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# SCREENING THE ASSYMETRIES OF THE UPRIGHT POSTURE, IN BOYS AGED 13-16 WHO PARTICIPATE IN FOOTBALL ACADEMY USING THE POSTURE SCREEN MOBILE (PSM) APPLICATION. THE REPORTED BACK PAIN AND RELATION WITH WEIGHT, PLACEMENT OF THE SCHOOL BAG AND WRONG SEATED POSITION

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**ABSTRACT**

**Introduction:** Standing attitude is a habit, which is cultivated during childhood in relation to the way of life. (1) The "Posture" is the position of the members of the body between them is defined. The correct posture of the body is the position where the joints receive the minimum tension (2). Adopting a correct posture reduce the malfunctions (eg, back pain) as well as fatigue (3). **Purpose:** This research study aims to investigate postural asymmetries using the Posture Screen Mobile (PSM) application as well as the back pain reported by children and the relation with weight and positioning of the backpack. **Subject:** Our study included 30 children, boys, aged 13 to 16 years who participate in a football academy sessions, three times per week with a duration of training one hour. Without recent injuries, chronic disease and musculoskeletal problems that may be the cause of asymmetry of the body .The sample selection was non-randomized. **Results:** The results of the study showed that 1/3 (23.3%) of children reported signs of back pain with a frequency of pain twice a month. We notice that as the weight of the school bag increasing, there are also increases the deformities observed in the upright attitude with the use of the application (PSM). Moreover, children who have the habit of holding the school bag on one shoulder are more varied. **Conclusion:** Posture Screen Mobile (PSM) application results that there are differences in translations and angulation in the standing posture that are directly related to the reported back pain with strong indications that the factors that affect the weight of the school bag is significant, as well as its placement. Although no statistically significant differences ($p > 0.05$)



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## INTRODUCTION

Good body posture tends to reduce the malfunctions (eg, back pain) as well as the appearance of fatigue and pain. The most common cause of wrong body posture is the habit of adopting the wrong body posture (3). The need to adapt the weight of the school bag to the physical weight of the students was first observed in Greece over the last decade , while the world's first references to the issue were made in the late 1990s (4). In a survey of the Hellenic Pediatric Society in 2007 it was recorded that students carry bags of a daily weight that exceed the permissible weight limit, equivalent to 10% of their body weight (5).

Hong et al, in a 2003 survey, report that when the weight of the school bag is over 15% of body weight, wearing the school bag on the two shoulders, there is an increase in the anterior gradient of the trunk. (6) Also, in another study by Chansirinukor et al, it is observed that when the child is standing, the heavy burden affects and modifies the correct posture (7). According to the results of the Hong et al 2011 study, greater movement was observed in the spine during equilibrium in the standing posture, as when the children were holding the bag on one shoulder, body asymmetry appeared in transport and movement (8). The result of this is the creation of imbalances and asymmetries in the spine. According to the survey, primary school pupils carry bags weighing between 4

and 7 kilos. In 2004, Korovesis et al., in an effort to find out whether there is a correlation between the weight of the school bag and back pain in 4225 Achaia students. They found out that the weight of the bag corresponded to 9.6% of their body weight, the students did not experience pain in the specific parts of the body (9). Similar results were obtained from the above researchers and in 2005 1263 students. The weight of the school bag was 10.6% and the students did not complain about dorsal or lumbar pain. Despite the results of the research done by the Hellenic Pediatric Society, Korovesis and his colleagues disagree about the percentage weight of the school bag. However, the results of the above investigations are consistent with those stating that weight percent of up to 10% of the pupil's body weight does not cause pain to students. (10, 11) It is clear that further research is needed regarding the weight of the school bag to Greek students and the extent to which it affects the balance of the spine and other physiological mechanisms. Incorrect posture is commonly seen in children between 30% and 40% of school children worldwide, resulting in a change in posture. (12,13,14). Compared to previous generations, studies show that the number of children with the wrong posture is constantly increasing. (15)

**Purpose:** The purpose of this research study is to investigate the asymmetries of the standing posture of children using the Posture Screen Mobile (PSM) application as well as the correlation between the reported back pain in relation to the weight and positioning of the backpack and adoption wrong sitting position.

**Subject:** The survey was conducted at the football academy of Panachaiki in Patras city of Greece. The survey lasted from October 2018 to May 2019. The survey involved 30 children, boys. The health condition is considered to be very good without injury. The ages of individuals ranged from 13 to 16 years, with an average age of 14.2 years, an average weight of 56.57 kg. The height is from 1.45 m to 1.86 m with an average height of 1m, 64 meters almost equal to the median height (1.65 meters). Finally, their BMI is in normal range with a mean BMI of approximately 21 and a standard deviation of 2.56. They participate on a fixed and permanent basis in football academy trainings three times a week for one hour each training session.

**Table 1. Placement and dispersion measures for age, weight, height and BMI**

| | N | Medium | Standard Deviation | Median Price | Minimum Value | Maximum Value |
|---|---|---|---|---|---|---|
| Age(years) | 30 | 14,2 | 1,16 | 14 | 13 | 16 |
| Weight (Kg) | 30 | 56,57 | 10,24 | 59,3 | 34,6 | 73,8 |
| Height (m) | 30 | 1,64 | 0,10 | 1,65 | 1,45 | 1,86 |
| BMI | 30 | 20,98 | 2,56 | 21,7 | 16,46 | 26,46 |

The data were collected from the review of children's assessment through general upright observation and the collection of questionnaires by parents, including epidemiological data (age, sex, weight, height, BMI). Limiting factors in research that are important in the results of measurements in which no statistically significant differences are found are the fact that they regularly training and have no musculoskeletal problems. For more reliable results, it may be necessary for the study to use a larger sample as well as in a population of the same age but without training activity.

**Statistical Analysis:** Methods of descriptive statistics for positioning and spreading of all the variables of our study were applied. Then the relations between the variables recorded with the Posture screen, among them but also with the demographic characteristics of the other two questionnaires were selected, with statistical methods of correlation but also comparison of average values and fluctuation analysis. All the conditions for the application of the statistical tests (regularity of distributions, dispersion equality, etc.) were checked and in case the regularity of the variables was not met in the whole or per group, the variable was converted to a logarithmic scale in order to implement parametric methods of analysis data. Also, due to the size of the sample and due to the uneven distribution of variables, resampling for 10,000 identical samples using the Bootstrap method was used to avoid bias of the results. All statistical tests were performed with the IBM SPSS Statistics ver. 24 and the statistical significance limit for case tests was $p = 0.05$.

## RESULTS

The differences in the variations in the percentage of reported back pain from the children, the weight and the way the backpack is placed. In the Table 2 below we observe the percentage of reported back pain from the children recorded during the general observation and evaluation by the researcher. We found that 1/3 (23.3%) of children said they sometimes mention back pain. Four of them reported back pain and three reported headaches one or two times a month.

**Table 2. Frequencies and percentages for body posture, chest shape, pain and dyspnea**

| | n | % |
|---|---|---|
| General observation: Uprightposture: | | |
| Left shoulder higher | 11 | 36,7 |
| Left shoulder higher – scapular vertical abduction | 8 | 26,7 |
| Right shoulder higher- scapular vertical abduction | 7 | 23,3 |
| Anterior bending of shoulders | 1 | 3,3 |
| Chest shape | | |
| Normal | 30 | 100 |
| Diagnostic Symptoms | | |
| Back pain | 7 | 23,3 |
| Lower back pain | 2 | 6,7 |
| Headache | 3 | 10,0 |
| Dyspnea | | |
| None | 30 | 100 |

Then asked questions about the school bag about how they hold it, on one or both shoulders, where from the answers we see that half the children (53.3%) usually hold it on one shoulder as well as half the children do not fits well in the back leaving gaps. Usually (90%) has wide belts. Also the weight of the school bag along with the books ranges from 3 to 10 kilos with the most weight (53.3%) between 5 and 6 kilos. It is also characteristic that ½ children hold a school bag that exceeds 10% of their body weight (Table 3).

In the table below we observe the differences in total movements and deviations in relation to the weight of the school bag together with the books of the 30 children who participated in our study. From the observation of the results we find that there are differences in movements and deviations but they are not statistically significant ($p > 0.05$). In particular, on the shoulders of children, we also see differences in movements and differences in weight of the school bag that are not statistically significant ($p > 0.05$) (Table 4 & 5).

**Table 3. Frequencies and percentages related to the school bag**

| | n | % |
|---|---|---|
| Used to carry the school bag on opne shoulder? | | |
| No | 14 | 46,7 |
| Yes | 16 | 53,3 |
| The school bag has widereinforced straps? | | |
| No | 3 | 10,0 |
| Yes | 27 | 90,0 |
| | n | % |
| The school bag fits well without any gaps? | | |
| No | 15 | 50,0 |
| Yes | 15 | 50,0 |
| How many kg is the bag with the books? | | |
| 3 - 4 Kg | 6 | 20,0 |
| 5 - 6 Kg | 16 | 53,3 |
| 7 - 10 Kg | 8 | 26,7 |
| Weight bag and body weight. | | |
| Under 10% of body weight | 16 | 53,3 |
| Over 10% of body weight | 14 | 46,7 |

**Table 4. Comparison of total movements and discrepancies in the weight of the school bag**

| | Πόσα κιλά ζυγίζει η σχολική τσάντα μαζί με τα βιβλία; | | | | |
|---|---|---|---|---|---|
| | 3 - 4 Kg n = 6 | 5 - 6 Kg n = 15 | 7 - 10 Kg n = 8 | | |
| | Mean (SD) | Mean (SD) | Mean (SD) | F | p |
| Total Anterior Tranlations | 0,017 (0,014) | 0,115 (0,364) | 0,021 (0,01) | 0,464 | 0,633 |
| Total Anterior Angulations | 5,467 (2,393) | 7,25 (4,493) | 5,975 (2,956) | 0,603 | 0,555 |
| Total Right Lateral Tranlations | 0,068 (0,033) | 0,361 (1,136) | 0,07 (0,021) | 0,444 | 0,646 |
| Total Right Lateral Angulations | 19,233 (7,46) | 32,281 (26,778) | 22,775 (7,629) | 1,121 | 0,341 |
| Total Posterior Tranlations | 0,152 (0,225) | 0,146 (0,42) | 0,058 (0,043) | 0,222 | 0,803 |
| Total Posterior Angulations | 239,717 (133,946) | 152,075 (72,149) | 195,15 (84,406) | 2,213 | 0,129 |
| Total Left Lateral Tranlations | 0,085 (0,034) | 0,428 (1,173) | 0,093 (0,024) | 0,561 | 0,577 |
| Total Left Lateral Angulations | 27,383 (11,542) | 38,713 (32,71) | 30,813 (11,295) | 0,533 | 0,593 |

**Table 5. Comparison of movements and deviations of the shoulders relative to the weight of the school bag**

| | Πόσα κιλά ζυγίζει η σχολική τσάντα μαζί με τα βιβλία; | | | | |
|---|---|---|---|---|---|
| | 3 - 4 Kg n = 6 | 5 - 6 Kg n = 15 | 7 - 10 Kg n = 8 | | |
| | Mean (SD) | Mean (SD) | Mean (SD) | F | p |
| Shoulder Anterior Tranlations | 0,005 (0,008) | 0,013 (0,025) | 0,005 (0,005) | 0,599 | 0,557 |
| Shoulder Anterior Angulations | 1,967 (1,66) | 1,753 (1,081) | 1,325 (0,853) | 0,584 | 0,565 |
| Shoulder Right Lateral Tranlations | 0,018 (0,026) | 0,126 (0,422) | 0,019 (0,01) | 0,436 | 0,651 |
| Shoulder Right Lateral Angulation | 3,068 (4,295) | 2,841 (1,929) | 3,235 (1,267) | 0,071 | 0,932 |
| Shoulder Posterior Tranlations | 0,012 (0,019) | 0,013 (0,036) | 0,006 (0,005) | 0,146 | 0,865 |
| Shoulder Posterior Angulations | 1,35 (1,286) | 0,9 (0,824) | 1,425 (1,13) | 0,866 | 0,433 |
| Shoulder Left Lateral Tranlations | 0,012 (0,015) | 0,107 (0,352) | 0,018 (0,01) | 0,462 | 0,635 |
| Shoulder Left Lateral Angulations | 1,99 (2,452) | 2,78 (2,03) | 2,739 (1,907) | 0,33 | 0,722 |

Differences are also observed in the mean deviations and movements of the pelvic and tibial shoulder but others are not statistically significant differences (p> 0.05). In the table 6, show the comparisons of movements and deviations in relation to the weight weight of the school bag in terms of body weight.

The weight weight of the school bag in terms of body weight was divided into two categories below 10% of body weight and over 10% of the weight of children. In the first table showing the total movements and deviations, despite differences in the mean values, we observe that there are no statistically significant deviations (p> 0.05).

We notice that when the weight of the bag is over 10% of the child's body weight, the total movements forwards, laterals, right and left are slightly increased than when the weight of the bag is less than 10%. Also, comparisons made in shoulder measurements do not show statistically significant differences (p> 0.05). Average movements and mean deviations in the shoulders relative to the placement of the school bag according to the results of the table below are clearly higher in children holding the bag on one shoulder, but these differences are not statistically significant (p> 0, 05) (Table 7).

Another variable that probably affects movements and deviations is the correct implementation of the school bag. In the results for total movements and deviations in anterior position, right-hand side, posterior and left-hand side there are differences that can't be claimed statistically significant (p> 0.05), (Table 8). The effect of correct or non-application on the back of the school bag shows that there are differences in movements and deviations on the shoulders but without these differences being statistically significant (p> 0.05).

**Table 6. Comparison of total movements and deviations in relation to the weight weight of the school bag in terms of body weight**

| | Σχέση βάρους σχολικής τσάντας ως προς το σωματικό βάρος | | | |
|---|---|---|---|---|
| | >10% n = 14 | <10% n = 15 | | |
| | Mean (SD) | Mean (SD) | *t* | *p* |
| Total Anterior Tranlations | 0,113 (0,365) | 0,022 (0,01) | 0,924 | 0,363 |
| Total Anterior Angulations | 6,913 (4,349) | 6,143 (3,063) | 0,552 | 0,585 |
| Total Right Lateral Tranlations | 0,361 (1,136) | 0,07 (0,018) | 0,955 | 0,348 |
| Total Right Lateral Angulations | 30,719 (27,6) | 23,043 (6,36) | 1,015 | 0,319 |
| Total Posterior Tranlations | 0,19 (0,432) | 0,048 (0,034) | 1,225 | 0,231 |
| Total Posterior Angulations | 173,8 (104,914) | 189,421 (81,527) | -0,450 | 0,656 |
| Total Left Lateral Tranlations | 0,424 (1,174) | 0,094 (0,026) | 1,051 | 0,302 |
| Total Left Lateral Angulations | 37,469 (33,425) | 30,764 (9,647) | 0,723 | 0,476 |

**Table 7. Comparison of total movements and deviations in relation to the placement of the school bag**

| | Συνηθίζει να κρατάει την τσάντα στον έναν ώμο; | | | |
|---|---|---|---|---|
| | Όχι n = 14 | Ναι n = 16 | | |
| | Mean (SD) | Mean (SD) | *t* | *p* |
| Shoulder Anterior Tranlations | 0,005 (0,007) | 0,013 (0,025) | -1,115 | 0,275 |
| Shoulder Anterior Angulations | 1,579 (1,071) | 1,773 (1,242) | -0,451 | 0,656 |
| Shoulder Right Lateral Tranlations | 0,011 (0,01) | 0,111 (0,351) | -1,055 | 0,301 |
| Shoulder Right Lateral Angulations | 1,861 (1,885) | 3,3 (1,979) | -2,002 | 0,055 |
| Shoulder Posterior Tranlations | 0,007 (0,013) | 0,014 (0,035) | -0,684 | 0,500 |
| Shoulder Posterior Angulations | 1,079 (1,098) | 1,193 (0,954) | -0,301 | 0,766 |
| Shoulder Left Lateral Tranlations | 0,016 (0,017) | 0,128 (0,421) | -0,989 | 0,331 |
| Shoulder Left Lateral Angulations | 2,527 (2,857) | 3,435 (1,779) | -1,035 | 0,310 |

**Table 8. Comparison of total movements and discrepancies in relation to the back-to-back application of the school bag**

| | Η σχολική τσάντα εφαρμόζει στην πλάτη καλά χωρίς να αφήνει κενά | | | |
|---|---|---|---|---|
| | Όχι n = 15 | Ναι n = 15 | | |
| | Mean (SD) | Mean (SD) | *t* | *p* |
| Total Anterior Tranlations | 0,119 (0,377) | 0,021 (0,012) | 1,008 | 0,322 |
| Total Anterior Angulations | 7,433 (4,308) | 5,673 (3,013) | 1,297 | 0,205 |
| Total Right Lateral Tranlations | 0,379 (1,173) | 0,071 (0,024) | 1,019 | 0,317 |
| Total Right Lateral Angulations | 32,393 (27,843) | 21,88 (7,121) | 1,417 | 0,168 |
| Total Posterior Tranlations | 0,198 (0,445) | 0,049 (0,04) | 1,288 | 0,208 |
| Total Left Posterior Angulations | 199,773 (105,619) | 162,407 (78,689) | 1,099 | 0,281 |
| Total Left Lateral Tranlations | 0,415 (1,21) | 0,125 (0,161) | 0,922 | 0,364 |
| Total Lateral Angulations | 39,727 (33,82) | 28,953 (10,074) | 1,182 | 0,247 |

A similar picture also shows results of the table below. There are differences between the two groups but they are not statistically significant (p> 0.05), (Table 9).

**Table 9. Comparison of shoulder displacements and deviations in relation to the back of the school bag**

| | Η σχολική τσάντα εφαρμόζει στην πλάτη καλά χωρίς να αφήνει κενά | | | |
|---|---|---|---|---|
| | Όχι n = 15 | Ναι n = 15 | | |
| | Mean (SD) | Mean (SD) | *t* | *p* |
| Shoulder Anterior Tranlations | 0,011 (0,026) | 0,007 (0,007) | 0,483 | 0,633 |
| Shoulder Anterior Angulations | 1,529 (0,992) | 1,82 (1,293) | -0,677 | 0,504 |
| Shoulder Right Lateral Tranlations | 0,136 (0,436) | 0,017 (0,016) | 1,058 | 0,299 |
| Shoulder Right Lateral Angulations | 3,31 (1,861) | 2,704 (2,787) | 0,683 | 0,5 |
| Shoulder Posterior Tranlations | 0,018 (0,037) | 0,004 (0,005) | 1,421 | 0,167 |
| Shoulder Posterior Angulations | 1,221 (1,132) | 1,06 (0,912) | 0,424 | 0,675 |
| Shoulder Left Lateral Tranlations | 0,119 (0,363) | 0,01 (0,008) | 1,167 | 0,253 |
| Shoulder Left Lateral Angulations | 3,611 (2,065) | 1,666 (1,54) | 2,889 | 0,008 |

**Table 10. Comparison of movements and deviations of the shoulders relative to the seated position during the study**

| | Πώς θα περιγράφατε την καθιστή θέση του παιδιού σας κατά τη διάρκεια της μελέτης; | | | |
|---|---|---|---|---|
| | Σωστή n = 7 | Λάθος n = 23 | | |
| | Mean (SD) | Mean (SD) | *t* | *p* |
| Shoulder Anterior Tranlations | 0,004 (0,005) | 0,011 (0,021) | -0,759 | 0,454 |
| Shoulder Anterior Angulations | 1,629 (1,253) | 1,696 (1,142) | -0,132 | 0,896 |
| Shoulder Right Lateral Tranlations | 0,024 (0,021) | 0,09 (0,349) | -0,492 | 0,626 |
| Shoulder Right Lateral Angulations | 3,69 (3,642) | 2,776 (1,857) | 0,888 | 0,382 |
| Shoulder Posterior Tranlations | 0,004 (0,005) | 0,013 (0,03) | -0,722 | 0,477 |
| Shoulder Posterior Angulations | 1,5 (0,924) | 1,023 (1,027) | 1,094 | 0,284 |
| Shoulder Left Lateral Tranlations | 0,007 (0,005) | 0,081 (0,29) | -0,659 | 0,515 |
| Shoulder Left Lateral Angulations | 1,247 (0,974) | 3,037 (2,108) | -2,154 | 0,04 |

Another important factor is the right or wrong posture during the study. From the results of the table 10, we find that 23 children in the wrong place have higher deviations than the children who are in the right place during the study.

### Conclusions

The results of the study showed that there are indications that actually influence the observation of divergences and asymmetries in the standing posture such as:

1. The reported back pain, 23.3% of children reported signs of back pain 2 times a month.
2. The weight of the school bag. We notice that as the weight of the school bag grows, the discrepancies observed in the upright attitude with the use of the application (PSM) also increase.
3. The weight of the school bag, 16 children (53.3%) hold bags that exceed 10%, the weight of the bag is more than 10% of the body weight, the results of the measurements show that the total travel to the front, side, right and left are slightly increased than when the weight of the bag is below 10% of the SB. (15)
4. The habit of keeping the school bag on one shoulder is increased. The placement of the one shoulder bag in 16 children (53.3%) holds the bag exclusively on the one shoulder, it is noted that the average movements and mean deviations in the shoulders relative to the placement of the school bag according to the results of the table below are significantly higher in children holding the bag on one shoulder, but these differences are not statistically significant (p> 0.05)
5. The effect of sitting position during reading shows that 23 children (76.7%) adopt the wrong seated position during the study. There are no statistically significant differences between children who have a correct or wrong seated position during reading. But there are clear differences and far higher displacements and deviations among children in the wrong place.

## DISCUSSION

In the present study, there was a correlation between the factors responsible for the occurrence of back pain. The clumsy-wrong seated position causes extreme strains in the muscles, ligaments, intervertebral discs and joints, especially in the lumbar joints (Oyewole, Haight & Freivalds, 2010). As for the weight of the school bag, there are indications that it has a significant effect on the occurrence of higher deviations than normal. After the findings from research about the weight of the school bag, we observe discrepancies in the upright position using Posture screen mobile application. We found that 16 children (53,3%) hold bags that exceed 10% more than 10% of the body weight. When the weight of the bag is over 10% of the child's body weight, the total movements forwards, laterals, right and left are slightly increased than when the weight of the bag is less than 10%.The occurrence of spinal deformities in children has become worrying in size and predisposition for development of S.S. disorders. (Rusnák et al. 2019). Average movements and mean deviations in the shoulders relative to the placement of the school bag according to the results are clearly higher in children holding the bag on one shoulder. The habit of keeping the school bag on one shoulder is increased. The placement of the one shoulder bag in 16 children (53.3%) holds the bag exclusively on the one shoulder, The lack of movement and the long and wrong seated position contribute to the increase in the appearance of deformaties to the children (Oyewole, Haight & Freivalds, 2010, Rusnák et al. 2019). Asymmetries in standing posture are directly related to the habit of standing up. Initially, disturbances of physiological attitudes affect function, as the lack of proper help leads to permanent structural changes in the body (Mitova, 2015). One more important finding of this study is the reported back pain from 23,3% of children two times a month. Dueto the frequent occurrence of S.S. problems it is necessary to create new methods for screening standing posture, treatment and rehabilitation due to the large increase in S.S. dysfunctions, as recent reviews (Mitova.2015,Kamper et al, 2016).

### Suggestions

1. The lack of movement and the long and wrong seated position contribute to the increase in the appearance of deformatiesto the children. (16,17)
2. Dueto the frequent occurrence of S.S. problems it is necessary to create new methods for screening standing posture, treatment and rehabilitation due to the large increase in S.S. dysfunctions, as recent reviews. (18,19)
3. Asymmetries in standing posture are directly related to the habit of standing up. Initially, disturbances of physiological attitudes affect function, as the lack of

proper help leads to permanent structural changes in the body (18)

**Suggestions**

- Early control of the attitude of the child's body is critical to prevent the occurrence of musculoskeletal problems that will develop and possibly remain in adulthood. (20,21,22)
- Using the Posture screen Mobile (PSM) application (23,24,25) is an easy way to have a reliable standing-up analysis that is easily implemented by a Physiotherapist without requiring specialized training to use that application
- Equally important is to give instructions on how to educate a good standing and sitting position during the reading, the weight of the school bag and the right way to wear the school bag.

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