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ARTICLE

An Insight into Select Physical Parameters amongst Primary School Children: A Call for Sustainable Information for Effective Sports Management

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Abstract

The prevalence of flat feet and knock knees is a result of postural deformity or incorrect posture that can be corrected, if taken care of, at an early age. If these postural deformities are not dealt with at an early age, they can hamper the quality of life and restrain children from participating in many sports activities. The main aim of the work is to find the prevalence of flat feet and knock knees among primary school children aged between 6 to 10 years. The relationship between demographic factors such as age, gender and weight with flat feet and knock knees among primary school children is also analysed. The results of the study are drawn using data collected from two schools with 1590 children, out of which 888 are males and 702 are females. The Chi-square test and univariate logistic regression are used for analysis. Further, in this paper, we also analyse the relationship of flat feet with knock knees. In summary, three out of every five children are diagnosed with flat feet and two out of every five children are diagnosed with knock knees. The results show that gender and weight are associated with flat feet and weight was associated with knocked knees. It is also shown that 80% of children with knock knees also had flat feet. It is suggested that screening and assessment of flat feet and knock knees must be conducted periodically for primary school children.

Keywords: Flat foot, knock knees, primary school children, sports activities.

1 Introduction

Postural and foot deformities can lead to the malfunctioning of various parts of the body including knees, feet and legs. Flat feet or pes planus and knock knees or genu valgum are two common problems occurring among children (Dunn et al., 2004). Children with these problems are often restrained from participating in sports activities and physical activities. The presence of flat feet and knocked knees can negatively affect the quality of life and sports activities (Abdel Fattah et al., 2006; Dabholkar and Agarwal, 2020). It can increase the risk of occurrence of injuries and the presence of musculoskeletal conditions (pain, fatigue, imbalance and uneven distribution of planer pressure) (LÓpez-LÓpez et al., 2021; Pita-Fernandez et al., 2017). Pediatric care reduces or eliminates the occurrence of flat feet and knocked knees at an earlier age in children (Staheli, 1992). Flat feet can be defined as a biomechanical problem in which arcs of the inside of the feet flatten and the

sole touches the ground (LÓpez-LLÓpezpez et al., 2021). Flat feet can cause feet or knee and back pain, balancing issues, fatigue and uneven distribution of planer pressure Lovett and Dane, 1896). The most commonly occurring flat foot type is flexible flat feet (Lakstein et al., 2010). Various reasons for the occurrence of flat feet include overweight, structural and musculoskeletal abnormalities, neuromuscular issues, family history and urban residency (Cappello and Song, 1998; Chang et al., 2010). Knock knees are a condition when the knees are inward bend and knees touch each other even after an individual stand with ankles apart. Often the flat feet and knock knees can persist together and may negatively impact the lifestyle of an individual. There have been various studies analysing the association between personal characteristics and the presence of flat feet and knock knees among varied aged children (Al-shenqiti et al., 2020; Belsley et al.,1980; Chang et al., 2010; Daneshmandi, et al., 2009; Eluwa et al., 2009; Enrique et al., 2012; Ezema et al., 2014; Ganeb et al., 2021; Jankowicz-Szymanska and Mikolajczyk, 2016; Kachoosangy et al., 2013; Korkmaz et al., 2020; Mobarake et al., 2005; Pashmdarfard et al., 2019; Pourghasem et al., 2016; Sadeghi-Demneh et al., 2015; Xu, et al., 2022). The focus of this study is to examine the prevalence of flat feet and knock knees in primary school children. The study assesses 1590 children from two schools in Delhi, India aged between 6 to 10 years. The age group selected is appropriate as at this age the development of arc and knee misalignment can be seen in children. In this work, we examine and analyse the following Research Questions (RQ):

RQ1. What is the prevalence of flat feet and knock knees amongst primary school children? To answer this question, the data collected from schools is analysed in the form of tables and charts.

RQ2. What is the effect of age, gender and weight on the prevalence of flat feet and knock knees amongst primary school children? This RQ is answered using the chi-square test and univariate logistic regression analysis.

RQ3. What is the relationship between flat feet and knock knees concerning primary school children? The results of this RQ are statistically analysed using the chi-square test.

RQ4. What is the effect of flat feet and knock knees in sports activities and what suggestive measures for preventing flat feet and knock knees amongst children? The results of this RQ are qualitatively analysed using domain knowledge and existing literature.

Although there are studies that examined the prevalence of flat feet and knocked knees with its association with age and weight, there is no study to the best of the author's knowledge that examines the prevalence of flat feet and knock knees in the Indian context amongst school children. Hence, the major contribution of the work is to 1) conduct an awareness campaign for examination of the presence of flat feet and knock knees amongst school children of two schools in Delhi; 2) find an association between age, gender and weight with flat feet and knock knees 3) effect of flat feet and knock knees on sports activities. The detection and management of flat feet and knocked knees at an early stage can prevent the issue from converting into a serious medical condition amongst children. It will also educate parents and children in the selection of appropriate sports as a future career. The rest of the paper is organized into the following sections: section 2 provides related work and section 3 presents the details of the education campaigns carried out in schools. Section 4 presents participant characteristics, variables, hypothesis and techniques used. Section 5 presents the answers to the research questions. Section 6 summarises the theoretical and practical implications of this study and conclusions are presented in section 7.

2 Related Work

In this section, the studies in the literature closest to this work are summarized. Mobarake et al. (2005) analysed 3000 primary Iranian school children aged 7-11 years and found that knock knees were more prevalent in girls than boys. Daneshmandi et al. (2009) analysed 1180 high school students aged between 12 to 15 years. The results showed the relationship of obesity with flat feet and the authors concluded that weight may cause flat feet. Eluwa et al. (2009) analysed 1000 students aged between 20 to 30 years and concluded that flat feet were more common in female students than in males. Chang et al. (2010) examined 2083 children aged 7 to 12 years and found that children who were obese were more likely to have flat feet. In the study carried out by Enrique et al. (2012), 940 school children aged 3 to 10 years were examined and the results showed that flat feet were related to age, city, body mass index (BMI) and gender. Kachoosangy et al. (2013) analysed 945 school children aged 7 to 12 years and using the chi-square test it was found that there was no significant relationship between gender and age with flat feet. In Ezema et al. (2014) the authors analysed 474 school children aged between 6 to 10 years and the results showed that one in every five children was diagnosed with flat feet and obesity is positively related to flat feet. In the study by Bhoir, Anap and Diwate (2014), 80 students aged 18-25 were examined and no correlation between gender and BMI could be established. Rasheed and Pagare (2015) assessed 25 schoolchildren and found that 32% of children were diagnosed with knock knees. In Sadeghi-Demneh et al. (2015), the authors examined 667 school children aged 7 to 14 years and the results showed a significant correlation among age and weight with flat feet. In the study by Jankowicz-Szymanska and Mikolajczyk (2016), 1364 children between 5 to 7 years were examined and a significant correlation between BMI was found with flat feet and knocked knees. Pourghasem et al. (2016) analysed 1158 school students and found there was a significant relationship between obesity and flat feet. Pashmdarfard et al. (2019) examined 1700 school children of 7 to 12 years of age and found that weight was a significant predictor of flat feet. In the

study by Al-shenqiti et al. (2020), 563 children with age between 6 to 12 years were assessed and it was detected that no significant correlation between weight and gender with flat feet exists and there is a significant correlation between age and height with flat feet. Ganeb et al. (2021) examined 4689 children aged 6 to 12 years and concluded that early examination and screening are essential in school children. In the current literature, there are no studies, to the best of the author's knowledge that examine the prevalence of flat feet and knock knees amongst children in Delhi, India, and there are very few studies in total that examine the prevalence of knock knees. The prevalence of flat feet and knocked knees in the Indian context, amongst children in schools having sports mandatory will provide insight into the state of prevalence of these deformities and will help in taking corrective action at an early stage.

3 Management of Physical Attributes through Education Campaigns in Schools

The results of this study are derived through massive screening campaigns in schools. The duration of these campaigns was two months and each child was screened for the presence of flat feet and knock knees following the steps given below. The school management and parents were educated about these two important issues and due consent was taken by the parents to carry out the screening tests of the children.

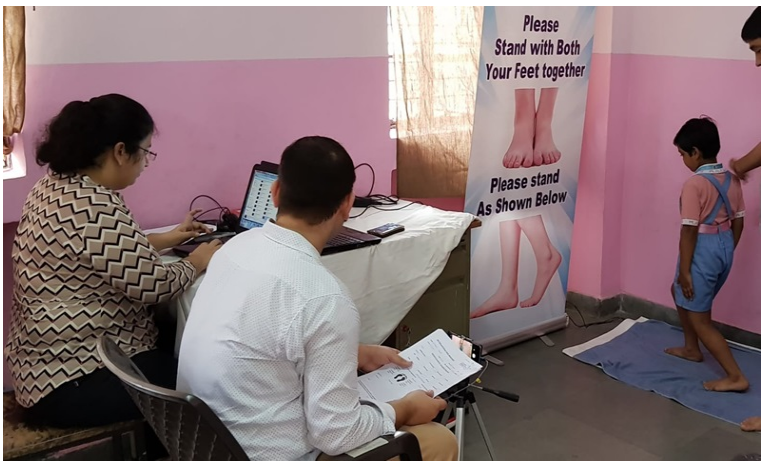
The children are assessed for the prevalence of flat feet and knocked knees by a team of experts. The position of the child was examined multiple times to rule out even the slightest error in the detection of flat feet and knock knees in the school children. The summary of various assessment parameters including age, weight, gender, observations in standing position and the results of foot scan analysis were summarized in the form of performas. All the ethical practices were followed to perform the analysis. The screening and assessment at an early age amongst school children will not only provide information to parents but also prevent the issue from being converted into a serious concern. Further, this information can be effectively utilized by parents in deciding on appropriate sports for their children.

The study is carried out in two schools in Delhi, India consisting of 1590 participants with 888 male children and 702 female children aged between 6 to 10 years. The two schools of Delhi were selected for analysis as they made compulsory the participation of children in sports events. Both the schools were position holders in the zonal or state-level sports tournaments. The physical examination of flat feet was carried out initially followed by photographic analysis (see Figure 1). Then, a foot imprinter plate was applied for foot scanning to analyse the presence of flat feet in the children. The portable foot imprinter plate had 2704 calibrated sensors, 5 Hz frequency, 100% digital calibration, -10 to +45 degree C temperature and 5% accuracy.

Knock knees have been assessed keeping the child in a standing position with fully extended knees. The distance between the medial malleoli at the ankle with knees touching each other was measured using a plastic and divider scale (>5 cm taken as knock knees) (Jankowicz-Szymanska and Mikolajczyk, 2016). This method is simple, and reliable and prevents children from being exposed to radiation.

After examination, the expert team performed a careful analysis of the obtained parameters. With detailed reports, the parents and teachers were made aware of flat feet and knocked knees and provided suggestive recommendations for exercises to the children.

Figure 1: Foot Assessment



4 Research Methods

The first step of the research process involves the compilation and summarization of data from the school children collected from the forms collected in section 3. After data collection, the hypothesis on the physical attributes and flat feet and knocked knees was formed. Then, the techniques for analyzing the relationship were identified. The details about the data

characteristics, hypothesis formed and techniques used are presented in the below sub-sections.

4.1 Participant Characteristics and Variables

The analysis of 1590 primary school children has been carried out from class I to V. The various variables such as age, gender and weight were collected along with the prevalence of flat feet and knock knees. the parents were completely made aware of the procedure of assessment and ethical permission was taken for the inclusion of the data. Table 1 summarizes the count with percentages of children concerning age, gender, flat feet and knocked knees. There were 24.77%, 20.31%, 21.38%, 18.99% and 14.53% children at the age of 6, 7, 8, 9, and 10, respectively. Out of 1590, 55.85% of children were male and 44.15% were female. A total of 68.8% of children were diagnosed with flat feet and 45.59% of children were diagnosed with knock knees.

Table 1. Characteristics of Participants

Variable	Value	Count (Percentage)
Age	6	394 (24.77%)
	7	323 (20.31%)
	8	340 (21.38%)
	9	302 (18.99%)
	10	231 (14.53%)
Gender	Male	888 (55.85%)
	Female	702 (44.15%)
Flat Feet	Normal Feet	496 (31.19%)
	Flat Feet	1094 (68.80%)
Knock Knees	Normal Knees	865 (54.4%)
	Knock Knees	725 (45.59%)

Table 2 presents the summary of descriptive characteristics (minimum, maximum, mode, mean, median, standard deviation and percentile) of children namely age and weight. The most occurring value in age is 6.

Table 2. Descriptive Statistics for Variables

Variable		Age	Weight
Mean		-	28.92
Median		-	27.00
Mode		6.0	-
Std. Deviation		-	10.00
Minimum		6.0	13.00
Maximum		10.0	78.00
Percentiles	25	-	22.00
	75	-	35.00

4.2 Research Hypothesis

In this subsection, the research hypothesis is formulated and stated. The hypothesis is drawn considering the previous literature to find the association between age, gender and weight with flat feet and knock knees.

4.2.1 Hypothesis for answering RQ2

In RQ2, the following examination of the hypothesis is done by applying the chi-square test and univariate logistic regression:

H1a: The prevalence of flat feet amongst primary school children has a significant relationship with age (Null Hypothesis: The prevalence of flat feet amongst primary school children has no significant relationship with age).

H2a: The prevalence of flat feet amongst primary school children has a significant relationship with gender (Null Hypothesis: The prevalence of flat feet amongst primary school children has no significant relationship with gender).

H3a: The prevalence of flat feet amongst primary school children has a significant relationship with weight (Null Hypothesis: The prevalence of flat feet amongst primary school children has no significant relationship with weight).

H1b: The prevalence of knock knees amongst primary school children has a significant relationship with age (Null Hypoth-

esis: The prevalence of knock knees amongst primary school children has no significant relationship with age).

H2b: The prevalence of knock knees amongst primary school children has a significant relationship with gender (Null Hypothesis: The prevalence of knock knees amongst primary school children has no significant relationship with gender).

H3b: The prevalence of knock knees amongst primary school children has a significant relationship with weight (Null Hypothesis: The prevalence of knock knees amongst primary school children has no significant relationship with weight).

4.2.2 Hypothesis for answering RQ3

In RQ3, the following hypothesis is examined using the chi-square test: H4: The prevalence of flat feet in primary school children has a significant relationship with knock knees (Null Hypothesis: The prevalence of flat feet in primary school children has no significant relationship with knock knees).

4.3 Statistical Techniques

4.3.1 Chi-square Test

In this work, we use the chi-square test to find an association between age and gender with flat feet and knock knees. The association between flat feet and knock knees is also analysed. The Chi-square test, a non-parametric test, is applied to find the existence of a significant difference between expected and observed frequency (Weaver et al., 2017). The test works on categorical data that is either nominal or ordinal. The test has been applied at a level of significance of 0.01 level.

4.3.2 Univariate Logistic Regression

Logistic Regression, a statistical technique, predicts the value of dependent variables based on the set of independent variables. In logistic regression, the dependent variable should have categorical or dichotomous values and there should not be any dependency between independent variables. In other terms, we can say that the independent variable should not have multicollinearity (Hosmer and Lemeshow, 1989). Logistic Regression makes use of the sigmoid function to convert the results of linear regression (probabilities) into logistic regression results (categories either 0 or 1). A complete description of logistic regression is given in (Belsley, Kuh and Welsch, 1980; Hosmer and Lemeshow, 1989). In this work, univariate analysis is carried out in which the individual effect of the independent variables is found on the dependent variable. The statistics reported for each variable are coefficient (B), standard error (SE), statistical significance (Sign.), and odds ratio (Exp(B)).

5 Analysis Results

In this section, the answers to the research questions formulated in section 1 are provided.

5.1 RQ1: What is the prevalence of flat feet and knock knees amongst primary school children?

The data collected from a total of 1590 primary school children of age between 6 to 10 years attending school in Delhi, India is analysed for the prevalence of flat feet and knock knees. There are a total of 888 male and 702 female children. Tables 3 and 4 present the prevalence of flat feet and knock knees concerning age amongst school children, respectively. The results show that out of 1590 children, there were 1094 children (639 males and 455 females) with flat feet and 725 children (415 males and 310 females) with knocked knees.

Table 3. Prevalence of Flat Feet Concerning Age

	6 years	7 years	8 years	9 years	10 years	Total
Normal Feet	115	103	104	109	65	496
Flat Feet	279	220	236	193	166	1094
Total	394	323	340	302	231	1590

Table 4. Prevalence of Knock Knees Concerning Age

	6 years	7 years	8 years	9 years	10 years	Total
Normal Knees	205	181	197	169	113	865
Knock Knees	189	142	143	133	118	725
Total	394	323	340	302	231	1590

Figure 2: Percentage of Flat Feet amongst Children concerning Age

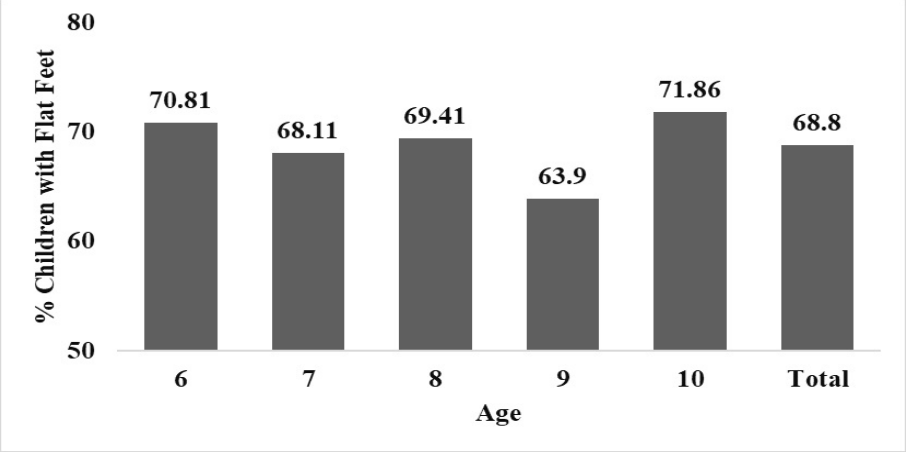
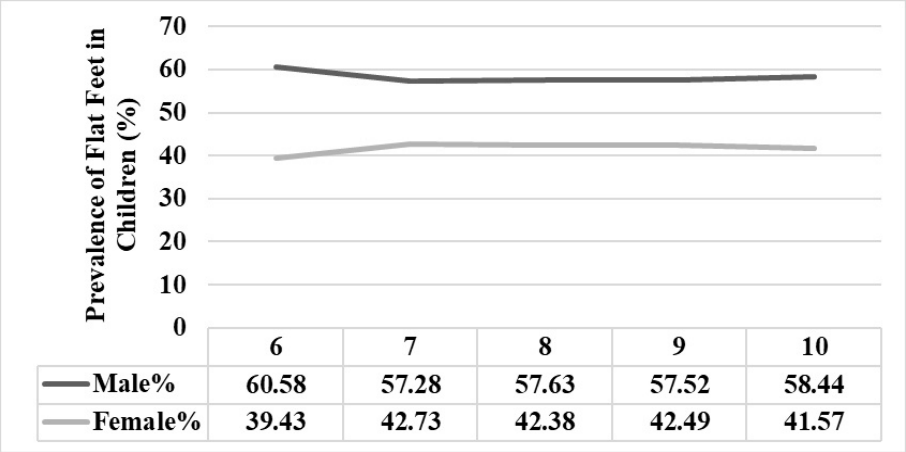


Figure 3: Percentage of Male and Female Children with Flat Feet



	6	7	8	9	10
Male%	60.58	57.28	57.63	57.52	58.44
Female%	39.43	42.73	42.38	42.49	41.57

Figure 2 depicts the percentage (%) of children having flat feet at various levels of age. The results show that there were 70.81%, 68.11%, 69.41%, 63.9%, and 71.86% of children aged 6, 7, 8, 9, and 10 years with flat feet, respectively. There is a minor difference in the presence of flat feet at the age of 6 to 10 years. The presence of flat feet is highest in school children at the age of 10 years. This may be because there is unawareness amongst the parents and children about flat feet and corrective action is not being taken at an early age. Figure 3 shows the percentage of male and female children with flat feet. It can be seen that at various age levels, about 57-60% of male children and 39-41% of females are having flat feet. The percentage of male children having flat feet is greater as compared to female children.

Figure 4 presents the age-wise percentage of knocked knees in or amongst school children. The bar chart shows that 42-51% of children have knocked knees and children at the age of 10 years have the highest percentage of knocked knees. Figure 5 shows the age-wise percentage of male and female children with knocked knees. The results show that the presence of knock knees in male children is higher as compared to female children. It is observed that the graph shown in figures 3 and 5 remains almost flattened, indicating that no previous efforts have been made to address the situation which may indicate the need for early intervention and identification to correct the situation. Further, it can be seen in Figure 5 that there is a sudden rise in female children with knock knees at the age of nine.

Table 5 presents the comparison of the existence of flat feet and knock knees amongst school children in this study with related work. The table summarizes the country, participant count, participant age, and percentage of presence of flat feet and knocked knees amongst the participants. The results show that the prevalence of flat feet and knock knees was very high in this work as compared to the previous studies with 68.8% and 45.59%, respectively. Only two studies showed a high prevalence of flat feet among children with 74% (Kachoosangy et al., 2013) and 77% (Al-shenqiti et al., 2020). The rest of the studies depicted the presence of flat feet between 13% - 28.9%. The prevalence of knock knees is about 2%-52% in the previous studies. Hence, immediate attention and measures are required to handle the high prevalence of flat feet and knock knees among primary school children in urban cities of India.

Figure 4: Age-wise percentage of Knocked Knees amongst Children

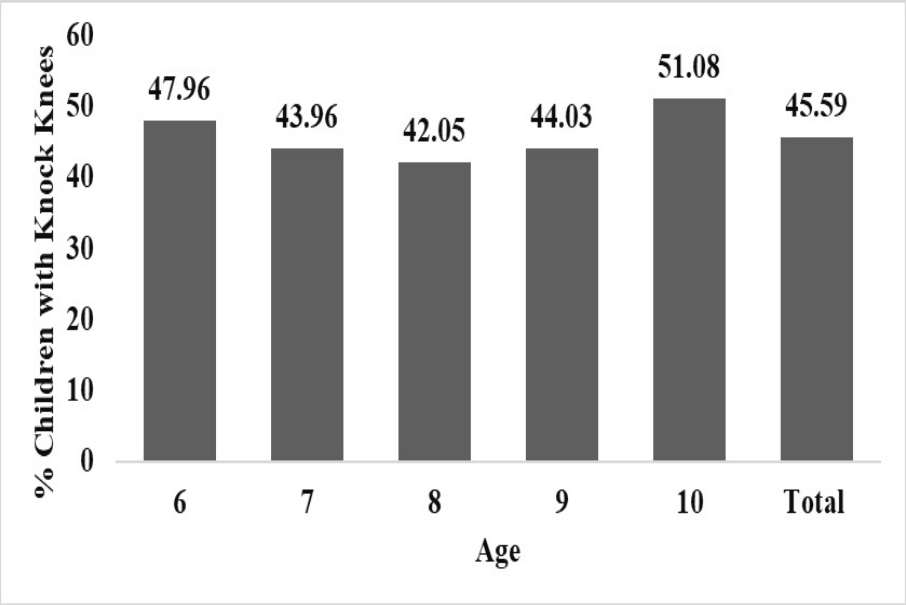
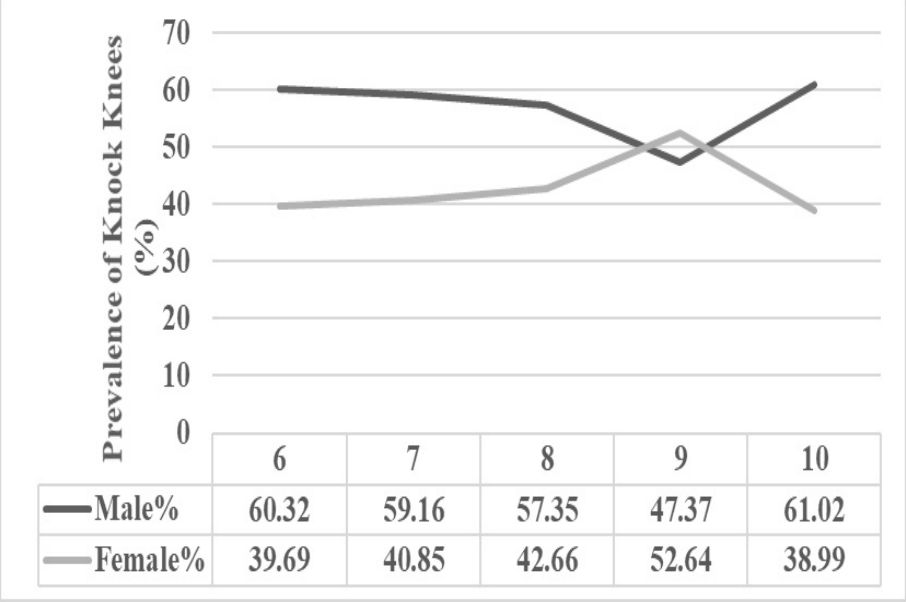


Figure 5: Percentage of Male and Female Children with Knock Knees



	6	7	8	9	10
Male%	60.32	59.16	57.35	47.37	61.02
Female%	39.69	40.85	42.66	52.64	38.99

Table 5: Comparison of Prevalence of Flat Feet and Knock Knees with Related Studies

Authors	Country	Study Size	Age	Flat Feet %	Knock Knees %
Our study	India	1590	6-10	68.8	45.59
Mobarake et al., 2005	Iran	3000	7-11	-	2
Daneshmandi et al., 2009	Iran	1180	12-15	23.5	-
Eluwa et al., 2009	Nigeria	1000	20-30	13.4	-
Chang et al., 2010	Taiwan	2083	7-12	59	-
Enrique et al., 2012	Columbia	940	3-10	15.7	-
Kachoosangy et al., 2013	Iran	945	7-12	74	-
Ezema et al., 2014	Nigeria	474	6-10	22.4	-
Bhoir et al., 2014	India	80	18-25	11.25	-
Rasheed and Pagare, 2015	India	25	9-14	-	32
Sadeghi-Demneh et al., 2015	Iran	667	7-14	17.1	-
Jankowicz-Szymanska and Mikolajczyk, 2016	Poland	1364	5-7	-	52
Pourghasem et al., 2016	Iran	1158	6-18	16.1	-
Pashmdarfard et al., 2019	Iran	1700	7-12	28.9	-
Al-shenqiti et al., 2020	Saudi Arabia	563	6-12	77	-
Ganeb et al., 2021	Egypt	4689	6-12	13.86	0.11

5.2 RQ2: What is the effect of age, gender and weight on the prevalence of flat feet and knock knees amongst primary school children?

To answer this research question, the chi-square test and univariate logistic regression are used. The hypothesis formed in section 3.3.1 is validated. The significance level of the chi-square test is 0.01. The chi-square statistics showed that gender is related to flat feet. It is found in section 4.1 that male children are more affected with flat feet as compared to females. The hypothesis H2a is accepted as a relationship is found to be significant. Hypothesis H1a, H1b, and H2a are rejected.

Tables 6 and 7 show the results of univariate analysis for finding the individual effect of age, gender and weight on flat feet and knocked knees. In table 6, it is shown that gender and weight are significantly related to flat feet and Table 8 shows that weight is significantly related to knock knees. Hypothesis H2a and H3a are accepted. Thus, male children have more flat feet as compared to females and flat feet are likely to increase with higher weight in school children. Hypothesis H1a is rejected.

In the case of knock knees, hypotheses H1b and H2b are rejected and hypothesis H3b is accepted. Thus, higher weight among school children is likely to increase the occurrence of knock knees.

Table 6: Univariate Logistic Regression Analysis Results for Flat Feet

Variable	B	SE	Sign.	Exp(B)	R2
Age	-0.024	0.039	0.532	0.976	0.000
Gender	0.340	0.109	0.002	1.405	0.009
Weight	0.029	0.006	0.000	1.029	0.019

Table 7: Univariate Logistic Regression Analysis Results for Knock Knees

Variable	B	SE	Sign.	Exp(B)	R2
Age	0.009	0.036	0.808	1.009	0.000
Gender	0.101	0.102	0.318	1.107	0.001
Weight	0.079	0.007	0.000	1.083	0.138

Mobarake et al. (2005) found that knocked knees were more prevalent in girls than boys. However, in this study, it is found that the presence of knock knees is slightly higher in boys than girls but these results are not statistically significant. The association between weight and flat feet has been established (Pourghasem et al., 2016) and the results show a significant effect of weight on flat feet. In Eluwa et al. (2009), it was found that the prevalence of flat feet was higher in female students than in males. This may be because the authors considered 20-30 aged students and flat foot increases in females with age. Table 8 summarises the results of hypothesis testing.

5.3 RQ3: What is the relationship between flat feet and knock knees for primary school children?

To answer this question, the chi-square test was used so that the association of flat feet and knock knees can be examined and hypothesis H4 given in section 3.3.2 can be validated. Table 9 presents the cross-tabulation to summarize the relation between flat feet and knocked knees. The table shows that 580 children have both flat feet and knock knees. As can be

Table 8: Results of Hypothesis Testing

No.	Hypothesis	Decision
H1a	The prevalence of flat feet amongst primary school children has a significant relationship with age.	Rejected
H2a	The prevalence of flat feet amongst primary school children has a significant relationship with gender.	Accepted
H3a	The prevalence of flat feet amongst primary school children has a significant relationship with weight.	Accepted
H1b	The prevalence of knock knees amongst primary school children has a significant relationship with age.	Rejected
H2b	The prevalence of knock knees amongst primary school children has a significant relationship with gender.	Rejected
H3b	The prevalence of knock knees amongst primary school children has a significant relationship with weight.	Accepted

seen, 80% of children having knock knees also have flat feet, while 53% of children having flat feet also have knock knees. The value of the chi-square statistic is 77.81 at 0.00 significance level. Hence, the prevalence of flat feet amongst children having knock knees is greater, thus hypothesis H4 is accepted as the relationship is found to be significant.

Table 9: Cross Tabulation of Flat Feet and Knock Knees
KN: Knock Knees, NK: Normal Knees, FF: Flat Feet, NF: Normal Feet

	NK	KN	Total
NF	351	145	496
FF	514	580	1094
Total	865	725	1590

6 RQ4: What is the effect of flat feet and knock knees in sports activities and suggestive measures for preventing flat feet and knock knees amongst children?

The analysis of data collected from primary school children shows that there are 1094 (68.8%) and 725 (45.59%) children with flat feet and knock knees, respectively. The high number of children with flat feet and knocked knees is a matter of concern and a "red" signal for parents and children. The initial signs of flat feet and knock knees can become a serious issue at a later age. The prevalence of flat feet can affect the quality of life by causing health issues (pain, gait problems, foot fatigue), limiting physical mobility (walking, running, exercising, balance) and other complications (injury, fractures, arthritis) (Dabholkar and Agarwal, 2020; López-López et al., 2021; Pita-Fernandez et al., 2017; Sharma and Upadhyaya, 2016). Similarly, the presence of knock knees can lead to knee pain, flat feet, difficulty in walking or running, knee arthritis, and instability of knees.

Flat feet and their relationship with the formation of foot arc and biomechanics of the lower extremities may affect walking, jumping, running, balance and coordination which are the most important factors involved in the training and performance of an athlete (Bhosale and Nandala, 2021). Athletes with flat feet are more prone to low performance, foot and knee injuries, calf fatigue, fractures, and spasms during exercising due to exertion of higher load and pressure on feet than usual (Korkmaz, Acak and Duz, 2020). Many times, an athlete only comes to know about the presence of flat feet while playing a specific sport. In the study carried out by Sharma and Upadhyaya, the running performance of an athlete with a flat foot is analysed and it is concluded that the running performance decreases due to a reduction in ankle muscle strength. Similarly, in sports, the presence of knock knees is a cause of concern in athletes, as an athlete grows physically, more pressure is exerted on the knees.

This study has been conducted as a part of an educational program in schools where knee and foot assessments of children aged between 6 to 10 years have been carried out to educate and spread awareness among parents and children. This is done by providing the parents with information and knowledge about their child's feet and knee condition so that they can understand and provide extra care at this initial age, as flat feet and knocked knees may become a cause of concern as the child grows older. Hence, a check should be kept that the flat feet or knocked knees that could have been easily corrected by precautions and easy exercises at an earlier age do not become permanent as the child becomes older. The aim of the educative program was also that the information provided could be further used for effectively deciding on the pursuit of sports now and in the future. Thus, the following suggestive measures are recommended to be taken at a large scale at rural and urban schools:

1. Annual screening and assessment of flat feet of primary school children for prevention of foot and postural deformities at an early age.
2. Conduct mass educative programs for parents and children so that information and knowledge about dealing with flat feet and knock knees can be provided at an early age. Parental education and awareness are essential to encourage children to play on natural surfaces.

The above measures will help in preventing the permanent occurrence of flat feet and knock knees, thus, improving quality of life and non-hindrance in physical and sports activities in the coming generations.

6.1 Discussion

It can be seen from the data collected from two schools in Delhi that 68.8% of children had flat feet and 45.59% of children had knocked knees. This implies that at least three in every five children have a flat foot and two in every five children have knocked knees. The percentage of flat feet among school children is very high and corrective action is required to prevent it from becoming a serious health condition.

It is found that the prevalence of flat feet amongst children having knock knees is higher. The reason can be that if a child has knocked knees while walking the weight is transferred to the inside part of the feet which makes it overloaded resulting in flattening of the arc converting into flat feet. There must be mass education programs to create awareness among parents, children and society and screening camps to detect deformities among children at an early age so that preventive and corrective action can be taken. Further, proper management strategies should be developed including exercise schedules and dietary regulations.

6.2 Limitations of the Study

First, in this work, children aged more than 10 years were not studied for the prevalence of flat feet and knocked knees. Thus, the results of the study can be generalized up to 6 to 10 years of children. The results of the study can be generalized to children living in urban cities like Delhi. Another study needs to be conducted to detect the prevalence of flat feet and knock knees among children in rural areas. Further, the prevalence of flat feet and knock knees was compared with the children of older age and the effect of flat feet and knock knees in later ages was not considered. Finally, the study is cross-sectional and only finds the association of flat feet and knock knees with age, gender and weight.

6.3 Theoretical and Practical Significance

The study highlights the presence of two important problems in school children namely flat feet and knock knees. The purpose of the study was to analyse the presence of flat feet and knock knees among children aged between 6-10 years. The results show that 68.8% and 45.59% of school children were having flat feet and knock knees, respectively. In the study, gender was found related to flat feet and weight was found to be related to both flat feet and knock knees. If flat feet and knocked knee problems in children are not detected at an early stage or if it is left untreated, then there is a high risk of health issues such as knee pain, foot pain, injury of the knee, muscle spasms, fracture, lower back pain, poor performance while exercising. Footwork and balance are key elements in any sport which includes badminton, basketball, and tennis. The flat feet will lead to a lack of strength which will become a hindrance in becoming a successful player. The player with flat feet will be more prone to injuries. The physical fitness of the player is essential in raising the success rate of the country in international sports. The results of the study can be used by the parents, health care professionals and sports personnel to focus on the important issue of flat feet and knock knees by conducting awareness drives, and educational programs to sensitize about these issues so that treatment can be provided in time to the children.

Conclusion

In this work, an assessment of 1590 children from two schools is carried out with children of 6 to 10 years of age for the prevalence of flat feet and knock knees. The main results are summarised as follows:

1. The assessment shows that there are 68.8% of school children have flat feet and 45.59% of children have knock knees. There are three in every five children and two in every five children with flat feet and knocked knees, respectively.

2. The results show that gender and weight are related to the prevalence of flat feet and weight is related to the presence of knock knees in children.

3. It has been found that 80% of children with knock knees also had flat feet.

4. The flat feet and knock knees adversely affect the mobility of children in terms of walking, running, and balancing and hence may hinder their participation in a particular sports activity.

The study shows the high prevalence of flat feet and knock knees among school children. Thus, immediate attention is required to address this important issue among primary school children. Further, educational programs and mass campaigns for screening children in schools must be carried out for the prevention and early cure of flat feet and knock knees amongst school children. This will not only improve the quality of life but also guide the parents about the participation of their children in appropriate sports. This study is important from the viewpoint that the phenomenon of flat feet and knock knees has been examined simultaneously, which has not been done hitherto.

In the future, the analysis of flat feet and knock knees in rural and urban areas in India will throw interesting insights into this phenomenon. Further, in the future, the study can be generalized to detect the prevalence of flat feet and knock knees in children aged between10-15 years children. The presence of flat feet and knock knees in players and their causes can also be analyzed.

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