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# Postural assessment of primary school children in Liechtenstein: a longitudinal study 2008–2010

## Abstract

Studies indicate that the number of school-children with postural imbalances has increased in recent decades. This negative trend also becomes apparent in the current survey. Data were taken from an ongoing screening project undertaken by the national public health department. In this orthopaedic follow-up study a total of 367 children (aged 6–11 years) were observed in 1<sup>st</sup> grade (2008) and 3<sup>rd</sup> grade (2010). The examinations included two central aspects of posture: a static postural assessment (5 items) and a dynamical muscular check (6 items). In summary, a significant postural decline from 1<sup>st</sup> to 3<sup>rd</sup> grade could be detected and on average each 5<sup>th</sup> pupil was recommended to special posture gymnastics. Due to a low participation rate of merely 45% at this voluntary and free programme, a critical evaluation of the practical implementation seems necessary.

## Zusammenfassung

Studien deuten darauf hin, dass Haltungsschwächen bei Schulkindern in den letzten Jahrzehnten zugenommen haben. Diese besorgniserregende Entwicklung wird auch in der vorliegenden Längsschnittstudie bestätigt. Die Daten stammen aus schulischen Vorsorgeuntersuchungen, welche unter der Leitung des Amtes für Gesundheit in den Jahren 2008 und 2010 auf der 1. und 3. Primarstufe bei 367 Kindern (im Alter von 6–11 Jahren) durchgeführt wurden. Diese orthopädischen Untersuchungen umfassten zwei Parameter: eine statische Haltungsbeurteilung (5 Items) und eine dynamisch-muskuläre Funktionsprüfung (6 Items). Zusammenfassend zeigte sich eine signifikante Verschlechterung der Körperhaltung im Altersverlauf und im Durchschnitt wurde jedes 5. Kind ins Haltungsturnen empfohlen. Aufgrund der geringen Teilnahmequote an diesem freiwilligen und kostenlosen Förderangebot von lediglich 45,5% scheint eine kritische Evaluation der Umsetzungspraxis angezeigt.

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## Introduction

The developmental tendency in the health and fitness status of the next generation is, according to experts, increasingly becoming a cause for concern. In our consumer-oriented and media-impacted society, lifestyles and habits appear to have changed decisively. Children and adolescents of today frequently show an inactive lifestyle, unhealthy nutritional habits as well as media-dominated free time activities. As a result of the lack of exercise in the daily routine, the prevalence of insufficient motor fitness, postural disorders and overweight has increased during the last decades (Brettschneider et al., 2006; Graf et al., 2006; Opper et al., 2005). Depending on the kind of study and statistics, between 40–65% of growing children and adolescents show postural and motor developmental deficits (Hollmann and Hettinger, 2000; Ketelhut and Bittmann, 2001). A weak musculature, in particular a weak crural and trunk musculature not only leads to limited motor skills, but also increases the danger of spine instabilities as well as back pain. Today already one third of all primary school children have back pain (Opper et al., 2005; Prätorius and Milani, 2004).

These unhealthy behaviour patterns and motor disorders outlined above must not be allowed to become habitual because of their long-term effects. Multifaceted and various exercise stimuli in childhood not only build the base for a good development of the musculoskeletal system, the promotion of coordination and body awareness, but also are an important protective factor against metabolic and psychosomatic impairments as well as accidents (Dordel, 2007; Graf et al., 2006; Opper et al., 2005). Therefore, early recognition and management of postural deviations and mo-

tor developmental deficits is of particular importance. In clinical practice (primarily for practical reasons), postural analyses are done through a static posture assessment in addition to a functional examination (Dordel, 2007; Janda, 2000; Niethard and Birnbaum, 2002).

Until now and in contrast to other countries, no scientific study exists in Liechtenstein on the prevalence of endangered posture among school-children. Other studies do not offer any data for comparison purposes because they are frequently regionally limited, use different samples and research methods, and thus their conclusions cannot be generalised. The aim of this survey was therefore to document the present situation in our region.

## Methods

For this study, examination sheets from a follow-up survey between 2008 and 2010, from primary school children ( $n = 367$ ) aged 6 to 11 years from all schools in Liechtenstein were reviewed. The pupils have been orthopaedically examined as 1<sup>st</sup> (mean:  $7.7 \pm 0.6$  years) and 3<sup>rd</sup> (mean:  $9.7 \pm 0.6$  years) grades. Based on legal guidelines, this screening was organised by the national public health department and conducted by two trained physiotherapists. The examination was offered to all children of the respective school level; the only inclusion criterion was the consensus of the parents. If evidence of postural weakness and motor deficiency was found, relevant children were invited to voluntary posture gymnastics.

The clinical postural examination consisted of two parameters: a static postural and a following dynamical assessment. The test

items have been rated with a simple point system (0 = no pathological findings, 1 = pathological findings). In the posture analysis section (5 items), cervical, thoracic and lumbar spine were looked at for abnormalities (symmetry and shape), shoulders were examined for elevated shoulders and winged scapula, any pelvic obliquity, and knee or foot anomalies. In the motor-functional section (6 items), the child had to jump 7 m on one foot, perform a 7 m hands-walk in a push up position while the investigator was holding the child's legs, sit on the heels, bending the upper body towards the knees as well as to demonstrate hamstrings flexibility, strength of the upper body (Matthiass posture test) and if the body weight was distributed equally on both feet. From the findings of both sections, two sum scores and a total score of all conspicuities were evaluated.

Statistical analyses were performed using SPSS (version 17) and non-parametric McNemar-test and Mann-Whitney-U-test, drawn at significant level of  $p < 0.05$ .

**Results**

The actual prevalence of endangered posture among primary school children in Liechtenstein was extensive (Table 1). Many children already in 1<sup>st</sup> class showed spinal or functional-muscular conspicuities. Furthermore posture deficits hardly occurred isolated; the majority of the 1<sup>st</sup> and 3<sup>rd</sup> grades (2008: 55%; 2010: 66.5 %) showed a combination of static postural and functional-muscular imbalances. From the preliminary enquiry in 2008 to the follow-up observation in 2010, the pathological findings increased significantly in the area of the cervical spine, the lumbar spine, and of the forward bent heel sitting position. However, in the jumping task a significant improvement in both sexes could be detected. While boys showed increased spinal abnormalities, girls in 3<sup>rd</sup> grade showed more functional weaknesses.

During the two examination periods (Figure 1), on average each 5<sup>th</sup> child was referred to postural gymnastics. While there were no differences in boys and girls in 1<sup>st</sup> grade (2008), in 3<sup>rd</sup> grade (2010) there was a significant increase within the girls and a significant decrease within the boys. The participation percentage in postural gymnastics overall was disappointing: only 45.5% of all recommended 1<sup>st</sup> grades children really took part in this optional and free remedial education. In the follow-up examination 2010, 11.7% of all observed children were new referrals, 9.8% were recommended to continue with postural gymnastics and for 11.2% of the children no further participation was necessary.

A point of central interest in this study was whether there was a difference in the examination results in 3<sup>rd</sup> grade between children who took part in postural gymnastics in 2<sup>nd</sup> grade or not. According to our findings (Table 2), the remedial postural gymnastics lesson at least led to a small improvement of the children's static posture. Children who did not take part in postural gymnastics, were significantly worse in the static postural assessment ( $p < 0.05$ ) than those who did.

**Discussion**

According to other studies (Dordel et al., 2005; Prätorius and Milani, 2004), the findings from the current survey are a cause of concern. Postural deviations and musculo-functional deficits were not isolated occurrences and already each 5<sup>th</sup> pupil in primary school was referred to special posture gymnastics. Furthermore, during the two examination periods a significant postural decline from 1<sup>st</sup> to 3<sup>rd</sup> grade could be detected. Focussing on the single test-items, boys in 3<sup>rd</sup> grade achieved better results in the functional assessment than girls. This finding must be regarded in the context of children's development as well as their involvement in sport. Changes in body proportions and growth as well as the level of physical activity in daily routine can influence the motor fitness and postural performance (Sygusch et al., 2003; Winter and Hartmann, 2007). Girls are more likely to start their growth spurt

and puberty earlier than boys (Buyken et al., 2009) and the boys in this study may have had a higher participation in sports, which could be an explanation for possible gender differences. Other studies concluded that not all postural alterations in school-aged children are caused by an unhealthy or not-optimal lifestyle, but that some postural alterations occur during normal development and disappear during the children's growth (Onodera et al., 2008; Penha et al., 2005).

Only 45.5% of all recommended 1<sup>st</sup> grade children really took part in the voluntary postural gymnastics class. It is necessary to analyse why this percentage was so low. Studies report a wide variety of reasons one of which is that parental involvement in schools generally is somewhat restricted, e.g. because of limited transportation opportunities, negative attitudes towards schools or school activities in general, unmatched expectations from both

Diagnosis	1 <sup>st</sup> grade 2008 (N=367)		3 <sup>rd</sup> grade 2010 (N=367)	
	girls	boys	girls	boys
<b>Static postural assessment</b>				
cervical spine	18.9	22.4	31.4**	40.1***
winged scapula	7.4	9.4	6.9	10.9
thoracic spine	21.7	28.6	25.1	21.4
lumbar spine	38.9	33.3	47.4	45.3**
knee/feet anomalies	22.9	17.7	20.6	16.1
<b>Dynamic-functional assessment</b>				
Forward bent heel sitting	36.0	31.3	49.7**	31.8
Hamstring flexibility	13.2	42.2	22.3*	43.8
Matthiass posture test	36.0	45.3	46.9*	37.5
Weight distribution	13.7	21.9	13.1	16.7
Jumping	32.6	43.2	22.9*	27.6**
Wheelbarrow walking	31.4	38.0	37.1	30.9

Table 1: Prevalence of detected static and muscular misbalances (%) 2008 and 2010. Significant differences between 3<sup>rd</sup> and 1<sup>st</sup> grade, McNemar-Test: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

	Postural gymnastics programme in 2 <sup>nd</sup> grade		
	Group 1: Taken part	Group 2: Not taken part	Group 3: Not neces- sary
3 <sup>rd</sup> grade 2010			
Static postural assessment	1.5 ± 1.1	2.2 ± 1.5*	1.2 ± 1.2
Dynamic-functional assessment	3.2 ± 1.3	3.4 ± 1.3	2.4 ± 1.2***
<b>Total score</b>	<b>4.7 ± 2.1</b>	<b>5.6 ± 2.4</b>	<b>3.5 ± 2.0**</b>

Table 2: Comparison of sum scores (mean ± SD) of children with or without postural gymnastics. Significant differences between group 1 and other groups, Mann-Whitney-U-Test: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

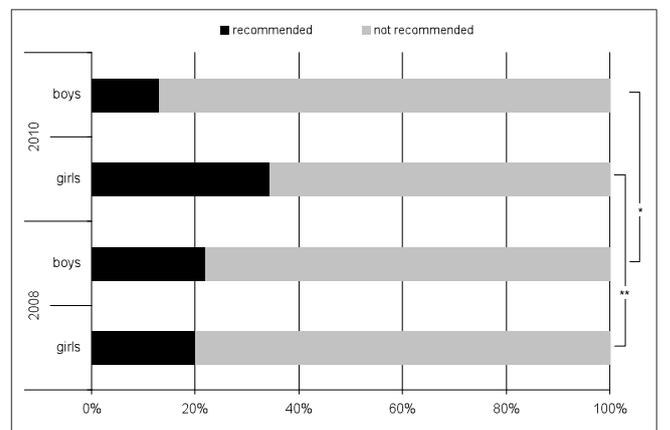


Figure 1: Proportion of children with recommended posture gymnastics 2008 and 2010. Significant differences, McNemar-Test: \*  $p < 0.05$ , \*\*  $p < 0.01$ .

sides and social and cultural differences (Garcia et al., 2010; Knöpfli et al., 2007). Additionally, in relation to the postural examination in particular, by experience, teachers' involvement, support and cooperation play an important part. Therefore, it would be interesting to evaluate the parents' and teachers' opinion towards the postural examination and the voluntary postural gymnastics class. Within the framework of this investigation, a critical inspection of the practical implementation of today's postural gymnastics class would be useful regarding the rather low impact shown in the results of the children's posture and musculo-functional abilities. Moreover, within the academic setting, an evaluation of the physical education is desirable.

Based on the complexity and connection of different parameters of body posture (e.g. growth, muscular system, neural processes and psychological factors), static posture analysis examinations done as in this screening as a snap-reading method, have their limitations (Ludwig et al., 2003). To conduct objective and reproducible measurements, time-consuming and technical methods are needed (Ludwig and Schmitt, 2006). Due to the fact that in the academic context the availability of time for screenings is usually short and has to be cost effective, the use of complex, expensive and time-consuming assessments is not practicable (Dordel, 2007; Pommier et al., 2009). But these test procedures or used items (i.e. Matthiass-test) often depend on the subjective assessment and qualification of the assessor. A photographic respectively video based assessment is needed to objectify posture assessments, and a following computer-aided metric analysis is recommended (Dordel et al., 2005; Ludwig and Schmitt, 2006). For 2 years, the static posture and musculo-functional assessment in Liechtenstein has been done by the same two physiotherapists. Therefore an appropriate level of expert knowledge can be assumed. According to the present results, 40.9% (1<sup>st</sup> grade) and 42% (3<sup>rd</sup> grade) of the assessed children have postural weaknesses. Other studies also using the Matthiass-test (slightly different objectivity rate taken) show postural weaknesses between 40 to 55% (Dordel et al., 2005).

Although the screening-tool used in Liechtenstein has been used for a few years, some items of the musculo-functional section are questionable because they were not done in an internationally standardised way or seem to be physically disputable (e.g. wheelbarrow walking). According to Watson and McDooncha (2000), "a reliable posture rating scale with unambiguous criteria used to define each deviation is required so that: a) the incidence of posture deviations can be compared internationally, b) a practical and effective assessment tool is available for screening populations and c) the relationship between posture and ill-health may be examined." Taking these aspects into account, a modification of the existing test items and examination sheet is suggested. Today's variety of investigation methods and focussed age groups complicates the comparison of studies within Liechtenstein and internationally. In addition, no standardised measures to grade posture exist (Dordel, 2007; Wydra, 2004).

## Conclusions

This national postural screening in primary schools offers useful information about the health status of our children and represents an essential opportunity for early recognition and prevention of possible postural misbalances. Based on our analysis two proposals for improvement can be derived: apart from modifying the existing survey instrument the general acceptance of voluntary postural gymnastics should be enhanced. To achieve this, not only an attractive setting is required but also a stronger sensibility and cooperation of all the players involved.

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