Pair 1	Pre verbal IQ testing	30	90.20	13.60	-2.49	-5.14	.95	.00
	Post verbal IQ testing	30	94.33	14.62				

$^{**}p < .001$, $^{*}p < .005$

The paired t-test study assessed that the mean verbal score varied substantially between the pre and posttests. The results of the above table showed that at the point of r =.954, the pretest and posttest had a strong association. The pretest implied the results of the score indicated that (M=90.20, S. D=13.609 and the mean score of the posttest (M=94.33, S. D= 14.625) had a substantial difference at the t value (-2.490) =-5.145, p<.000. The findings therefore showed that there was a substantial difference in the mean score between the agreed pre-and post-test and H1 and the rejected null hypothesis While Tiwari et al. (2017) accepted the H1.

3.7 Association between preverbal score and posttest verbal score

The paired t-test study assessed that the mean verbal score varied substantially between the pre and posttests. The results of the above table showed that at the point of r =.954, the pretest and posttest had a strong association. The pretest implied the results of the score indicated that (M=90.20, S. D=13.609 and the mean score of the posttest (M=94.33, S. D= 14.625) had a substantial difference at the t value (-2.490) =-5.145, p<.000. The findings therefore showed that there was a substantial difference in the mean score between the agreed pre-and post-test and H1 and the rejected null hypothesis. Simarly, Liu and Lynn, (2013) worked that after providing iron supplementation, there was very limited proliferation in the intelligence level vales as well as in academic achievements. It was therefore concluded that the intelligence level and academic achievement association through iron intake among teenagers was not significant. He worked on a growth of intelligence in China. Results were reported for an IQ growth of 6.19 IQ points among 12-year-olds on the Full-Scale IQ WISC-R. Documenting Flynn effects was important for ensuring proper construction and validity of intelligence tests, they said. Deary et al. (2009) also identified the growth of intelligence and academic achievement was marginal increase iron additions. Thus, the level of intelligence and the iron intake academic support association were not significant for adolescent. The MHT's psychometrical accuracy. At a later follow-up, 6 subtests of the Wechsler adult intelligence scale were administered at a mean, and only the first unroasted key segment was selected from these 6 subtests. It accounted for 48.9% of the variation. The general element of cognitive capacity was interpreted as all 6 subset measures showing high loads between 0.63 and 0.76.

H2: There would be the significance difference in mean performance score between pre and posttest.

Table 8: Descriptive Statistics and t-test statistics for the significance difference in mean performance score between pre and post IQ test. (N=30)

Variable	Groups	N	M	S. D	df	t	P	95% CI	
								LL	LU
Pair 1	Pre performance IQ testing	30	56.90	5.75	29	-5.73	.00	-2.71	-1.28
	Post-performance IQ testing	30	58.90	5.73				-2.71	-1.28

$^{**}p < .001$, $^{*}p < .005$

In the table above, the significance difference between the pre and post IQ tests in the mean performance score was calculated. The results showed that the mean score (M=56.90± S. D=5.75) of the pre-performance IQ test was lower than that of the post-performance IQ test (M=58.90± S.

D=5.73) at t (-5.73) =29, p < .000. The findings therefore showed that the mean score of pre-performance IQ testing had lower ratings relative to post-performance IQ testing. The H2 hypothesis was thus rejected and the null hypothesis was accepted. While Lind *et al.*2004 accepted H2.

3.8 Association Between Preperformance Score and Post-Performance Score IQ Test

The significance difference between the pre and post IQ tests in the mean performance score was calculated. The results showed that the mean score (M=56.90± S. D=5.75) of the pre-performance IQ test was lower than that of the post-performance IQ test (M=58.90± S. D=5.73) at t (-5.73) =29, p < .000. The findings therefore showed that the mean score of pre-performance IQ testing had lower ratings relative to post-performance IQ testing. The H2 hypothesis was thus rejected and the null hypothesis was accepted. Similarly, Sullivan et al. (2009) argued that the relationship with cognitive transformations had so far-off solitary remain verified in two very exploratory experiments for a few unique cognitive tasks. This survey specified that, after providing iron supplementation, there was very limited increase in the intelligence level vales as well as in academic achievements. It was therefore concluded that the Intelligence Level and Academic Achievement Association through Iron Intake among teenagers was insignificant. Keller et al. (2015) worked literature did not contain evidence of correlations between IDs and discrepancies of a possible cause and contributor to cognitive pathological impairment in regular intellectual mature. Studied the potential effect of cumulative brain IDs as a biomarker of below-average general cognitive skill distribution and cognitive dysfunction associated with age in a stable elderly cohort of style relationships. This study concluded that after providing iron supplementation, there was precise escalation in the intelligence level values along with in educational achievements. It was therefore concluded that the intelligence level and academic achievement association through iron intake among teenagers was unimportant

H3: There would be a significant difference in the mean of the full-scale score between pre and posttest.

Table 9: Descriptive Statistics and t-test statistics for a significant difference in mean of full-scale score between pre and posttest (N=30)

Variable	Groups	N	M	S. D	df	t	P	95% CI	
								LL	LU
Pair 1	pre full scale score IQ test	30	83.43	6.73	29	-1.67	.10	-3.04	.30
	post full-scale score IQ test	30	84.80	6.88				-3.04	.30

$^{**}p< .001$, $^{*}p< .005$

Above table explored the major difference between pre and post-test in mean full scale score. The results of the table showed that the mean score (M=83.43± S. D=6.735) of the pre full scale IQ test was lower than the post full scale IQ test (M=84.80± S. D=6.885) with the value t (29) =-1.670, p < .106. Therefore, the findings indicated that there was a substantial difference between pre and post-test in the mean full-scale score. So, H3 accepted the hypothesis. While Dissanayake et al. (2009) also accepted H3.

3.9 Association Between Full Pretest and Posttest of Intelligence

The major difference between pre and post-test in mean full scale score. The results of the table showed that the mean score (M=83.43± S. D=6.735) of the pre full scale IQ test was lower than the post full scale IQ test (M=84.80± S. D=6.885) with the value t (29) =-1.670, p < .106. Therefore, the findings indicated that there was a substantial difference between pre and post-test in the mean full-scale score. So, H3 accepted the hypothesis. Similarly, Yao et al. (2009) also argued that, after providing iron supplementation, there was very limited proliferation in the intelligence level vales as well as in academic achievements. It was therefore concluded that the Intelligence Level and Academic Achievement Association with Iron Intake among teenagers was not significant. However, according to detailed histopathology, these mineral deposits were closely linked to small blood vessels and displayed primarily iron-staining properties, though a small proportion of calcium may be present. Similarly, by using the Wechsler intelligence scale of children, Pongcharoen et al. (2011) measured cognitive performance. Using general linear mixed models, long-term effects were measured. Substantial differences among the 4 groups were found across all outcomes at 9 years of age. This research concludes that, despite the availability of iron supplements, there was very little increase in intelligence and educational achievement. Therefore, it was concluded that the level of intelligence and the link between academic achievements among adolescents through iron intake were unimportant. Lind et al. (2004) also operated on a randomized meticulous trial of iron and zinc supplements in a group environment. Beginning at 6 to 12 months of age, 680 Indonesian infants were randomly allocated to daily supplementation of 10 mg Fe (Fe group), 10 mg Zn (Zn group), or placebo. The results of the weight-for-age, knee-heel length, and BSID psychomotor development tests have been published. Single zinc supplementation and single iron supplementation both significantly improved development, according to the findings. On the other hand, there was no significant impact on morbidity. Combining iron and zinc supplements for children at the iron-to-zinc level used in this study was not commonly recommended. This research concluded that, despite the availability of iron supplements, there was a small increase in intelligence and educational achievement. Therefore, it was concluded that the level of intelligence and the relationship between academic achievements among adolescents through iron intake were unimportant.

H4: There would be a significant difference in the semester academic achievement of respondents before and after the provision of iron supplementation.

Table 10: Descriptive Statistics and t-test statistics for a significant difference in semester academic achievement of respondents before and after provision of iron supplementation. (N=30)

Variable	Groups	N	M	S. D	df	t	P	95% CI	
								LL	LU
Pair 1	Pre-semester academic performance	30	452.23	96.76	29	-3.96	.00	-4.54	-1.45
	Post-semester academic performance	30	455.23	98.83				-4.54	-1.45

$^{**}p< .001$, $^{*}p< .005$

This hypothesis explored substantial differences in respondents' semester academic achievement before and after the provision of iron supplementation. According to the results of the table the pre-semester academic performance means that the score (M=452.23± S. D=96.769) had a substantial difference compared to the post-semester academic performance, meaning that the score was (M=455.23± S. D=98.838) at t (29) = -3.965, p< .000. The findings thus indicated a substantial difference in the semester academic output of respondents before and after iron supplementation supply. So H4 had accepted it. Similarly, Penke et al. (2012) also accepted H4.

3.10 Association of Semester Academic Achievement and Iron Supplementation

This hypothesis explored substantial differences in respondents' semester academic achievement before and after the provision of iron supplementation. According to the results of the table the pre-semester academic performance means that the score (M=452.23± S. D=96.769) had a substantial difference compared to the post-semester academic performance, meaning that the score was (M=455.23± S. D=98.838) at t (29) = -3.965, p< .000. The findings thus indicated a substantial difference in the semester academic output of respondents before and after iron supplementation supply. So H4 had accepted it. Similarly, Nugroho et al. (2010) presented a paper on the effect of iron and zinc reinforced milk supplementation on working memory in underweight poor-urban schoolchildren. According to the report, the associated micronutrient deficiencies in children in most developed countries were still prevalent under nutrition. The most prevalent micronutrient deficiencies worldwide had been iron and zinc deficiencies, which lead significantly to cognitive function deficits. In reducing some cognitive impairments such as memory, iron and zinc fortification had proven successful. they assessed the effect on the memory of underweight urban schoolchildren of iron and zinc enhanced milk. It concluded that iron and zinc-fortified milk improved the occupied memory of deprived municipal school children. According to this research paper, there is very limited proliferation after obtaining iron supplementation in intelligence-level vales as well as academic achievements. Therefore, it was concluded that the intelligence level and academic achievement association through iron intake among teenagers was not significant. Christian et al. (2011) also declared In Nepalese school-aged girls, antenatal iron-folic acid supplementation enhanced facets of logical, managerial, and fine motor control. The deficiency of iron and zinc impacts on mental and motor development may be explained by the late timing of preschool supplementation. When opposed to the comparison sample, children in the C-IFA Zn cluster had a little poorer mark in the recessive digit range and the movement appraisal measure for children. M-IFA, C-FAI, or C-FAI in conjunction with infant supplementation had little effect on general intelligence measures or executive performance, but the combination of these two supplements had little effect on cognitive outcomes. The zinc alone did not result in any variations in outcome about M-FAI with child supplementing and neither did M- FAI with C-AFI with zinc alone, but both supplements had slightly lower scores on finger tapping tests in a finger tapping study.

H5: There is significant association between full scale score of intelligence and academic achievement.

Table 11: Descriptive Statistics and t-test statistics for association between full scale score of intelligence and academic achievement (N=30)

Variable	Groups	N	M	S. D	df	T	P	95% CI	
								LL	LU
Pair 1	Pre full scale score IQ test	30	83.43	6.73	29	-1.67	.10	-3.04	.30
	Post full scale score IQ test	30	84.80	6.88					
Pair 2	Pre semester academic Performance	30	452.23	96.76	29	-3.96	.00	-4.54	-1.45
	post semester academic performance	30	455.23	98.83					

$^{**}p < .001$, $^{*}p < .005$

The above table explored that their significant association between full scale score of intelligence and academic achievement. The findings indicated that the pre full scale score of intelligence mean score was (M=83.43± S. D=6.73) and post full-scale score IQ test mean (M=84.80± S. D=6.88) had a significant difference as compared with pre semester academic performance and post semester academic performance mean score was (M=452.23± S. D=96.76) (M=455.23± S. D=98.83) respectively in pair 1 the value of t (29) = -1.06, p<.10 and pair 2 t (29) = -1.06, p< .00. So, the result reveals that there was a significant association between full scale score of intelligence and academic achievement. H5 accepted and the Ho was rejected. On other hand Chaudhari *et al.* (2004) accepted the H5

3.11 Association Between Intelligence and Academic Achievement

The result explored that their significant association between full scale score of intelligence and academic achievement. The findings indicated that the pre full scale score of intelligence mean score was (M=83.43± S. D=6.73) and post full scale score IQ test mean (M=84.80± S. D=6.88) had a significant difference as compared with pre semester academic performance and post semester academic performance mean score was (M=452.23± S. D=96.76) (M=455.23± S.D=98.83) respectively in pair 1 the value of t (29) = -1.06, p< .10 and pair 2 t (29) = -1.06, p< .00. So, the result reveals that there was a significant association between full scale score of intelligence and academic achievement. H5 accepted and the Ho was rejected. Similarly, Sanz-Caballero (2013) stated that UNICEF defined micronutrients as nutrients required by the body only in minute quantities. Sanz-Caballero (2013) stated that nearly two thirds of children's deaths worldwide were directly or indirectly related to dietary deficiencies. Such flaws may result in serious health issues such as decreased infectious disease immunity, Blindness, lethargy, decreased learning capability, intellectual disability, and, in some circumstances, death are also possible outcomes. Dietary shortages have serious effects, including the loss of human resources and growth. Subclinical micronutrient deficiencies, also known as "secret hunger," can jeopardize a physical and behavioral stimulation of a child's full genetic ability. Subclinical micronutrient shortages made children more vulnerable to common infections. This resulted in a malicious sequence of malnutrition and recurring contaminations. There was very minimal proliferation after obtaining iron supplementation in intelligence-level values as well as academic accomplishments, as per this research paper. It was therefore concluded that the intelligence level and academic achievement association among teenagers via iron intake was not important.

4 Conclusion

Iron deficiency is a common disorder, affecting more than 1 billion people worldwide. It can reduce work capacity in adults and reduce mental development in children. Studies have focused on individuals with anaemia, but there is little evidence to implicate iron deficiency without anemia in causing developmental problems. Iron deficiency is a major public health issue, with the prevalence of iron deficiency without anemia being much greater than the prevalence of iron deficiency with anemia. It is essential for the development of myelin and monoamine synthesis, and is associated with slower processing via the auditory and visual systems. Intelligence refers to the capacity to think rationally, to read, to imagine and to think critically. It is the ability to perceive or infer facts and to remember the facts to be used on the road to adaptive behaviors in the environment or circumstances. The relationship between level of intelligence and accomplishment is very strong, it can be deduced that the intelligence test has a significant contribution in connection with other variables such as curriculum, study program, teacher and school features. Iron deficiency has permanent effects on the brains of children, whether it occurs during pregnancy or the first year of life. Iron is an important micronutrient for child development and growth. The study was designed to evaluate the relationship between iron intake, intelligence level and academic achievement among pre-adolescent who are at highest risk for iron deficiency. The data was gathered from the Sargodha School of Government. They targeted 30 pupils aged 11-13 years. Academic accomplishments were recorded from their school records. The analysis was conducted in the Sargodha district. Determination of the influence of the iron intake of information intelligence in adolescents. The paired t-test sample was used in the analysis to examine discrepancies between pre-iron and post-iron respondents. The Wechsler Intelligence Scale for Children is a method for collecting data before and after the iron supplementation requirement to measure the iron and intelligence relationship and academic achievements (WISC). There was quite a small increase in the amount of IQ after the provision of iron supplementation. There was no significant relationship between IQ and academic achievements. Even iron has no important impact on the accomplishments of academia. No important outcome was shown after the statistical analysis. Compared to the pre-test, the post-test had a marginally higher mean grade.

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