

# Hypermobility among school children aged five to eight years: the Hospital del Mar criteria gives higher prevalence for hypermobility than the Beighton score

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### Abstract

#### Objective

*The purpose was to investigate the distribution of hypermobility among school children aged five to eight years.*

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#### Methods

*One hundred and twenty-eight participants were assessed using the Beighton score and the Hospital del Mar criteria.*

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#### Results

*With the Beighton score using the cut-off  $\geq 4$ , the prevalence was 12%, and with the Hospital del Mar criteria the prevalence was 34%. There were significantly higher scores for females on both the Beighton ( $p=0.01$ ) and Hospital del Mar criteria ( $p<0.0001$ ). The youngest children aged five to six years scored higher compared with the seven- and eight-year-olds ( $p=0.016$ ). The knee flexion was most likely to be hypermobile (97%), followed by shoulder rotation (80%), thumb (31%), elbow (27%), metatarsal-phalangeal (16%), hip (15.5%), fingers (10%) or knee (10%), ankle (6%), trunk (4%) and patella (2%).*

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#### Conclusion

*Gender and probably age must be taken into account when children are assessed for hypermobility. The Hospital del Mar criteria need to be modified for some of the motions.*

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#### Key words

hypermobility, Beighton score, Hospital del Mar criteria, children

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## Introduction

Joint hypermobility refers to an increase in passive range of motion that exceeds normal values, given the individuals age and gender (1). Children and adolescents generally have greater ROM than adults (2, 3). The prevalence of hypermobility in children has been estimated to be 10–25% (4), however prevalence's higher than 58% has been reported (5, 6). Females tend to be more hypermobile than males at any age (1, 2, 5, 7–12). In children with joint hypermobility a higher incidence of late walking, congenital hip problems, delay in motor development or poor motor competence, clumsiness, “growing pains” and sleep disturbance is found (3, 13–16). For some individuals the joint hypermobility is associated with musculoskeletal symptoms in absence of any systemic disease. The condition is then named joint hypermobility syndrome or benign joint hypermobility syndrome (17, 18). Children with hypermobility syndrome are found to score lower in balance test and activities on a daily basis are affected (19). A connection between joint hypermobility and pain, joint dislocation, joint subluxation, idiopathic scoliosis, multiple soft tissue injuries, functional gastrointestinal disorders, laxity in other supporting tissues, anxiety, fatigue, and autonomic dysfunction have been found (3, 13, 19–27). The most frequent choice of cut-off for the Beighton has been  $\geq 4$  points (4, 28–30). The Beighton score is probably the most widely used method for measuring joint hypermobility (30, 31). The instrument is a modification of the Carter-Wilkinson criteria and was originally developed as a rapid screening tool for use in epidemiological studies (2, 32, 33).

It is found that there is increased mobility in other joints not covered by Beighton (34). The Hospital del Mar criteria supplements the Beighton test with tests for the shoulder, hip, knee flexion, patella, ankle and metatarsal-phalangeal joints (35). The aim of this study is to investigate the distribution of the results of the Beighton score and the Hospital del Mar criteria for a cohort of children aged five to eight years of age.

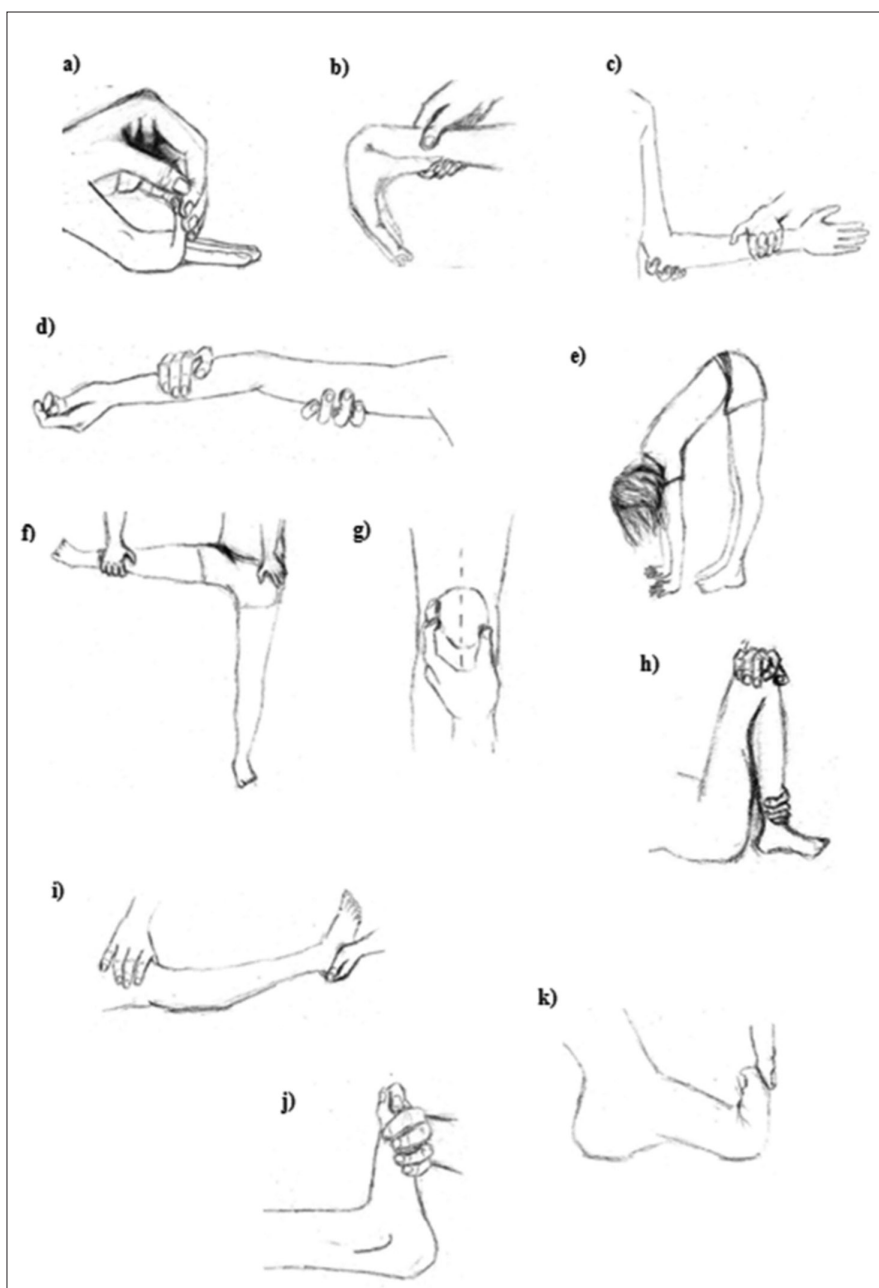
## Method

A total of 128 healthy children (74 females and 54 males) aged five to eight years were assessed in September and October 2011. The children came from two elementary schools in Sweden. A written consent letter from all parents was obtained before the examination. The study has ethical approval.

The Beighton score and Hospital del Mar criteria were used for assessment. The children were assessed at school, during school time in the school nurses room. They were instructed to wear shorts and t-shirt or soft clothing that would not limit their motion.

The Beighton score assesses the degree of hypermobility in passive movements of eight joints (right and left little finger, thumb, elbow and knee) and trunk mobility *i.e.* the ability to reach to the floor with the palms of the hand with stretched legs (Fig. 1. illustrations a, b, d, e, i). With one point given for each hypermobile joint and one point for trunk mobility, maximum score nine points (2). Beighton scores are found to have validity and reliability (31, 34–38). The Hospital del Mar criteria assesses the degree of hypermobility in passive movement in ten joints; (right and left little finger, thumb, elbow, shoulder rotation, hip, knee extension and flexion, patella, ankle and metatarsal-phalangeal joint) and trunk mobility *i.e.* the ability to reach to the floor with the palms of the hand with stretched legs (Fig. 1. illustrations a–k). The test is performed bilaterally but only one point is given regardless of bi- or unilateral hypermobility resulting in maximum score eleven points. The validity and reliability is found to be high (35). This version of the Hospital del Mar criteria was presented by Professor A. Bulbena during a course in Barcelona in September 2009. Five of the test motions are the same as in the Beighton score. Both the Beighton and the Hospital del Mar criteria have been used in paediatric populations (8, 9, 19, 20, 28, 29, 34, 36, 40). Two physical therapy students, on the last term of their course, examined the children. They were trained by an experienced paediatric physical therapist for the Beighton and Hospital del Mar criteria before the assessments.

Competing interests: none declared.



**Fig. 1.** Illustration of the motion for Beighton score (a, b, d, e and i) and Hospital del Mar criteria (a-k). Scores is given if: a. little finger passive dorsiflexion beyond 90°. b. Thumb passive dorsiflexion to the flexor aspect of the forearm c. Shoulder passive rotation beyond 85°. d. Elbow passive hyperextends beyond 10°. e. Trunk mobility palms and hands can rest flat on the floor. f. Hip passive abduction beyond 90°. i. Knee passive hyperextends beyond 10°. h. Knee hyperflexion: passive heel to buttock. g. Patella passive motion beyond midline. j. Ankle passive extension beyond 30° and k. metatarsal-phalangeal joint passive beyond 90°.

### Statistics

Descriptive statistics were used to describe the characteristics of the participants and the distribution of the result of the Beighton score and the Hospital del Mar criteria. Gender and age analysis was made using the Mann-Whitney U-test. A significance level of  $p < 0.05$  was used.

### Results

Of the 128 children that participated, 126 were tested for all motions in both tests, one girl was not tested for the ankle and the metatarsal-phalangeal movement, and one boy was not tested for the hip. There were significantly higher scores for females for both the Beighton ( $p = 0.01$ ) and Hospital del

Mar criteria ( $p < 0.0001$ ) (Table I). With the Beighton children aged five to six years scored median 2 points for females (range 0–6) and 1 point for males (range 0–6), children of seven years of age scored median 1 point for females (range 0–6) and 0 points for males (range 0–4), children of eight years of age scored median 1.5 points for females (range 0–6) and 0 points for males (range 0–2). With the Beighton using the cut-off  $\geq 4$ , the prevalence was 12%, the prevalence was higher among females than among males (16% vs. 6%). With the more rigorous cut-off  $\geq 6$  the prevalence was 3% (5% in females, 0% in males). The thumbs were most likely to be hypermobile (31%), followed by elbow (27%), fingers (10%) or knee (10%) and trunk (4%).

With the Hospital del Mar criteria, children aged five to six years scored median 4 points for females (range 2–7) and 2 points for males (range 1–7), children of seven years of age scored median 3 points for females (range 1–6) and 2.5 points for males (range 1–6), children of eight years of age scored median 3 points for females (range 0–7) and 1 point for males (range 0–3). Using the cut-off  $\geq 4$ , the prevalence with the Hospital del Mar criteria was 34%, the prevalence was higher for females than among males (47% vs. 17%). With the more rigorous cut-off  $\geq 6$  the prevalence was 8% (9% in females, 6% in males). The knee flexion was most likely to be hypermobile (97%), followed by shoulder rotation (80%), thumb (31%), elbow (27%), metatarsal-phalangeal (16%), hip (15.5%), fingers (10%) or knee (10%), ankle (6%), trunk (4%) and patella (2%) (Fig. 2). When analysing the total group of participants, elbow, shoulder, trunk, hip and knee extensor hypermobility were more prevalent for females than for males (Fig. 3). There was a trend that the youngest children five to six years scored higher compared with the seven- and eight-year-olds ( $P = 0.16$ ). With the Beighton 78% of the children had equal scores bilaterally, 12% had more points on the left side and 10% on the right side. With the Hospital del Mar criteria 59% of the children had equal scores bilaterally, 18% had more points on the left

side and 23% had more points on the right side. Mostly there were only one point difference; 3% had two points difference.

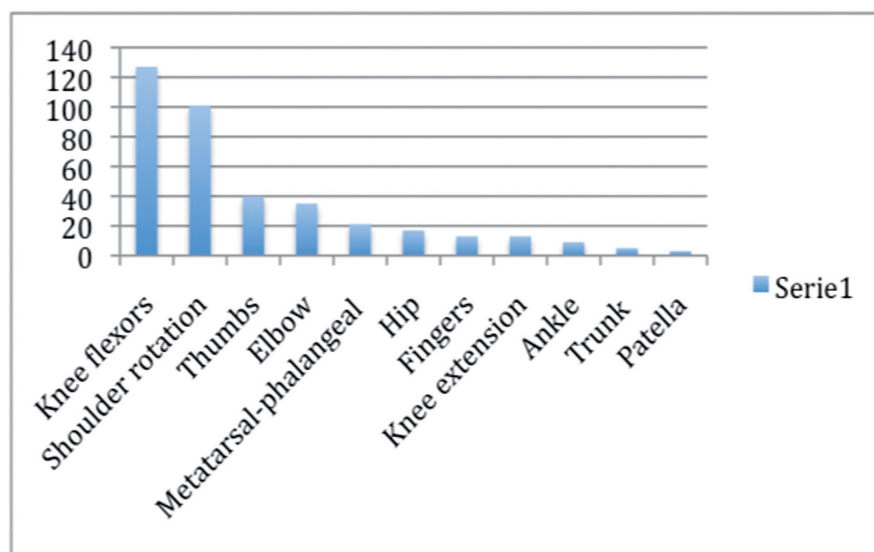
**Discussion**

The aim of the current study was to investigate the distribution of hypermobility in children aged five to eight years with Beighton and Hospital del Mar criteria. On the Beighton most of the children scored <4 which has been considered as a cut-off point for hypermobility. Twelve percent of the children achieved ≥4 points on the Beighton, this is within what could be expected (30, 39) and it seems reasonable to have a cut-off with 4 points. However 67% of the children who scored ≥4 were aged five to six years. Maybe some caution is needed when drawing conclusions from the result of ≥4 points for the younger children. The cut-off ≥4 has been questioned and assumed to be too low (8, 29, 34, 40). Van der Giessen *et al.* suggested a cut-off ≥5 for Dutch children at the age of 4-9 years, and cut-off ≥4 for children >10 years of age (40). For Caucasian children aged six to twelve Smits-Engelsman *et al* recommend that a cut-off of 7/9 points with the Beighton is used (34). Jansson *et al.* suggest that a different cut-off for different ages and gender are needed (8). In the current study both tests showed that females score more points for hypermobility than males. This has previously been found in other studies (1, 2, 8-12, 29). If a difference for genders is also expected to be found in younger children e.g. at or below the age of three and infants is as far as we are aware unknown. For the Hospital del Mar criteria the prevalence was 34% in the current study. The high occurrence found for knee hyperflexion (78–100%) and external shoulder rotation (67–95%) suggest that the limit values for these motions might be within “normal” in children five to eight years old and therefore not an appropriate criterion for hypermobility in children.

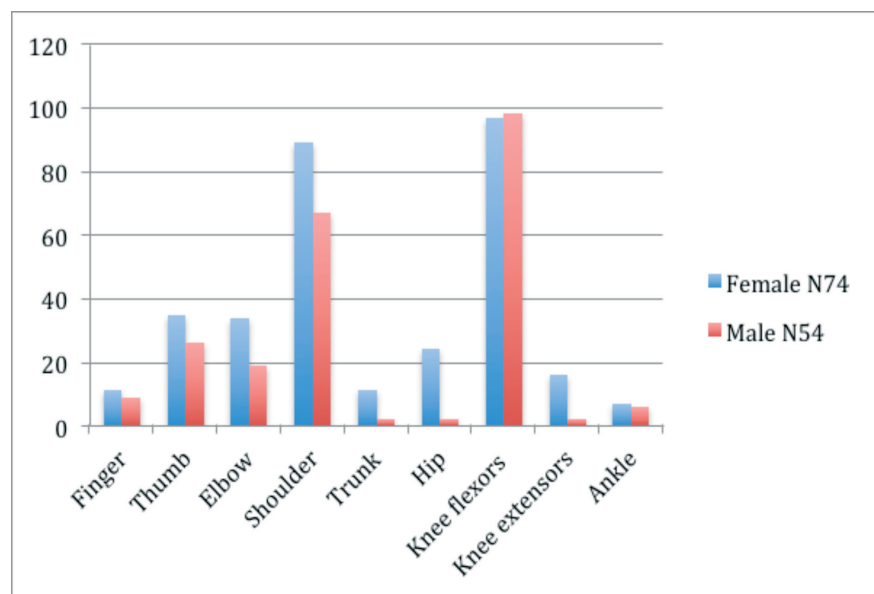
In another study heel to buttock was examined and 99% of the children were able to do this with at least one leg (87% with both legs) and there was no correlation with this motion and num-

**Table I.** Distribution of hypermobility points for gender.

	Female n=74	Male n=54
Finger	8 (11%)	5 (9%)
Thumb	26 (26%)	14 (26%)
Elbow	<b>25 (34%)</b>	10 (19%)
Shoulder	<b>66 (90%)</b>	36 (67%)
Trunk	<b>8 (11%)</b>	1 (2%)
Hip	<b>18 (25%)</b>	1 (2%)
Knee flexors	71 (97%)	53 (98%)
Knee extensors	<b>12 (16%)</b>	1 (2%)
Ankle	5 (7%)	3 (6%)
Metatarsal-phalangeal	13 (18%)	8 (15%)
Patella	2 (3%)	1 (2%)



**Fig. 2.** Distribution of hypermobility of all the motions included in the Hospital del Mar criteria and the Beighton score. Thumbs, elbow, fingers, knee extension and trunk are included in the Beighton score and all motions are included in the Hospital del Mar criteria.



**Fig. 3.** The percentage of hypermobility for females and males; in all motions for the children who scored ≥4 points on the Beighton score and Hospital del Mar criteria.

ber of hypermobile joints (34). Our interpretation is that heel to buttock is the same motion as knee hyperflexion. If there is no history of injury or muscle shortening there is nothing that limits the knee flexion apart from the body constitution. To keep this motion in a hypermobility test is doubtful for both children and adults. When comparing the criterion for external shoulder rotation with a reference value the mean value is 107.4° for 6-12 years old (1), this exceeds the Hospital del Mar criteria of >85°. With this knowledge these two motions could probably be excluded in the current study. And with these exclusions only 9% get ≥4 points with the Hospital del Mar criteria, this is fewer than with the Beighton scale. Five motions are the same in both tests, however in the Hospital del Mar criteria you get one point if any or both sides are positive, in contrast to the Beighton score where the two-sided positive test scores two points and one-sided scores one point. This has to be considered when deciding cut-off points in the Hospital del Mar criteria. Smits-Engelsman *et al.* found that hypermobility was greater on the left side however asymmetry in typically developed children was rare (34). They suggest that for a quick screening the left side could be examined; but for clinical situations they recommend the full-standardised Beighton protocol (34). In the current study there was an asymmetry in points, with 22% for the Beighton and 41% for the Hospital del Mar criteria. With the Beighton it was slightly more common with more points on the left side, and with the Hospital del Mar criteria it was more common with additional points on the right side. It may be valuable to add hip, ankle and metatarsal-phalangeal joints when examining children for hypermobility. The limit for hypermobility of the hip is 85°, the reference values for hip abduction are 55° for children aged four years, and 39° for adults aged 60–74 years. At what degree the hip can be considered hypermobile could be discussed, probably at less than the chosen 85°. The shoulder rotation needs to be modified for children and knee hyperflexion ought to be excluded. There seem to be good reasons to have

the ankle included in a test for hypermobility as Pes Planus is associated with joint hypermobility (13, 41). It could be discussed whether the cut-off for the Hospital del Mar criteria ought to be higher/lower and/or if it would be a good suggestion to change the scoring system, and give one point for each joint. Further investigations will be needed to establish if these changes are more relevant for children than adults. If shoulder rotation and knee hyperflexion were excluded more children would score <4 points on the Hospital del Mar criteria than on the Beighton. Especially for young infants hypermobility in the lower extremities may play a key role in motor development. Crawling, standing and walking may be delayed in infants who have hypermobility. At later ages the hypermobility in the lower extremities may affect the standing balance (19). Pain is most commonly associated with the knee and ankle (13, 30), presumably because they are weight-bearing joints (30).

#### Limitations

The Hospital del Mar criteria has been developed over a period of years and the version used in this study is not exactly the same as in other studies. This makes comparisons more complicated.

#### Conclusions

The prevalence of hypermobility was 12% according to the Beighton and 34% according to the Hospital del Mar criteria. Our findings imply that gender and probably age must be taken into account when children are assessed for hypermobility. Some of the motions in the Hospital del Mar criteria need to be modified at least for children. Reference values for hyper mobility in infants and preschool children are still to be investigated to decide reasonable cut-offs for younger ages.

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