# POSTURAL VALUATION IN CHILDREN AND ADOLESCENTS: POSTURE CLASSIFICATION

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## ABSTRACT

***Introduction***
*As well known, to this day, the figure of school doctor is absent and much less physical activity is carried out in primary schools. For this reason, the Italian National Fair Play Committee, a meritorious association legally recognized, founded in 1994, in full synergy with Sport and Health, with CONI, Federations and Sports Promotion Bodies, aware of its vocational role, since 2010 had proceeded to establish "Medici Fair Play", as a not just conceptual defense, to integrate the precious action carried out by sports medicine with the verification of suitability for the practice.*

***Aim of the study***
*Through a screening project focused on postural problems, named "IOCHIRON, POSTURE IS HEALTH", we prepared a real cornerstone for health prevention and for charitable and useful purposes for the Higher Institute of Health. The initiative provides for a national screening activity in the three-year period 2022-2024, through an assessment with non-invasive tests, to study the structural level posture of over 7 million children and adolescents. This educational path aims to prevent wrong postures in children and adolescents, between 6 and 15 years of age, who are at the peak of growth, with a huge benefit on possible pathologies that could be found when adult, thus saving high costs to the SSN (or NHS).*

***Methods***
*The presented observational study represents the first experience carried out by the CeFiRR Structure (Center for Physiotherapy, Rehabilitation and Rehabilitation) at Gemelli Molise S.p.A. 120 school-age subjects were evaluated through a BioPostural questionnaire and an observational form which provided for the evaluation of the asymmetries of: shoulders, scapula, pelvis, knees, hindfoot, trunk rotation (through a scoliosometer), posterior overhang (through the plumb line) and the plantar vault (through static barodopometry).The outcome measures were calculated on the basis of the number of "YES" responses of the BioPostural questionnaire, and on the basis of the number of "YES" evaluations of the observational form.From the interdisciplinary communication and the interpretation of the outcome measures, Posture was classified the in: Asymmetrical, Dysfunctional and Pathological.*

***Results***
*The 42% of the examined subjects presented a shoulder asymmetry (bisacromial line) and a pelvis asymmetry (bisiliac line); the 33% presented a scapulae asymmetry (lower angle of the scapula); and the 9% of the examined subjects presented a flattening of the plantar vault.The BioPostural Questionnaire reflected what was subsequently observed with the observational form and in particular for the number of affirmative answers recorded, it did not suggest further insights into any subject through a Digitalized Biometric analysis, but it highlighted an important number of subjects in the sample who reported: low back pain (85), neck-pain while studying or reading (68).*

***Conclusions***
*The retrospective observational study showed the possibility of observing the adolescent subject in a very short time and with inexpensive instruments (e.g. plumb bob, Bunner's scoliometer, and stabulometric platform) with the collaboration of various health professionals.This experience allowed us to create a classification, in three degrees, of posture which encloses the objective and subjective characteristics of the subject evaluated for a better interpretation of the data, at a territorial and multi-specialist level.*
*The points of weaknesses of the study are represented by the exiguity of the sample examined, and by the difficulty in exposing and finalizing the data collected at a multidisciplinary level, in a field that is still not so much known.For future experiences, it would be necessary to increase the number of subjects examined and standardize the finalization of the data so that they can be ready for use and vision by a greater number of health professionals and medical specialists.*

## INTRODUCTION

In 2017 Ministerial Guidelines recognised the posture as a disease who needs to be identified since childhood. Posture is the result of three fundamental aspects: anatomical-mechanical aspect, neurophysiological and psychophysiological ones. Posture is the expression of perfect neurological functionality capable of reacting to proprioceptive stresses quickly finding homeostasis, maintaining balance, both in static and dynamic conditions. Posture was defined as a medullary reflex manifestation of phenomena of spinal convergence and facilitation secondary to Cortical expressiveness (Barassi et al., 2021).

In Italy about 2 million 130 thousand children and adolescents aged 3-17 are overweight, and almost 2 million do not practice any sport or physical activity. This condition changes the entire posture with breathing difficulties, joint problems, reduced mobility, and digestive and psychological disorders, including bullying. Physical inactivity and a sedentary lifestyle from the use of tablet, laptop and video games, is fertile ground for the onset of chronic diseases in adulthood, which get worse by the consumption of smoking and alcohol in adolescent age. Current levels of physical inactivity heavily weigh on the health system and translate into annual economic costs of over 12.1 billion euros, equivalent to 8.9% of Italian health expense. These are even more worrying data on the lack of movement in adolescents, since 92% of thirteen-year-olds do not reach the recommended levels (Spina, G., 2021).

In a study of 2013, has been analyzed an initial sample of 200 pediatric patients, between 7 and 18 years, and from these data was revealed that 64% of guys between 11 and 18 yeas admits to suffer of backache but, in the 90% of cases they never talked about it with anyone. Furthermore, the 72% of the youngest - between 7 and 10 years old - admits to experiencing or having experienced this type of pain. The causes of back pain in children are manageable with physical and drug therapies (Webb, H., 2014).

The high prevalence of low back pain (LBP) in children and adolescents has already been demonstrated in several older epidemiological studies (Pellisé, F., 2009). According to the literature, the lifetime prevalence of LBP in children and adolescents ranges from 9% to 69%. The prevalence of LPB increases considerably between the age of 12 and 18 (Kovacs, F.M., 2003).

Therefore, to prevent low back pain, is necessary to: adopt a correct posture, maintain good core muscle strength, flexibility and aerobic conditioning, regularly train the body while limiting sedentary lifestyle, avoid frequent use of heavy backpacks, and always wear both backpack straps to better distribute weight in a uniform way. Correct posture management implies proper breathing, to avoid diaphragmatic, lingual and mandibular muscles limits which are reflected on the vertebral column. The evaluation of the posture of children and adolescents may involve the participation of an ophthalmologist, a dentist for the receptor insights, as well as the support of the dietician for endocrinological aspects.

The Gemelli Molise experience made use of the collaboration of Physiatrists, Physiotherapists, Podiatrists and Orthopedic technicians. The analysis of the examined sample made it possible to alert the specialists concerned in the area for the prevention and treatment of the spine in pediatric age. Moreover, this interdisciplinary exchange experience allowed us to create a classification of postural asymmetries, useful for the specialist doctor.

## MATERIALS AND METHODS

The observational study was carried out in June 2022 at the CeFiRR. Gemelli Molise and at the "Mario Pagano" boarding school in Campobasso and examined a total of 120 subjects with an average age equal to 13 years (St. Dev; 1.4) of which 62% male and 38% female.

For the screening, a Biopostural Questionnaire (QBP) was used, compiled by the parent or adolescent himself, which stores the epidemiological data for the purposes of national statistics. Two models were used: one for children (6-13 years), and one for adolescents (14-18 years). An example is shown in Figure 1.

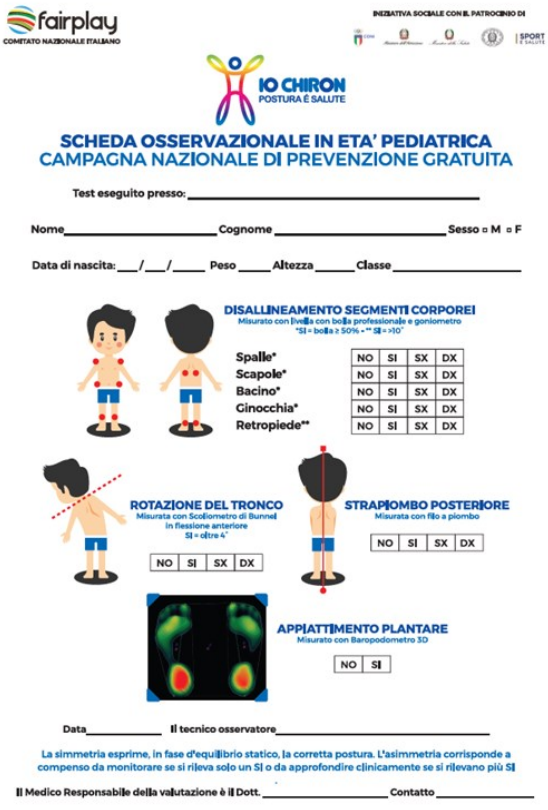


**Figure 1.** *Example of the observational sheet in pediatric age*

The study was committed to rehabilitation, prevention and orthopedic technique operators who

perform a free structural check-up in schools or sport centers using an observational sheet (Fig. 1) that allowed to measure in 5 minutes whether there were body asymmetries (YES or NO) from the shoulders to the feet.
The detected number of "YES" suggested a detailed medical study; in particular, if the result had a number of “Yes” higher than five they had a “dysfunctional” posture diagnosis, while if the result was lower than five “Yes” it was an “asymmetrical” posture diagnosis.

### *Importance of the diagnosis of the type of posture deficit*

**First grade: asymmetric posture**. It gives, in most cases, asymptomatic structural deficit, one of the most widespread problems. This because, not having the population right information and knowledge about, it is neglected and underestimated. Actually, nowadays is possible to prevent it in order to avoid aggravation of the physical and emotional individual condition.
**Second grade: dysfunctional posture**. This is the stage in which mainly occurs fatigue of the central nervous system, reduction of antigravity responses with structural asymmetries above three degrees, alteration of body balance, high energy waste, contractures, inflammation, stiffening, motor difficulties and dysfunctions of a receptor.
**Third grade: pathological posture**. This is the stage with a more complex clinical picture and with more symptoms, including tinnitus, dizziness, low vision, neck pain, low back pain, gonalgia, talalgia, metatarsalgia, tendonitis, breathing difficulties, gastrointestinal disorders, excessive energy expenditure, poor circulation in the lower limbs, unstable body balance with possible risk of falling, relapsing headaches and sleep disturbances, also caused by psycho-emotional stress, respiratory problems and tachycardia (Laouissat F., 2018).
From the study carried out on this sample of 120 adolescents, only 14 subjects (11.6%) found a number of "YES" higher than 5, falling into the category of dysfunctional posture. Of these 14 subjects, in relation to the Biopostural Questionnaire, 5 had a positive response as regards having done or are still doing orthodontics and 9 as regards assuming incorrect positions while writing or reading.
Simple and inexpensive tools were used for the work, such as a scoliometer and a plumb bob.
The support technology was represented by a stabilometric platform for the evaluation of plantar support (Diasu Health Technologies-Rome-Italy).
Subsequently, with these available data and with this new form of communication, the deepening of the data was entrusted to the general practitioner (GP), or free choice pediatrician (PLS), who can decide the patient's access to a second level specialist check-up carried out by Orthopedic, Physiatrist, Neurologist, Sports Doctor potentially trained in clinical posturology and who through 3D instrumental diagnostics (digitalized biometry) are supported in defining the exact diagnostic orientation.
Network of experts from various medical and health disciplines, have collaborated for the promotion towards the public, institutions and colleagues and it has been possible to implement information and awareness actions on prevention that derives from correct lifestyles towards families, in the classroom, in sports clubs, in society and on the territory.
Furthermore, it was possible to promote sport as a pillar of well-being in the pediatric age, as a culture of prevention and good health.
For territorial communication, the Specialist Doctor has become necessary to frame and classify the Posture from a Clinical Point of View. (Pausić J., 2011) (Rosário JL., 2014).

## RESULTS

Collected data were analyzed using Excel software (Microsoft, Redmond, WA, USA).

| | DISALLINEAMENTO SEGMENTI CORPOREI 120 SOGGETTI ESAMINATI | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SPALLE | SCAPOLE | BACINO | GINOCCHIA | RETROPIEDE | ROTAZIONE DEL TRONCO | STRAPIOMBO POSTERIORE | APPIATTIMENTO PLANTARE |
| NUMERO valutazioni "SI" | 50 | 40 | 50 | 24 | 26 | 19 | 30 | 11 |
| NUMERO valutazioni "NO" | 70 | 80 | 96 | 94 | 101 | 90 | 109 | 109 |

**Table 1.** *Misalignment of body segments data.*

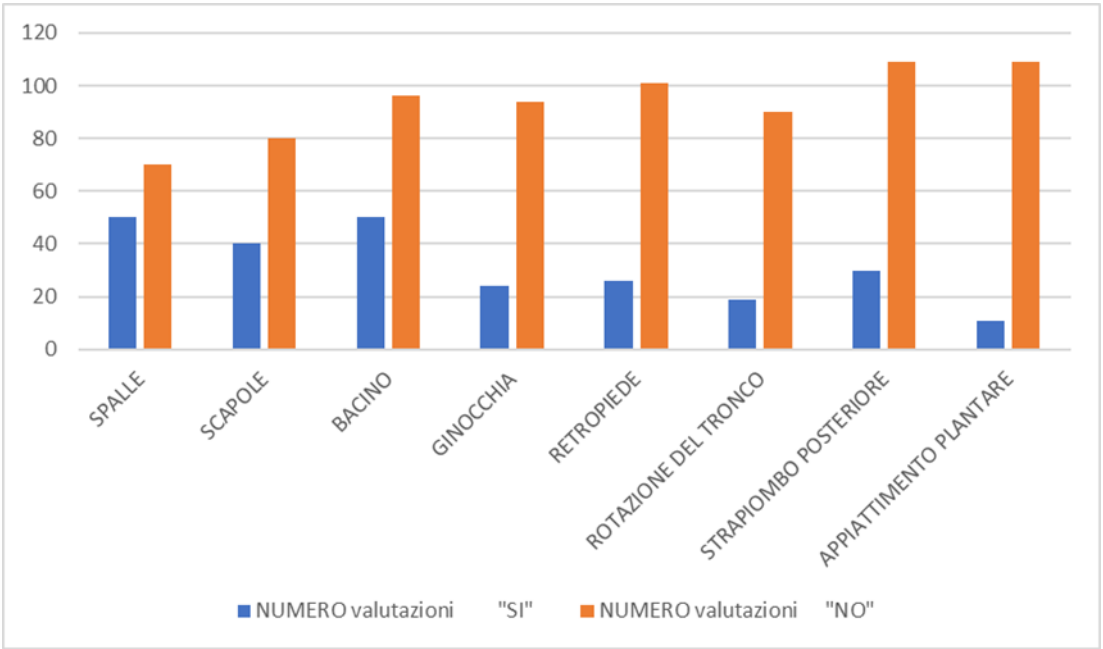


**Figure 2.** *Valuation of Observed Misalignments*

Using the instrument of the observational form, the states of asymmetry of the bisacromial line (50 subjects) of the bisiliac line (50 subjects), a posterior overhang in 30 subjects and a plantar flattening in 11 boys were highlighted.

The results allow us to state that the most important alterations of the subjects examined were the asymmetries of the bisacromial line and of the bisiliac line in 42% of the cases, the asymmetry of the scapulae in 33% of the cases, in 22% of the cases a misalignment of the hindfoot, in 24% of the cases there was a significant alteration in the evaluation of the posterior overhang and 9% of the examined presented a flattening of the plantar vault.

The clinical relevance of these asymmetries and/or dysfunctions has been associated with low back pain in adolescents, corroborating the results of previous studies conducted around the world (Trevelyan, F., C.2011).

Indeed, this situation can give emotional symptoms which is common among young students, which can be triggered by the moment lived, by the pressure in the school atmosphere, by economic difficulties and by food and/or relationship problems. As a matter of fact, it seems to be an association between emotional symptoms and physical manifestations, such as increased cortisol secretion and changes in hormonal regulation of the adrenal glands, which generates inhibitory effects on the immune response, digestion and symptoms of excessive body wear, tiredness, fatigue, muscle aches, joint disorders and reduced physical capacity.

In our little experience it became clear that the (targeted) anamnesis and the interview have a fundamental value, both in prevention and obviously in treatment of this disease and observational data allowed us to identify a significant amount of body misalignments (Figure 3).

The questionnaire was therefore an important tool for correlating the clinical condition of the subject with respect of a certain anamnestic causality.

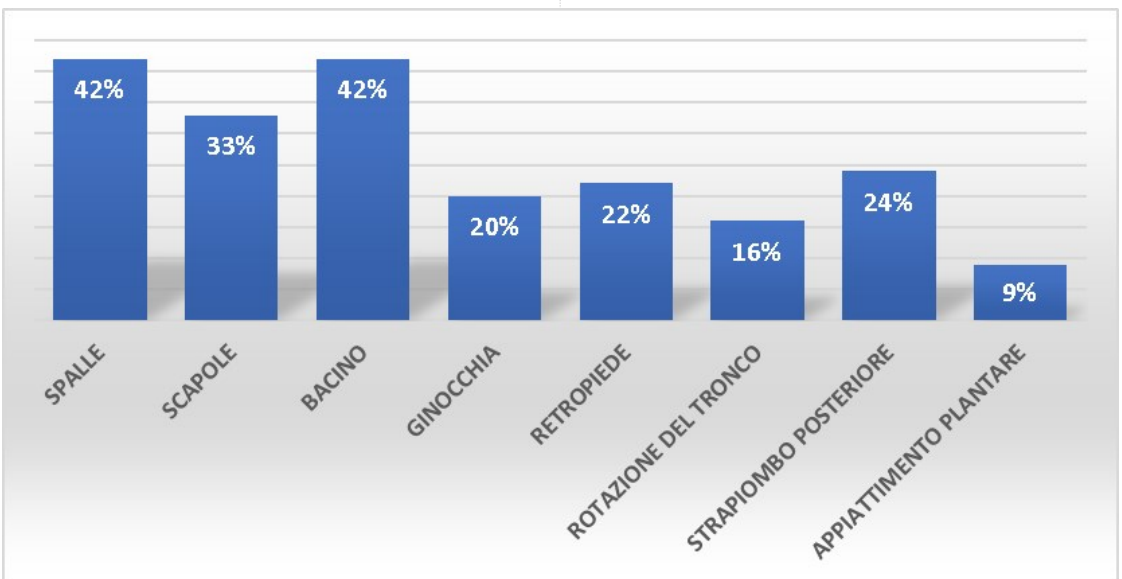


**Figure 3.** *Positive percentages of observed misalignments*

| **BioPostural Questionnaire** | |
|---|---|
| | **Number of "YES"** |
| Does he/she have one shoulder higher than the other? | 95 |
| Does he/she report back pain? | 85 |
| Does he/she report neck pain when studying? | 68 |
| Does he/she report leg pain when standing? | 34 |
| Does he/she report knee pain after sitting for a long time? | 45 |
| Does he/she report heel pain? | 15 |
| Has he/she ever been diagnosed with flatfoot? | 2 |
| Does he/she have internal knee-touching? | 3 |
| Has he/she ever been diagnosed with a leg shorter than the other? | 2 |
| Does he/she take an incorrect posture while reading or writing? | 85 |
| Does he/she constantly keep his/her head tilted to one side? | 64 |
| Does he/she report frequent severe headaches? | 35 |
| Does he/she have ever felt a click in his/her jaw? | 10 |
| Have you ever heard if he/she grinds his teeth during the day or night? | 25 |
| Does he/she complain of muscle pains in his/her cheeks when he/she wakes up? | 12 |
| Has he/she done or is doing orthodontics? | 52 |
| Does he/she complain of hearing rustles inside the ear? | 1 |
| Does he/she started walking after 20 months? | 1 |
| Does he/she have troubles when reading fonts? | 1 |
| Does he/she wear eyeglasses? | 45 |
| Has he/she ever practiced postural gymnastics? | 52 |
| Does he/she practice physical activity, except for school, at least once a week? | 65 |
| Has he/she ever had surgery? | 10 |
| Does he/she have chronic or congenital pathologies? | 2 |
| **Total "YES" answers** | **809** |

**Table 2.** *BioPostural Questionnaire*

## DISCUSSION

In the collection of the anamnestic data of the questionnaire before completing the observational form, it emerged that none of the questionnaires had exceeded the minimum safety and/or predictive threshold for a major postural dysfunction such as to be investigated with a Digitized Biometrics.
Indeed, as already scientifically demonstrated, higher values of the BioPostural questionnaire score corresponded to greater asymmetries in the observational form (Barassi, G.,2022).
It was fundamental, through this experience, to define the various degrees of posture: Asymmetric, Dysfunctional and Pathological.
In this study, mainly emerged Asymmetrical postures and in eleven cases Dysfunctional postures, with structural asymmetries greater than 3 degrees, alteration of body balance objectively confirmed by the Barodopometric examination.

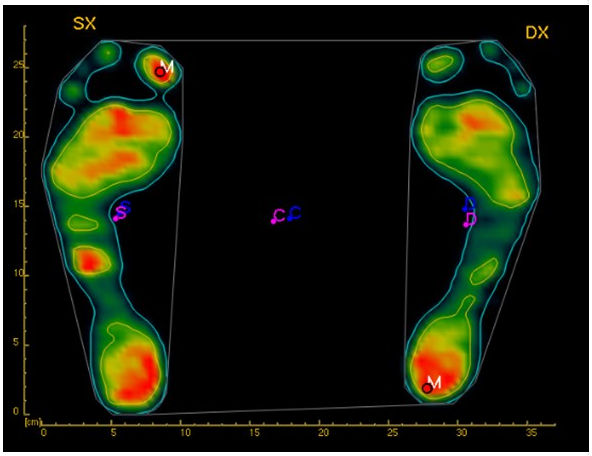


**Figure 4.** *Static Barodopometric exam*

The aim of the Static Barodopometric exam was to study the pressure characteristics of the foot in an orthostatic position and to evaluate the areas that are most under load. Stabilometric data were acquired on a force platform in standardized conditions of the Association Française de Posturologie (AFP): barefoot subject, feet oriented at 30°, heels 2 cm apart, arms along the body, visual target 90 cm away in front of the subject.
The duration of the Static Baropodometry is 5 seconds which is enough long for the instrumentation used to acquire a sufficient number of samples and correctly describe the foot support on the ground.
The resulting image is an average of the acquired samples and there is no calculation on the micro movements induced by the Postural Tonic System.
Plantar flattening was defined considering the physiological arch as: a pressure on the lateral edge of the midfoot, tangents from the podalic axis to the center of the calcaneus up to the second-third toe.
The condition in which an alteration of the support was detected starting from one third of the support perimeter of the midfoot was defined as "plantar flattening" (Association Française de Posturologie. Normes 85. ADAP; Paris, France: 1985.) (Wojtków M., 2018).

## CONCLUSIONS

An important conclusion emerged from the importance of this multidisciplinary experience and the need for multi-specialist dialogue: first of all, after this exchange of information, we are now able to define the grade of deficit from a specialist medical point of view through a classification of posture; and subsequently it becomes important to evaluate the grade of motor activity of the subject.
The use of television, mobile phones and tablets for at least 3 hours a day was associated with the outcome from the evaluations and questionnaires.
The use of information and communication technologies is a potential risk factor for the development of low back pain and/or wrong posture.
Is believed that the explanation is based on an inadequate static posture adopted using these devices associated with a prolonged time, which generates musculoskeletal overload, reduced blood flow and muscle spasm, activating pain receptors. Furthermore, daily excess time in static postures generates insufficient recovery time after local muscle fatigue, essential in the genesis of muscle pain in static work (Aarås, A., 2000).
Therefore the “Iochiron, posture is health” project has as its main purpose that one of observing any asymmetries to prevent back pain/rachialgia and deformities of the spine in children and adolescents. In fact, although there is fairly strong evidence on the effectiveness of commonly used preventive treatments, such as supervised exercise in adults, there are few randomized trials focusing on adolescents with back pain.
Hence, there is a need to preemptively intervene with greater observational attention to improve the multidisciplinary management of posture in non-adult population (Michaleff, Z.A., 2014).

## BIBLIOGRAPHY

*Aarås,A., Horgen,G., &Ro. O. (2000)Work with the visual display unit: health consequences. Int J Hum Comput Int.12:107–134.*

*Barassi,G., Di Simone, E., Galasso, P., Cristiani, S., Supplizi, M., Kontochristo,s L., Colarusso, S., Visciano C,P., Marano, P., Antonella, Di Iulio., &Giancola, O. (2021 )Posture and Health: Are the Biomechanical Postural Evaluation and the Postural Evaluation Questionnaire Comparable to and Predictive of the Digitized Biometrics Examination? Int J Environ Res Public Health. Mar 28;18(7):3507. doi: 10.3390/ijerph18073507.*

*Barassi,G.,Di Simone, E.Supplizi,M.,Prosperi,L.,Marinucci,C.,Pellegrino,R., Galasso,P.,Guerri,S.,Della Rovere,M.,Younes,A., and Di Iorio,A. Bio-Physico-Metric approach: integrated postural assessment in musculoskeletal dysfunctions. Journal Of Biological Regulators & Homeostatic Agents Vol. 36, no. 1, 129-135 (2022)*

*Kovacs,F.M., Gestoso, M., del Real, M.T. G., López, J., Mufraggi,N.,& Méndez, J.I. (2003)Risk factors for non-specific low back pain in schoolchildren and their parents: a population based study. Pain.103:259–268. doi: 10.1016/S0304-3959(02)00454-2.*

*Laouissat F, Sebaaly A, Gehrchen M, Roussouly P. Classification of normal sagittal spine alignment: refounding the Roussouly classification. Eur Spine J. 2018 Aug;27(8):2002-2011. doi: 10.1007/s00586-017-5111-x. Epub 2017 Apr 28. PMID: 28455623.*

*Michaleff,Z.A., Kamper,S.J., Maher, C.G., Evans, R., Broderick,C.,& Henschke, N,.(2014)Low back pain in children and adolescents: a systematic review and meta-analysis evaluating the effectiveness of conservative interventions. European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society.23(10):2046–2058.*

*Pausić J, Dizdar D. Types of body posture and their characteristics in boys 10 to 13 years of age. Coll Antropol. 2011 Sep;35(3):747-54. PMID: 22053551.*

*Pellisé,F., Balagué, F., Rajmil, L., Cedraschi, C., Aguirre, M., Fontecha, C.G., Pasarín, M.,&Ferrer, M. (2009) Prevalence of low back pain and its effect on health-related quality of life in adolescents. Arch Pediatr Adolesc Med.163:65–71. doi: 10.1001/archpediatrics.2008.512.*

*Rosário JL. Biomechanical assessment of human posture: a literature review. J Bodyw Mov Ther. 2014 Jul;18(3):368-73. doi: 10.1016/j.jbmt.2013.11.018. Epub 2013 Nov 27. PMID: 25042306.*

*Spina,G., Bozzola,E., Ferrara,P., Zamperini,N., Marino,F., Caruso,C., Antilici,L., &Villani,A,.(2021) Children and Adolescent's Perception of Media Device Use Consequences. Int J Environ Res Public Health. Mar 16;18(6):3048. doi: 10.3390/ijerph18063048.*

*Trevelyan,F.,C.,& Legg, S.,J. (2011)Risk factors associated with back pain in New Zealand school children. Ergonomics.54:257–262.*

*Webb, H.,(2014) 'Back on Track' - development of a school-based back care education programme Perspectives in Public Health; London Vol. 134, Fasc. 1, (Jan ): 18-9.*

*Wojtków M., Szkoda-Poliszuk K., Szotek S. Influence of body posture on foot load distribution in young school-age children. Acta Bioeng. Biomech. 2018; 20:2*