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# Prevalence of Generalized and Selective Joint Hyper-Mobility in School Going Children of Age 6-12 Years of Central India

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## ABSTRACT

**Introduction:** Most individuals showing hyper-mobility are asymptomatic but many complications may arise as a result of hyper-mobile joints. Hyper-mobility may have a significant impact on quality of life of affected children and their parents, even in the milder forms. Joint hyper-mobility is common in childhood. To date, prevalence study has not yet been conducted in central India.

**Material and Methods:** A cross sectional observational study was performed in 1,006 asymptomatic typically developing 6-to-12 year's school going children (569 boys and 437 girls). Children were included from four local schools of city which was selected by random number table method out of total 244 schools by convenient sampling. All the children from each class were screened and assessed on the basis of Beighton's score. They were classified as generalized joint hypermobility (GJH) if they scored≥4/9 and as selective joint hyper-mobility (SJH) if they scored 1-3/ 9 and score 0 as no joint hyper-mobility.

**Data analysis and Results:** Data was analyzed using Microsoft Excel Sheet version 2009 to calculate the mean and standard deviation of the demographic data and prevalence of GJH and SJH was calculated in percentage. The prevalence of JH in 6-12 years children was 78.32%(788/1006) (Beighton's score 1-to-9). The prevalence of GJH (Beighton score ≥4/9) was 34.49%(347/1006) and SJH (Beighton's score 1-3) was 43.83% (441/1006).

**Conclusion:** Prevalence of JH in 6-to-12 years children is very high (78.32 %) including GJH-34.49 % and SJH- 43.83 % in central India. GJH was common in girls whereas SJH was common in boys.

***Key words:*** Joint Range, Children, Prevalence, Goniometer, Beighton's Score, Hypermobility

## INTRODUCTION

Generalized joint hyper-mobility (GJH) is defined as an increase in mean joint range of motion more than normal. [1-3] Joint hyper-mobility is classified as localized or selective (increased range of motion of a single joint) and generalized (increased range of motion of more than 4 joints).[3] It is generally accepted that this phenomenon runs in families and tends to be dominantly inherited.[4] The genetic causes of joint hyper-mobility includes Ehler-Danlos syndromes[5], some types of osteogenesis imperfecta including types 1 and 4, Marfan's syndrome and related disorders.[4,6,7] It is assumed that GJH is an expression of laxity of connective tissue, due to genetic alterations in elastic fibers and thus affecting the structural integrity of connective tissue throughout the body.[2] Some individuals, who show hyper-mobility, take advantage of the condition and perform well in sports like gymnastics, martial arts and dancing.[2] Though, most individuals showing hyper-mobility are asymptomatic[2,8], many complications may arise as a result of hyper-mobile joints. It has been suggested that hyper-mobile individuals are prone to orthopaedic

disorders and musculo-skeletal complaints, [9-13] such as degenerative joint disease, dislocations, joint effusions, muscular pains[13,14] and loss of joint proprioception. [15] These are also at a higher risk of sport-related injuries.[13,16] It may also be related to gleno-humeral joint in-stability.[16] Hyper-mobility may have a significant impact on quality of life of affected children and their parents, even in the milder forms. [17,18]

Joint hyper-mobility syndrome is diagnosed when individual reports symptoms like pain in more than 4 joints for a period of more than 12 weeks along with hyper-mobility.[3,17] Joint hyper-mobility is common in childhood. [3,4,12,14,17,19] The relation of hyper-mobility with age is inverse, lesser the age more hyper-mobility is prevalent and it is also seen more commonly in girls than in boys. [[3,4,14,16,17] Schweitzer (1970) conducted an investigation in Cape town and found Indians were showing joint hypermobility than Xhosa and Hlubi, whereas white African had least hyper-mobility [14] which indicated ethnic variations for joint hypermobility.

Beighton's score is a valid measure to test for generalized joint hyper-mobility and has been used commonly[1-4,8,12-14,16,17,20-23] it include of five maneuvers out of which four are passively performed and one is active component.[12,13,23,25] According to Remvig L, Jensen DV and Ward RC the prevalence of GJH among children varies from 4 to 40%, depending on age, gender, ethnicity, and the tests and criteria for classification used.[1,17,20] The prevalence of asymptomatic generalized joint hyper-mobility in children has been variably and widely reported, between 3% and 30% and symptomatic generalized hyper-mobility is believed to be less common, 10-12% and poorly recognized in childhood.[3] Asymptomatic joint hyper-mobility is very common among children, this condition is largely under-recognized by primary care physicians and hence often poorly managed.[17] All physicians and allied professionals that may be involved in the care of children with musculoskeletal complaints should therefore be well trained to recognize hyper-mobility, will help to save the time and money spent in investigations.[17]

In 2008, Viswanathan V and Khubchandani R conducted a study in Mumbai, in which 443 children of 3-9 years of age were examined for the existence of hyper-mobility, 40.8% of the children were found to have hyper-mobility.[26] A study conducted by R. Hasija, R. Khubchandani and S Shenoi in 2008 in Mumbai, studied 829 children of 3-19 years out of which 58.7% were hyper-mobile.[27] In 2013, P. Sanjay, P. Bagalkoti and R. Kubasadgoukar examined 420 children, in Karnataka, of 6-12 years of age and found that 34.2% were hyper-mobile.[28] A study done by Deshmukh AA (2018) found that generalized joint hypermobility (boys 15.27%, girls 19.79%) whereas selective joint hypermobility(boys 31.75%, girls 32.94%) in 6 to 12 years children but compared physical activity level among these two groups of joint hypermobility. [13] To date, prevalence study has not yet been conducted in central India. Thus this study aims to find the prevalence of joint hyper-mobility in 6-12 years school going children.

## METHODS

A cross sectional observational study was performed in sample size of 1,006 school going children (569 boys and 437 girls). The list of schools was obtained from block education office of city. Children were included from four local schools of city which was selected by random number table method out of total 244 schools by convenient sampling. Asymptomatic Typically developing children of both the gender were included in study within the age group of 6 to12 years. Sample size was collected in 4month duration. Children who were co-operative and ability to follow verbal commands included in study whereas any musculoskeletal complaints, trauma or

surgery, any diagnosed case of connective tissue disorders, any neurological disorders were excluded. [12,13,23]

## Procedure

Permission and approval from the institutional head, ethical committee and scientific committee was obtained. Permission was taken from the block education officer and the list of schools was collected. Out of 244 schools, four schools were selected by simple random sampling using random number table method. Permission was obtained from the school authorities. The procedure of the evaluation and the importance of the study were explained to the principal of school. Permission was obtained from the principal to carry out the project work in the school. Children were divided in 7 sub-groups according to their age. The purpose of the study and procedure was demonstrated to the class teacher. Written consent was obtained from children.

Demographic data like name, age, gender was taken. Height and weight were measured. BMI and BMI percentile was calculated. BMI was calculated by the formula weight/ Height$^2$ (kg/m$^2$) The Beighton's test was performed (Figure 1,2,3,4 and 5). Passive range of motion of 5$^{th}$ MCP extension, apposition of thumb, elbow hyperextension and knee extension were measured using a finger goniometer and half circle universal goniometer respectively.

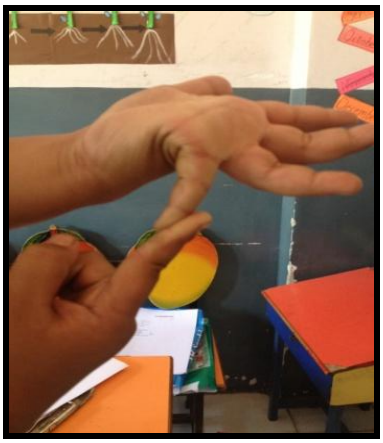

**Figure 1: Passive dorsi-flexion of 5$^{th}$ MCP joint**

**Figure 2: Passive apposition of thumb (1$^{st}$ MCP Joint)**

**Figure 3: Hyper-extension of elbow**

**Figure 4: Passive hyper-extension of knee**

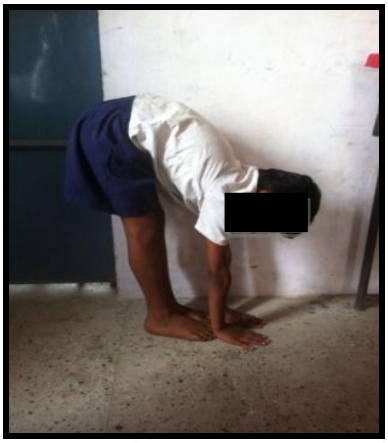

**Figure 5: Lumbar flexion-Palms touching the floor**

The information sheet and the consent form were sent for the approval of their parents and assent form was filled by the subject and once the approval was received, the subject was included for the study. All the children from each class were screened and assessed on the basis of Beighton's score. [1-4,8,12-14,16,17,20-23] They

were classified as generalized joint hypermobility if they scored ≥4/9 and as selective joint hyper-mobility if they scored 1-3/ 9 and score 0 as no joint hyper-mobility. The test was determined by qualified Physical therapist.

### *Data Analysis*

Data was analyzed using Microsoft excel sheet version 2009 to calculate mean and standard deviation of the demographic data like height, weight and BMI and prevalence of generalized and selective joint hypermobility was calculated in percentage.

## RESULTS

**Table 1: Gender-wise distribution of the mean and standard deviation of the anthropometric data of children in each subgroup of age 6-to-12 years**

| Age (years) | Boys (*n*) | Girls(*n*) | Total | Height (cm) | Weight (Kg) | BMI (Kg/m$^2$) |
|---|---|---|---|---|---|---|
| 6 | 22 | 12 | 34 | 107.76±6.15 | 16.44±1.79 | 14.28±1.08 |
| 7 | 72 | 53 | 125 | 115.32±5.97 | 18.57±2.94 | 17.98±1.81 |
| 8 | 60 | 42 | 102 | 120±7.02 | 19.95±3.12 | 14±2.19 |
| 9 | 106 | 86 | 192 | 124.75±8.4 | 22.98±3.9 | 14.75±2.48 |
| 10 | 130 | 110 | 240 | 130.74±8.09 | 24.71±6.18 | 14.37±2.71 |
| 11 | 105 | 78 | 183 | 137.22±6.9 | 29.66±6.36 | 16.13±6.62 |
| 12 | 74 | 56 | 130 | 143.95±7.16 | 35.94±10.73 | 16.88±4 |
| **Total** | **569** | **437** | **1006** | - | - | - |

BMI- Body Mass Index, *n*- number of children

**Table 2: The mean and standard deviation of anthropometric data of boys and girls of each age subgroup of 6-to-12 years**

| Age(years) | Gender | Height (cm) | Weight (Kg) | BMI (Kg/m$^2$) |
|---|---|---|---|---|
| 6 | B | 109.45±5.79 | 16.63±1.46 | 14.13±1.21 |
| | G | 106.08±6.52 | 16.25±2.13 | 14.43±0.96 |
| 7 | B | 115.79±5.79 | 18.75±2.17 | 13.98±1.45 |
| | G | 114.86±6.16 | 18.4±3.72 | 21.99±2.17 |
| 8 | B | 121.05±8.68 | 20.79±3.52 | 14.29±2.89 |
| | G | 118.97±5.36 | 19.11±2.73 | 13.74±1.49 |
| 9 | B | 124.3±7.19 | 22.32±3.70 | 14.48±2.27 |
| | G | 125.20±9.61 | 23.65±4.12 | 15.02±2.69 |
| 10 | B | 131.45±7.52 | 25.6±6.89 | 14.69±3.08 |
| | G | 130.03±8.67 | 23.82±5.48 | 14.05±2.34 |
| 11 | B | 138.51±6.2 | 29.78±5.16 | 16.32±9.88 |
| | G | 135.94±7.61 | 29.55±7.56 | 15.94±3.36 |
| 12 | B | 142.90±7.69 | 34.90±6.95 | 16.57±2.62 |
| | G | 145±6.64 | 35.94±10.73 | 16.88±4.00 |

B-Boys, G-Girls

The current study was conducted on 1006 normal healthy school going children (boys 569, girls 437) of age group 6-to-12 years from four different schools in city. Table 1 and 2 showed distribution of the population according to age and gender in subgroups (6-to-12 years) with mean and standard deviation of height, weight and body mass index (BMI) which belongs to normal limits of Indian children.[29]

Figure 6 showed the prevalence of joint hyper-mobility was 78.2%. Generalised joint hyper-mobility prevalence was 34.4% whereas of selective joint hyper-mobility was 43.8% and 21.6% children were not hyper-mobile according to Beighton's scale in 6-to-12 years of children.

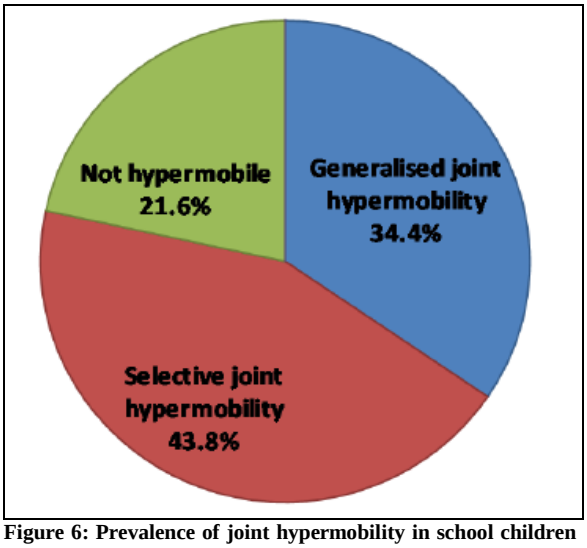


**Figure 6: Prevalence of joint hypermobility in school children among 6-to-12 yrs of age**

**Table 3: The prevalence of joint hyper-mobility among boys and girls of 6-to-12 years**

| Classification | Beighton's score | Boys | Girls | Total |
|---|---|---|---|---|
| Generalised joint hyper-mobility | ≥4 out of 9 | 165/569(28.9%) | 182/437(41.6%) | 347/1006(34.4%) |
| Selective joint hyper-mobility | 1-3 out of 9 | 265/569(46.5%) | 176/437(40.2%) | 441/1006(43.8%) |
| Not hyper-mobile | 0 out of 9 | 139/569(24.42%) | 79/437(18.07%) | 218/1006(21.6%) |

Among boys, 28.9% and 41.6% girls had generalised joint hyper-mobility. The Beighton's score 1 to 3 (selective joint hyper-mobility), was seen in 46.5% of the boys and 40.2% of the girls whereas 24.42% boys and 18.07% girls were not hyper-mobile. This showed that girls were showing higher percentage of GJH while SJH percentage was higher among boys (Table 3 and Figure 7).

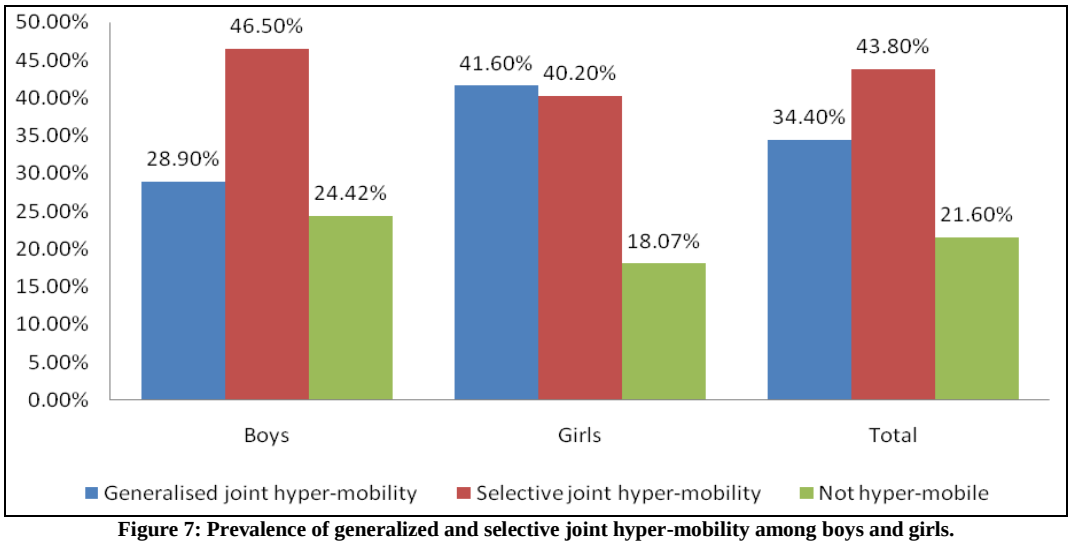


**Figure 7: Prevalence of generalized and selective joint hyper-mobility among boys and girls.**

**Table 4: The age-wise prevalence of joint hyper-mobility among children of age subgroup 6-to-12 years**

| Age (years) | No. of children | Generalised joint hyper-mobility | Selective joint hyper-mobility | Not hyper-mobile |
|---|---|---|---|---|
| 6 | 34 | 19 (55.88%) | 9 (26.47%) | 6 (17.64%) |
| 7 | 125 | 31 (24.8%) | 62 (49.6%) | 32 (25.60%) |
| 8 | 102 | 38 (37.25%) | 41 (40.19%) | 23 (22.54%) |
| 9 | 192 | 44 (22.91%) | 112 (58.33%) | 36 (18.75%) |
| 10 | 240 | 101 (42.08%) | 94 (39.16%) | 45 (18.75%) |
| 11 | 183 | 75 (40.98%) | 78 (42.62%) | 30 (16.39%) |
| 12 | 130 | 39 (30.00%) | 45 (34.61%) | 46 (35.38%) |

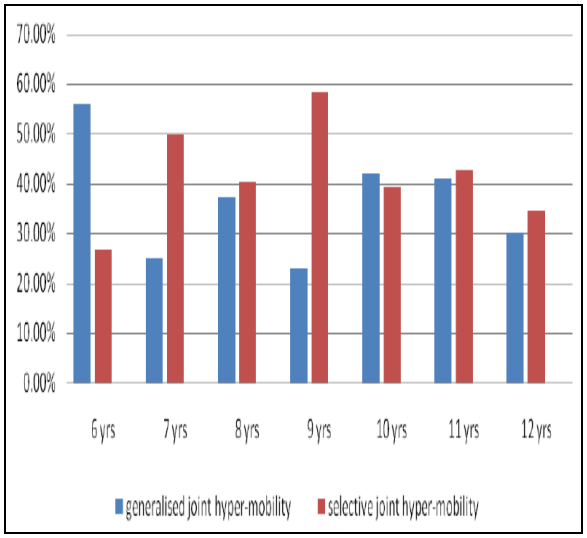


**Figure 8: Prevalence of joint hyper-mobility according to age 6-to12 years**

Table 4 and Figure 8, showed the age-wise prevalence of joint hyper-mobility among children of age subgroup 6-to-12 years. There was no specific trend followed from age 6-to-12 years with increase in age. There was unequal distribution of participants in each sub group.

**Table 5: The number and percentage of boys and girls of age 6-to-12 years with generalized joint hyper-mobility**

| Age (years) | Hyper-mobile boys | Hyper-mobile girls | Total number of GJH children |
|---|---|---|---|
| 6 | 14 (78.68%) | 5 (26.31%) | 19 |
| 7 | 16 (51.61%) | 15 (48.38%) | 31 |
| 8 | 16 (42.10%) | 22 (57.89%) | 38 |
| 9 | 18 (40.90%) | 26 (59.09%) | 44 |
| 10 | 46 (45.54%) | 55 (54.45%) | 101 |
| 11 | 38 (50.66%) | 37 (49.33%) | 75 |
| 12 | 17 (43.58%) | 22 (56.41%) | 39 |
| **Total** | **165 (47.55%)** | **182 (52.44%)** | **347** |

GJH- Generalized joint hypermobility

**Table 6: The number and percentage of boys and girls of age 6-to-12 years with selective joint hyper-mobility**

| Age (years) | Hyper-mobile boys | Hyper-mobile girls | Total number of SJH children |
|---|---|---|---|
| 6 | 7 (77.77%) | 2 (22.22%) | 9 |
| 7 | 35 (56.45%) | 27 (43.54%) | 62 |
| 8 | 29 (70.73%) | 12 (29.26%) | 41 |
| 9 | 65 (58.03%) | 47 (41.96%) | 112 |
| 10 | 54 (57.44%) | 40 (42.55%) | 94 |
| 11 | 45 (57.69%) | 33 (42.30%) | 78 |
| 12 | 30 (66.66%) | 15 (33.33%) | 45 |
| **Total** | **265 (60.09%)** | **176 (39.90%)** | **441** |

SJH- Selective joint hypermobility

Table 5 and 6, indicated that GJH was common among girls whereas SJH was common among boys in 6-to-12 years children.

**Table 7: The number and percentage of individual joint involvement in selective hyper-mobility among children**

| Individual Joint | Number of Hyper-mobile joint | Percentage (%) |
|---|---|---|
| Fifth MCP | 216/ 882 | 24.4 |
| Thumb(1$^{st}$MCP) | 402/ 882 | 45.5 |
| Elbow | 180/ 882 | 20.4 |
| Knee | 140/ 882 | 15.8 |
| Lumbar | 0 | 0 |

MCP- Meta-carpo phalengeal

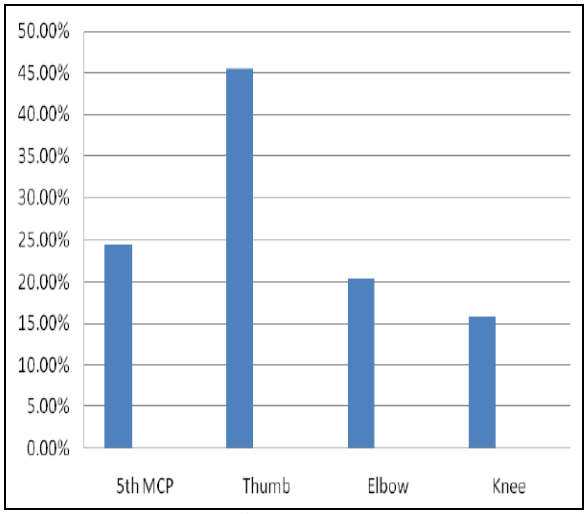


**Figure 9: Percentage of individual joint involvement in selective hyper-mobility among children**

Out of total 1006 children, 441 showed selective joint hyper-mobility, it means at least one joint is hyper-mobile in these 441 children. The evaluation was done on bilateral upper and lower limbs, thus number of each joint evaluated was 882 except the lumbar joint component. From table 7 and figure 9, it was found that the percentage of thumb (1$^{st}$ MCP) joint involvement was highest, followed by little finger, elbow and knee joint whereas the lumbar joint was not affected with joint hypermobility selectively among children.

## DISCUSSION

In the current study aimed to find out the prevalence of Generalised and Selective joint hyper-mobility in school going children 6-12 years. The number of children was 1006, 569 (56.56%) were boys and 437(43.43%) were girls. The height, weight, BMI were falling within normal limits for Indian children population for age 6 to 12 years among both gender. [29]

In present study, the prevalence of joint hyper-mobility in 6-12 years children was 78.32% (788/1006) (Beighton's score 1-9). The prevalence of generalized joint hyper-mobility (Beighton's score ≥4/9) was 34.49% (347/1006) and selective joint hyper-mobility (Beighton's score 1-3) was 43.83% (441/1006). Previous study performed in Mumbai on 829 individuals (3-19 years), among which number of children of 7-13 years were 474, in which the prevalence of generalised joint hyper-mobility (Beighton's score ≥4/9) was found to be 290/474 i.e. 61.2%. [27] Another study conducted in Iceland on 267 children of 12 years concluded that the prevalence of joint hyper-mobility was 27.7% (74/267), out of which 40.5% were girls and 12.9% were boys who had generalised joint hyper-mobility (Beighton's score ≥4/9). [30] In a study conducted in Egypt on 6-15 years individuals with the population of 997, found that the prevalence was 16.1% using the Beighton's score of ≥4/9 (girls- 18%; boys- 14.4%). [31]

The current study showed that the prevalence of hyper-mobility among children of age 6-12 years is much higher in central India. When considering prevalence according to gender, 28.9% boys had generalized joint hyper-mobility, 46.57% boys had selective joint hyper-mobility whereas 24.4% were not hyper-mobile and among girls, 41.6% had generalized joint hyper-mobility, 40.2% had selective joint hyper-mobility, whereas 18.07% were not hyper-mobile, (table 5 and figure 12) thus it

can be concluded that girls showed more hyper-mobility as compared to the boys in present study. These similar findings were also found in the previous studies. [1,2,14,17,30,31] In current study, results do not follow any pattern which revealed that as age advances, hyper-mobility decreases, which contradict the finding of the previous study[2] which found that, as age advances the joint hypermobility decreases among children. This finding might be due to lack of equal distribution of children in each age sub-group.

The current study, found that 43.83% (441/1006) of the total subjects had selective joint hyper-mobility. The percentage of generalized joint hyper-mobility was 34.4% out of which 47.55% were boys and 52.44% were girls. The percentage of selective joint hyper-mobility was 43.8%, in which 60.09% boys and 39.90% girls showed selective joint hyper-mobility. When considering individual joint hyper-mobility, highest percentage of affection was seen in thumb (45.5%), followed by fifth MCP (24.4%), elbow (20.4%), knee (15.8%) and least was lumbar. Average upper limb hyper-mobility was 30.15% (Out of 798/2646 joints) and lower limb hyper-mobility (knee) was 15.8% (Out of 140/882 joints) and spine was 0%. These findings revealed that upper extremity joint hyper-mobility was significantly higher as compared to the lower limb hyper-mobility, whereas selective lumbar joint hyper-mobility was not found. The percentage of GJH and SJH found in study done by Deshmukh AA and colleagues [13] was 17.32% and 32.97% respectively, which were much lesser compared to current study. This finding may be because of large difference i.e smaller sample size and unequal distribution of subjects in each age group in current study.

Children with joint hyper-mobility should be regularly followed for any musculo-skeletal complications.[2,8,12-14,17,20,24] Thus, it is concluded that joint hyper-mobility is highly prevalent and may lead to many complications in children. There is a need to take this condition seriously and treat the affected children accordingly. Children with upper and lower extremity hyper-mobility should be examined for muscle strength, balance and upper and lower extremity function in the age 6-12 years. These children should be evaluated for their quality of life at school, at home as well as at community level. School authorities should be informed about complications and precautionary measures for children with joint hyper-mobility by health support group. The result of current study will be helpful to plan various policies for children with joint hypermobility to participate in sports and any physical activity at school in future.

## CONCLUSION

Prevalence of joint hyper-mobility in 6-12 years children is very high (78.32 %) including GJH- 34.49 % and SJH- 43.83 %. Prevalence of generalized joint hyper-mobility is higher in girls whereas prevalence of selective joint hyper-mobility is more in boys. The thumb is the most commonly affected joint, followed by fifth metacarpophalangeal joint, elbow then knee joint. None of the subjects showed lumbar joint hyper-mobility. Upper limb joints showed more hyper-mobility than lower limb joints and spine.

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