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Prevalence And Associated Contributing Factors Among Students With Adolescent Idiopathic Scoliosis

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Abstract
Adolescent idiopathic scoliosis (AIS) is a progressive three- dimensional disfigurement of the chine involving side curve, axial gyration and generally thoracic hypokyphosis. Aetiology of AIS remains inadequately understood although asymmetrical vertebral growth has been hypothesized to contribute. This study shows early diagnosis is necessary to find progressing deformity, to see growth and disfigurement progression in school going students. The study is also concentrated to see the progression in students carrying heavy bags.
205 students passed the webbing to check AIS actuality and progression among them. Bag weight, distance shows main impact of AIS as a result.

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I. Introduction

The term scoliosis was extracted from the Greek word "skolios"by Galen around (130-201 AD) a scoliosis is determined by side-to-side curvature of >10 degree combined with rotation of vertebra [1]. According to Scoliosis Research Society (SRS) adolescent idiopathic scoliosis are deformity that occur in patients of 10 years or above and with an idiopathic structural lateral curve of at least 10° which is confirmed with the Cobb technique as well as vertebral rotation on a standing longitudinal radiograph of the spine combined with asymmetry on forward bending. Curves smaller than 10 degrees are within normal variation which are found to be asymptomatic, rarely progress, Curve progression is the most important factor of idiopathic scoliosis. Scoliosis is the three-dimensional deformity defined as lateral curvature of spine. The risk of curve progression in idiopathic scoliosis is associated spinal growth; therefore, skeletally immature patients with idiopathic scoliosis and major curves are more prone to progression and require some form of treatment [5]. Two major groups of scoliosis named as Idiopathic scoliosis and non-Idiopathic scoliosis are usually known, which are further subdivided. In many cases, AIS is benign if left untreated, but long-term follow-up has revealed that it can worsen chronic back pain, cause dyspnoea, and a minor loss in self-image. Physical incapacity, emotional discomfort, and cardiorespiratory impairment may eventually ensue from the deformity [5, 9–11]. Adolescent idiopathic deformity is the commonest type of deformity determined by physicians, not all AIS results in the complication of cardiopulmonary changes [3]. Scoliosis is known as three-dimensional deviation of the spinal axis.

Types
The two major groups of scoliosis:
1. Idiopathic Scoliosis
2. Non-Idiopathic Scoliosis
The diagnosis of an idiopathic scoliosis is made if a non-idiopathic one has been excluded.

Non-Idiopathic Scoliosis
Congenital scoliosis: Congenital scoliosis is a result of malformation of vertebrae like hemivertebra, unilateral bar or block vertebra however they are not clinically visible at birth and do not develop until adolescence Genes that are suspected for vertebral malformation.
Neuromuscular scoliosis: Neuromuscular scoliosis is the result of insufficiency of active stabilizers of the spine, clinical example is cerebral palsy, spinal muscular atrophy, spina bifida, muscular dystrophies or spinal cord injuries.

Mesenchymal scoliosis: Mesenchymal scoliosis is the result of insufficiency of passive stabilizers of the spine, clinical example is Marfan's syndrome.

Idiopathic Scoliosis

Infantile scoliosis: Development of infantile scoliosis take place between the age of 0–3 years and shows a. it has been discovered that in contrast with adolescent idiopathic scoliosis (AIS), there is a regression of scoliosis in more than half of the cases. Mehta has described the rib–vertebra angle difference and found that an angle difference of more than >20 indicates a poor prognosis and rapid progression.

Juvenile scoliosis: The occurrence of juvenile scoliosis is between 4–10 years and comprises 10–15 % of all idiopathic scoliosis in children if they left untreated, curves may cause serious cardiopulmonary complications, and curves of >30 seems to progress, 95 % of these patients need a surgical procedure.

Adolescent scoliosis: The time period at which adolescent scoliosis occur is between 11–18 years and are responsible for approximately 90 % of cases of idiopathic scoliosis in children this type of scoliosis has a prevalence of more than 8 % in adults over the age of 25 and rises up 68 % in the age of over 60 years, they even cause degenerative changes in the aging spine disease, further studies have advanced our understanding of this deformity as multifaceted with a polygenetic background. Surgery for AIS aims to relieve pain and improve function and cosmetics with minimal rates of complication.[1]

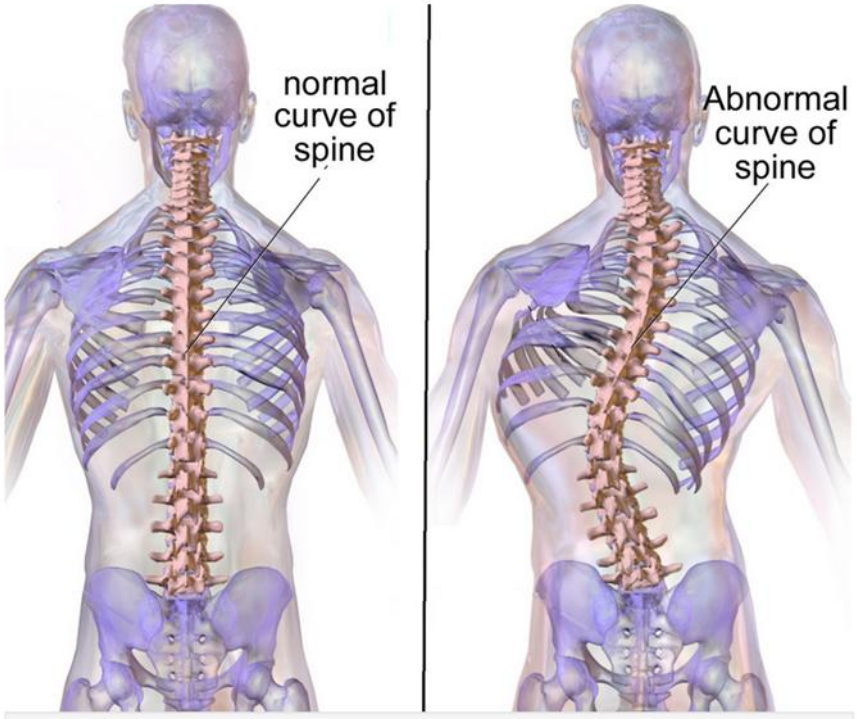

Figure 1A normal spine and one with scoliosis (Images from Medical gallery of Blausen Medical 2014. WikiJournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. https://commons.wikimedia.org/w/index.php?curid=27796937)

Causes

There are various causes that have been reported so far. Some of them are listed below:

Calmodulin: The studies have been reported a relationship between elevated platelet calmodulin levels and scoliosis progression. the platelet changes are synced to paraspinous muscle activity and that calmodulin play a role as a systemic mediator of contractile tissues it has been discovered that genetic variants of CALM1 gene are associated with AIS susceptibility. Though, there are interactions between calmodulin and melatonin, calmodulin may be associated with the changes in melatonin level and AIS development.

Melatonin: There was research done on 90 chicken that evaluated scoliosis developed in the majority of chickens treated with serotonin, only 6/30 chickens were treated with melatonin and there were 30 chickens who had no therapy. Amazingly, they found that the melatonin-treated chickens with scoliosis had less severe curves than those treated with serotonin. It was found that serum melatonin was significantly lower in AIS patients.

Anti-pathogenesis: The prevalence of small curvatures is thought to be equal among girls and boys; however, severe curves are more prevalent in girl.

Genetics: The pathophysiology of AIS is not truly known however; a genetic aspect has been found to some or the other reason there are more prevalence of AIS in people who have first degree of relatives affected by AIS with the prevalence of 6–11% studies have also discovered that monozygotic twins have higher AIS prevalence (73%) compared to dizygotic twins (36%).

Estrogens: Whilst scoliosis at younger ages shows an equal prevalence in males and females, during puberty the sex ratio increases to 8.4/1 (female/male), suggesting a role of sex hormones in the disease [11]. Esposito et al. and Kulis et al. found that blood content of oestradiol was lower in girls with AIS [11, 12]. Furthermore, Mao et al. and Grivas et al. found a tendency of delayed onset of menarche in AIS girls or girls in northern latitudes where AIS rates are higher.

Low bone mineral density (osteopenia): Osteopenia in both their axial and peripheral skeleton has been shown to occur in around 30% of AIS patients [35]. Chenget al. found that areal bone mineral density (aBMD) and volumetric bone mineral density (vBMD) measured at the bilateral lower extremities were significantly lower in AIS patients compared with controls [36]. Additionally, Yip et al. found that osteogenic patients with AIS had significantly higher risk of surgery even after adjustment for menarche status, age and initial Cobb angle [35].

Vitamin D: As higher levels of vitamin D correlate with greater bone mineral density, several researchers have questioned the role of vitamin D in AIS. Furthermore, recent studies have shown a relationship between gene polymorphisms of vitamin D receptors (VDRs) and low bone mineral density [37]. Suh et al. reported that the VDR BsmI polymorphism is associated with low bone mineral density at the lumbar spine (LSBMD) in girls with AIS [38]. The mean RANKL and RANKL to OPG ratio in AIS patients were also increased compared with control subjects in one study. Furthermore, the RANKL and RANKL to OPG ratios were negatively correlated to the LSBMD and serum OPG levels in both groups and serum OPG levels were positively correlated to the LSBMD in both groups [39]. Balioglu et al. found vitamin D levels were lower in AIS patients and levels were negatively correlated with Cobb's angle [37]. Moreover, Hampton et al. found 56% of patients had vitamin D levels requiring supplementation [1]

Bio-Mechanical Causes
Mechanical
Metabolic
Hormonal
Neuromuscular
Growth
Genetic abnormalities

Table 1: Causes of adolescent idiopathic scoliosis

Clinical Presentation

Clinical representation	*Description*
Shoulder	*The unlevel shoulder will be observe*
Waist line	*Waist line will be asymmetrical that means one hip sticking out more.*
Ribs	*Prominent ribs that are easily visible*
Back pain	*Patient may complain for backpain though it is not clinically evident.*

Table 2: Clinical features

Prevalence

Adolescent idiopathic scoliosis is a prevailing disease with an overall prevalence of 0.47–5.2 % The female to male ratio rises from 1.4:1 in curves from> 10 to >20 up to 7.2:1 in curves Infantile scoliosis advance at the age of 0–3 years and shows a prevalence of 1 %, Adolescent scoliosis advances at the age of 11–18 years and responsible for approximately 90 % of cases. Scoliosis has a currency rate of more than 8 % in adults over the age of 25 and intumesce 68 % in the age of over 60 years, adolescent idiopathic scoliosis affects people aged >10 years. In the case study of scoliosis done on 133 patients.it was found thar 68% of adolescent idiopathic curvatures were found to progress beyond skeletal maturity.

Thoracic curvatures more than 50° increases at an average of 1° a year, thoracolumbar curves increase at 0.5° a year, and lumbar curves progressed at 0.24° a year. Thoracic curvatures of less than 30° do not progress, from the recent study found it was estimated that 23% AIS patient experience back pain initially the 9 % had developed during study also found pathological condition such as spondylolisthesis, spondylosis and one of them were found with intraspinal tumor out of these 9% [3] In the chi-square test it was found that females had a higher rate of pathological rotation of the trunk angle when compared to males ($p<0.05$).

Average 15% of children stated that deformity arises from family, it was More than half of the children who were found of sporting activity at least twice a week. And above 96% of students were found carry schoolbag they also concluded that they walk an average distance of 10 min on foot while coming from home to school . Over 21% of students were carrying schoolbags that weighted more than 12.5% of their body weight highest frequency rate of vertebral rotation was found from 9th class that accounted for 31.3%.

7th class was in 2nd position for accounting (28.9%) of student , and lastly the sixth grade (26.9%) it was found that 118 (7.3%) of students had a angle deviation of≥5° of the angle of the trunk rotation when measured in 45° forward bend test at the upper thoracic level 293 (18.1%) had angle rotation of 60° at the lower thoracic level, and 197 (12.2%) in 90° at the lumbar region.[7]from the study prevalence of scoliosis in adolescents ranges from 0.5-5.2% in 2011 . Adolescent idiopathic scoliosis (AIS) is the most common type of scoliosis found in children and adolescents, and it is more common in females according to study in 2013 though in recent study of 2018 the prevalence has increased to 8% [8]

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Assessment & Diagnosis

Posteroanterior and lateral radiograph of spine are used to assess the degree of deformity

The angle of rotation of the vertebra which should be it is more than 7° rotatory asymmetry than for evaluation of scoliosis is done.

Monitoring growth velocity the imperative Rightward thoracic curves are predominate in the majority of AIS cases atypical scoliosis curve patterns, combined with rapidly progressing curves or neurological symptoms. should warrant an investigation into a possible underlying lesion.

The physical examination:

Assessment of curve patterns shoulder levels and waist asymmetry.

Gait and posture are assessed to evaluate for a short-leg gait due to leg length discrepancy and listing to one side seen in severe curves. Adams forward bending test is used to find out a rib rotational deformity (rib hump) on the convex side of the curve. this is done by bending patient forward, a scoliometer is one of the most reliable methods for this is simple height measurements. [3]

Adam’s Forward Bend Test: The Adams forward twist test shows the rotational part of scoliosis. It is performed by noticing the patient from the back while they twist forward at the abdomen until the spine becomes lined up with the flat plane. The patient's feet ought to be together, knees straight ahead, and arms hanging free. Lopsidedness of the upper thoracic, mid thoracic, thoracolumbar, or lumbar area is noted.(Kikanloo et al., 2019)

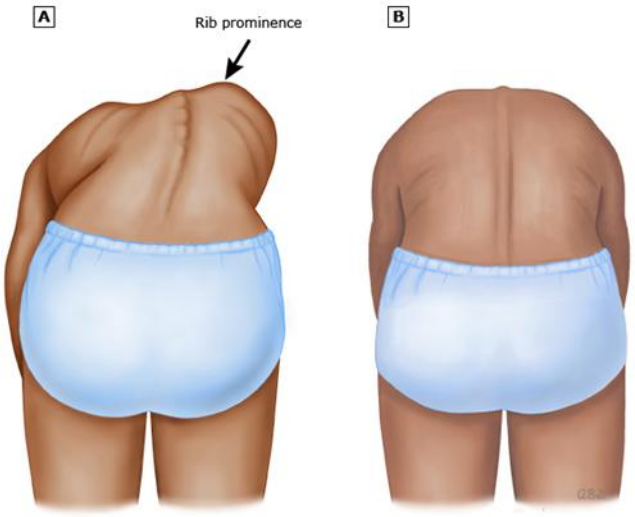

Figure 2; Adam's forward bend test © 2023 UpToDate, Inc. and/or its affiliates. All Rights Reserve

This test is frequently utilized at schools and specialists' workplaces to check for scoliosis. The patient makes a diving-like forward bend. When a patient has scoliosis, one side of their back is higher than the other and often forms a prominent line where the spine is. A patient's back is totally straight in the event that they don't have scoliosis.

Usual Treatments

Management depends on curve severity and remaining growth potential and includes intensive brace treatment for smaller curvatures, whereas surgical correction is needed for more severe curves.

In mild to moderate AIS, ranging from 20 to 45° Cobb's angle, bracing is currently the primary therapy to prevent curve progression in skeletal immature patients. As was demonstrated in a landmark study by Weinstein in 2013, External corrective forces applied to the trunk by a rigid plastic orthotic is effective for the treatment of AIS.

There are many different braces available for AIS. Though, thoraco-lumbo-sacral orthosis (TLSO) braces are most widely used. There are two types of frequently used TLSO braces:

I) Boston brace
II) Wilmington brace

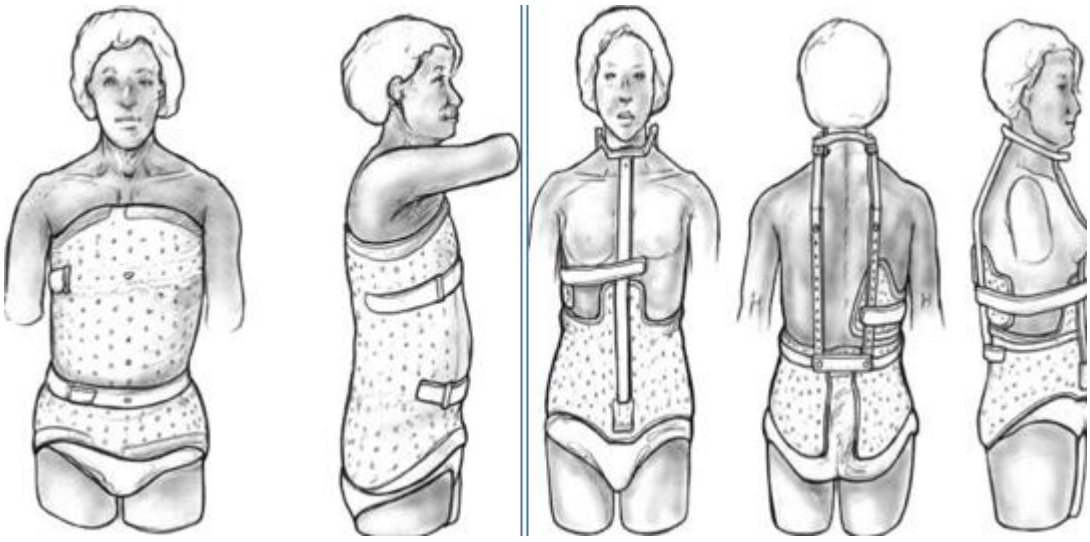

Figure 3 Illustration of Boston brace and Wilmington brace

The Boston brace was developed in 1972 and mainly used in North America. It is a prefabricated symmetric brace with apical pads and trimlines (cutouts) at the concave side of the spine to allow room for shifting of the trunk. The Wilmington brace was designed in 1969 and is a total contact TLSO.

The Wilmington brace is, unlike the Boston brace, a custom fitted brace based on a cast. Most braces are recommended to be worn for at least 18 h per day during several years (until skeletal maturity has been reached). though this may cause a high level of physical discomfort [3,4].

Surgical treatment

Whether or not an AIS patient should undergo surgical intervention depends on several factors including the overall curve size and pattern, curve progression and skeletal maturity. Surgery is considered in skeletally immature patients with structural thoracic curve Cobb angles over 40° or patients who show continued progression [56]. For over 100 years, fusion surgery has been used for the treatment of scoliosis. Patients can undergo anterior spinal fusion (ASF), posterior spinal fusion (PSF) (Fig. 1) or a combined anterior/posterior approach [4]. Curve correction was performed in all patients with pedicle screw constructs. All surgeries were performed by two senior authors using a posterior midline incision with subperiosteal dissection.

All screws were placed using the freehand technique [24] based on specific anatomical landmarks. The restoration of the coronal and sagittal curves was performed following Cotrel-Dubousset technique [14] using a cobalt chrome rod for the concave side and standard titanium rod for the convex side. All surgeries were performed under neurological monitoring using a triggered electromyogram device. All subjects remained free from any post-operative neurological impairment. [5]

II. Methodology

This research was a cross sectional study of a high school student carrying heavy bags, this research has been concluded among random school going students with the approval of Ethical group of Galgotias university. In this research program 6th to 10th class student participated who all were between 11-17 years of children were included, Ryan international is a top 10 international school which is affiliated by CBSE. school principals and authority were very cooperative during the research they all were concern about their children screening procedure. Also, parents were informed about the screening program. The method of sampling was a random sampling procedure used for data collection and procedure used was of screening type, there were 100 children who participated for the research

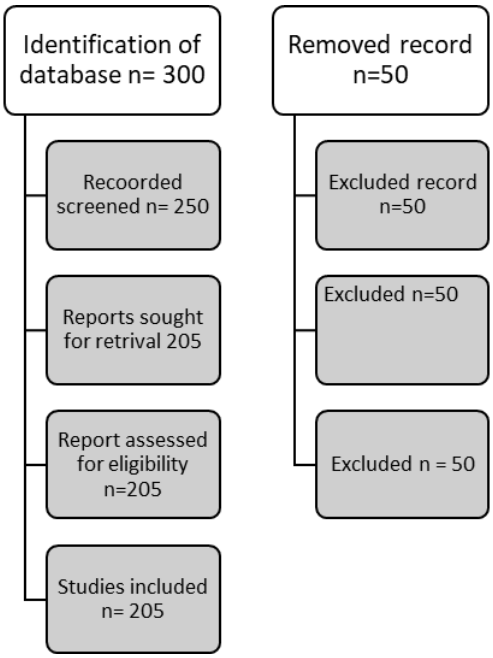

Figure 4; Procedure

This research was done for 3 months from 15th of march to 15th June, the students were selected randomly. High school student as well as middle schools were considered appropriate for the study due to their age group in which they come in.

Procedure

The procedure started from the screening of the population which then included 3 steps of screening:

Step 1: Screening was done through Adams forward bend test and observation in which vertebral curve were observed along posture of child this was the basic step of the procedure. during this step all together 205 participants participated with their consent, proper consent form was filled by the parents. The parents were also

educated and informed about the adolescent idiopathic scoliosis. The participant was standing straight in which therapist visually observe the rotation of vertebra during standing participant were commanded to look forward with both hands aside. The asymmetrical shoulder was also observed during the procedure to be prominent. The unequal waist line was also accounted in the observation. The distance between the arms and lower limb length discrepancy was also included.

Step 2: The selected participants were then sent for Adams forward bend test and for measurement from scoliometer to confirm the deformity, the angle which was found more than 5 degrees were included others were excluded from the research.

Scoliometer determined angle trunk rotation along with Adma's forward bend test during the procedure student were commanded to relax the arm by the side in a palm facing direction, palms were facing inward in a relaxed position, student was then commanded to bend down slowly in a forward manner until the shoulder got equal with hip, the therapist then observe the back with eye at the same level as the back, bending position was adjusted to get the accuracy in the result.

Scoliometer was then put forward at the deformity at right angle on the spinous process were marking of the cantered curve and angle were observed and recorded, the students were observed in frontal and sagittal view.

Step 3: The remaining participants were screen out for the factors that influence. based on this result, final analysis of data was done.

III. Data Analysis

A total of 205 school going students were screened for the study. The screening wasn't based at a certain locale, random school going students were asked through consent way to give the screening test. Adam's forward bend test and certain question such as approx. distance they travel from their home to school was asked. Also, the weight of their bag was measured to analyses the prevalence and affects, among which 17 students were suspected to have vertebrae progressing in scoliosis. After analyzing the data, I have a total of 205 records. Analysis by gender shows that there are more girls (103) than boys.

The weights of individuals ranged from 38 to 64, with an average weight around 53.83. The standard deviation of the weights is about 7.66, indicating a moderate change. The distance traveled has an effect on the incidence of the disease. There are differences in results based on distance traveled between male and female. The correlation coefficient for distance traveled is 37.546457, indicating a strong positive relationship. This suggests that as the walking distance increases, so does the incidence of the disease. However, it is important to note that further investigation is needed to determine if distance traveled directly affects.

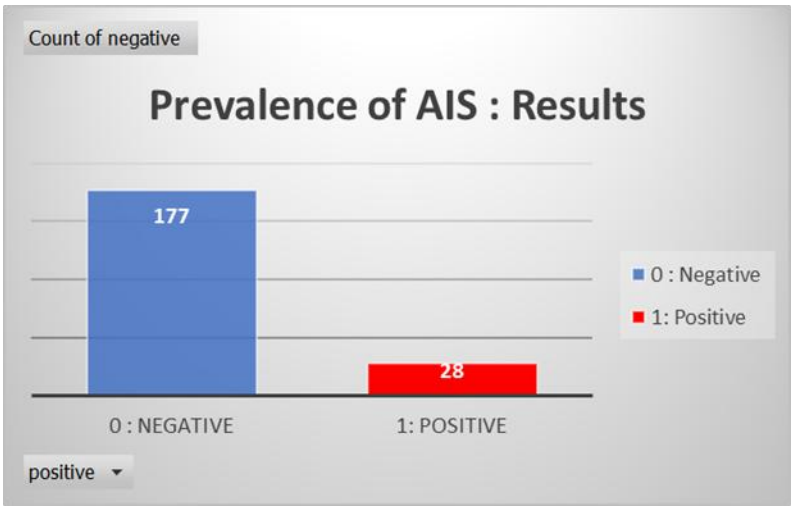

Figure 5:Prevalence of AIS result

In terms of other variables, individuals' weight and height showed an inverse correlation with the outcome, with coefficients of -0.769219 and -0.918379, respectively. This suggests that as weight and height decrease, the results tend to increase. Again, however, further investigation is needed to confirm these findings.

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Table 3: Gender distribution among participants

Gender	No	Yes
Female	84	19
Male	86	16

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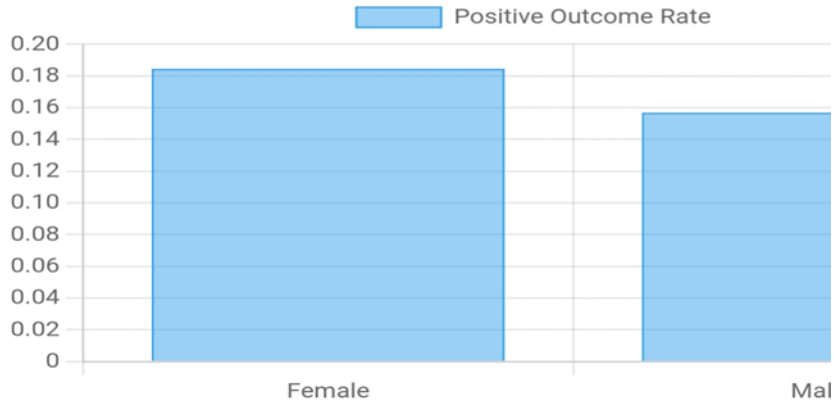

Figure 6; Positive outcome rate

Row Labels	Count of negative
0 : Negative	177
1: Positive	28
Grand Total	**205**

Figure 7;Total participants

IV. Results:

Prevalence

In total of 205 school going students were screened for the study, among which 17 students were suspected to have vertebrae progressing in scoliosis. Further out approx. 51% were female and 49% were male. The distribution of age among total screen are showed in table. Data analysis showed that gender has an impact on prevalence. Specifically, about 18.45% of females have a prevalence of AIS, while about 15.69% of male have a prevalence of AIS. This suggests that women are slightly more likely to have AIS than men, based on the data.

Factors influencing are:

I) Weight – The weight directly impacts as shown in the data, the curvature of students carrying heavy bags and travelling long distance directly are changing, confirmed by Adam's forward bend test.

II) Distance Travelled – Carrying heavy bags while travelling long distance impacts the spine and throughout development of the curve.

V. Discussion

In this study, screening was done for students aged 10 to 17 years because the literature supports this age group whose population is more susceptible to AIS. During the period of rapid growth of children, the growth of the AIS curve increases. The progress of most curves slows down considerably during skeletal maturation, while some curves continue to increase by more than 60° in adulthood.

In the current study, females were more vulnerable than men. There is a significant difference between AIS at age 13 and other age groups. The distance and weight carried by the impacts the prevalence is based on the Adam forward bend test conducted. However further study, based on other factors is needed to see how directly it impacts it. Data analysis showed that gender has an impact on prevalence. Specifically, about 18.45% of females have a prevalence of AIS, while about 15.69% of male have a prevalence of AIS. This suggests that women are slightly more likely to have AIS than men, based on the data.

VI. Conclusion:

This study focuses on early detection of AIS in school children from eleven to seventeen years old on the basis of its prevalence by global standards. Parents and teachers should know the type of school bags and weight, sitting and posture studies for early prevention with the age of limited time. This study specifically recommends similar screening programs in different geographical areas in India. Besides in addition, the government should set up a reasonable weight limits for the respective age categories.

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