

Ergonomic Risk Assessment in Elementary School Students in Baja California, Mexico. An Analysis as First Step

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Abstract - This study evaluates one of the relevant factors in ergonomics: the postural habits of elementary school children who sometimes perform school activities in uncomfortable positions and carry heavy backpacks. The assessment was conducted in ten elementary schools (seven public and three private). It was observed that in all the participating schools, students experienced discomfort and muscle pain in their upper back over a three-month period. This was attributed to the heavy weight of their backpacks, poor posture at their desks in the classroom, and participation in recreational and sports activities outside the classroom. The study was conducted from January to December 2019.

Keywords: Education, ergonomics, elementary school, discomfort and muscle pain.

1. INTRODUCTION

Inadequate educational planning in the primary school teaching area and a lack of organizational habits among students at this educational level, which occurs during certain periods of the school year, results in students taking home books they don't use, increasing the weight of their backpacks. This is considered an

ergonomic risk because it can cause discomfort for students. Even though students at several elementary schools in Mexicali have been observed using backpacks with wheels to pull them and avoid carrying them, the weight of these backpacks is considerable (around the weight that charge children of this age in his back), potentially causing discomfort or pain, primarily in the head, neck, shoulders, hands, back, and waist (X1). Students with backpacks lacking this mechanism have also been observed to experience health problems more frequently, affecting the head, upper back, and lower back. Various studies by pediatric associations have demonstrated that excessive backpack weight among elementary school students can negatively impact children's health. One such association that has evaluated this situation is the Spanish Association of Pediatrics (SAP), which suggests that a backpack's weight should not exceed 10% to 15% of a child's weight (X2). Figure 1 shows the health symptoms presented when Childs charges scholar backpacks with overweight.

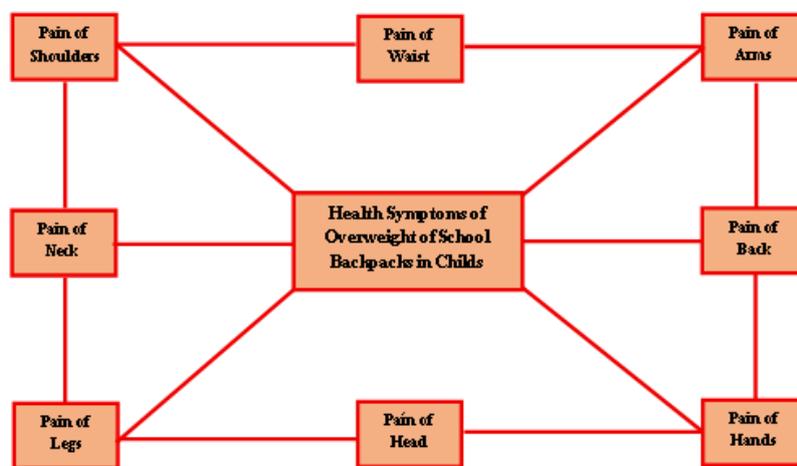


Fig -1: Health symptoms presented when Childs charges backpacks with overweight
Source. Analysis of the investigation

Figure 1 illustrates the possible health symptoms that can presents in Childs (girls and boys), when charges overweight in his scholar backpacks. This can occur because use a lot scholar books and other scholar utensils, which charge from his homes to schools and return to his homes with the same weigh. This is presented by the lack of scholar planning of the subjects in educational institutions, and is necessary charges all scholar books, which is presented in some elementary schools of the Baja California State that is located in the northwest of the Mexican Republic. The names of these schools are not presented in this investigation for the respect to the elementary schools and to the Secretaria de Educacion Publica (SEP- Secretaria de Educacion Publica, Estado de Baja California, 2025) of Mexico. For respect to Childs (girls and boys), is presented in this scientific study in figure 2 as cartoon image, to shows the action, when a Child charges a backpack with overweight (figure 2a), and a possible solution when Childs debit be do this action (figure 2b).



Fig -2: Actions of scholar backpacks: (a) charged by Childs with overweight and (b) a solution to avoid generates pain of the sections mentioned above

Source: (a) <https://pt.vecteezy.com/arte-vetorial/11539460-menino-dos-desenhos-animados-com-uma-mochila-grande-nas-costas-colegial>; (b) https://es.pngtree.com/freepng/children-carrying-schoolbags_17339185.html

In figure 2 is presented two types of actions, when Childs (girls and boys) charge scholar backpacks, which is showed in figure 2a, the manner of a boy walk with difficulty with his scholar backpack with high weight, generating a tendency of the presence of health symptoms, as are illustrated in figure 1. While, in figure 2b, exists the possibility of charging in a scholar backpack his scholar books and in a small scholar bag, can charge the scholar utensils, and sometimes Childs charge his lunch. This can reduce the weight in the back of Childs. Also, is necessarily to have an optimal planification of the educative activities, to that Childs charge only the scholar books and utensils in different days that assists to schools.

1.1 School Planning

This is a tool that supports the organization of school activities at all levels of public and private education in Mexico. Sometimes, in Mexico, there is a lack of control over the planning developed at the beginning of each school year, and classroom activities are not adequately implemented. To compensate, some teachers assign extracurricular activities (homework) to students. This is done to make up for activities not carried out in the classroom, but it results in elementary school students carrying backpacks home with weights exceeding those established by the AEP (Association of Pediatricians) and other associations (X3). Another aspect observed in some Mexican elementary schools, although not officially established in school regulations, is that teachers may observe elementary school students and inform the parents and school authorities of any health symptoms, especially headaches, neck pain, upper and lower back pain, or spinal problems, caused by carrying backpacks heavier than those recommended by pediatric associations. This situation is not observed by all teaching staff and primary school students, which is the level on which this research focuses, and some parents do not consider this aspect important until their children suffer from health complications or discomfort in the dorsal region of the body (X4).

1.2 Educational Teaching Materials

These are also called teaching aids, the main ones being books, which support students at any educational level in the teaching-learning process, primarily in the form of books with varying weights in kilograms, depending on their size and number of pages (X5). They are used in all educational institutions in every region of the world, and depending on the country, they are used to facilitate the dissemination of

knowledge on any subject by teaching staff. There are teaching materials such as books with a large amount of content, so each book can weigh a minimum of around 1.5 kilograms (X6). In cases where elementary school children lack organizational habits and teachers don't pay attention to the books students take home; they often carry at least three books along with other materials. Adding to the weight of their backpacks, students sometimes carry more than 5 or even 10 kilograms, which gradually causes discomfort and pain in the back, neck, and head of these elementary school children, the focus of this research.

1.3 School Activities

These are actions developed at various educational levels designed to acquire knowledge on a specific topic, inspire students' ingenuity, and reflect their educational performance in the classroom. There are various methods for carrying out school activities, and depending on how they are implemented, students develop a strong interest in continuing to learn outside the classroom in a self-directed way that fosters teaching and learning processes that can be replicated by anyone. Teaching staff must constantly engage in self-directed learning to enhance their academic tools and maximize their abilities (X7).

1.4 Types of Postures

A posture indicates the way a person assumes a position depending on the activity they are performing and can maintain it for periods of several hours, generating physical fatigue that could affect health with discomfort or pain, primarily in the upper back, as well as in the head and neck. Figure 3 represents the principal types of postures to any person, when walk or any person is standing. The postures of this figure show the optimal positions, and is referred to Childs (gurls and boys), which carry his scholar backpacks.

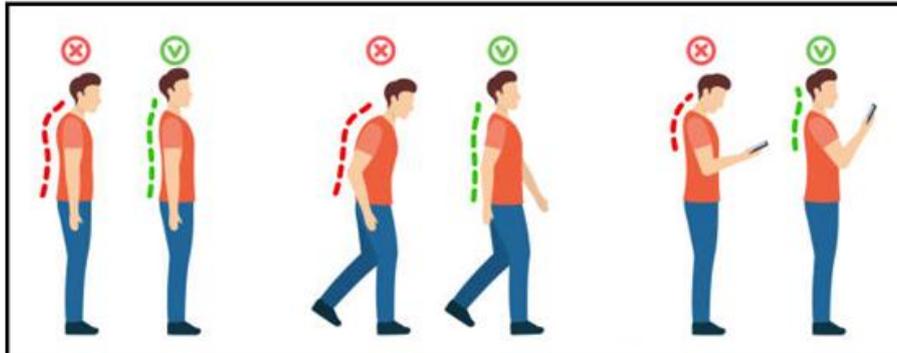


Fig -3: Diverse types of postures of persons when is standing and walking

Source. <https://www.istockphoto.com/es/vector/buena-postura-posturas-humanas-correctas-e-incorrectas-espina-dorsal-neutra-hombre-gm1187088233-335182058>

2. METHODOLOGY

This scientific study was made to evaluate the reaction of the activity of charge scholar backpacks, from Childs (girls and boys) of five elementary schools located in the Tijuana city, where 705 elementary schools are public and private (are more elementary public schools. around 70% of total) (SEP-Secretaria de Educacion Publica, Estado de Baja California, 2025). In this investigation was made main two actions in this first step of this investigation:

a) Evaluation of weight of 250 scholar backpacks of Child students (girls and boys) of five elementary schools (50 Childs by elementary school), located in the Tijuana city, in different scholar zones, which debit be around 20% of the weight of Childs.

b) Analysis of health symptoms of the 250 Childs students (girls and boys) evaluated.

3. RESULTS

Numerical data obtained of this scientific study, was relevant to determine the health symptoms of the action occurred when Childs (girls and boys) of elementary schools evaluated in the Tijuana city, charged his scholar backpacks with overweight. This important information is expressed in the next sections, representing the first step of this relevant scientific study.

3.1 Analysis of the weight of backpacks used by Childs

In this part of this investigation was evaluate the weight of backpacks used by Childs (25 girls and 25 boys of each elementary school analyzed), and being students of 5th and 6th grades of elementary educative level.

Table -1: Correlation analysis of weight of back packs of Childs and negative effects in five elementary schools of Tijuana (2025)

Schools	1		2		3		4,		5	
	Girls	Boys								
Distracted in class by the Charge of Backpack	16-25	19-25	14-25	18-25	11-25	20-25	13-25	15-25	14-25	16-25
Hyperactive	13-25	18-25	18-25	21-25	15-25	12-25	17-25	14-25	14-25	17-25
Suffer of Pain	16-25	15-25	13-25	11-25	17-25	14-25	19-25	12-25	13-25	11-25
Tired	13-25	11-25	20-25	16-25	14-25	12-25	13-25	10-25	14-25	12-25
Unwilling to socialize	14-25	10-25	17-25	14-25	13-25	11-25	14-25	13-25	12-25	10-25

Table 1 illustrates a correlation analysis of the weigh of the backpacks evaluated in the five elementary schools that permitted this relevant scientific study. This table presents a relation of the weight of the backpacks and the main negative effects presented in the Childs (girls and boys) evaluated, where was observed that in the first negative effects, the major oppositive actions were in boys, and the last three negative effects, the major oppositive actions were in girls. This means that in both cases Childs (girls and boys) were affected by the excess of weight of his scholar backpacks, and about the relation by each negative effects mentioned above, girls suffer more of the pain, tired and unwilling to socialize. In change boys suffer more of distraction in class and were hyperactive by charge his scholar backpacks. Once finished this step, was made the next, evaluating the health symptoms mentioned above.

3.2 Evaluation of the health symptoms in Childs

In this part of the investigation was made a correlation analysis of the occurrence of health symptoms mentioned above and the weight of the backpacks utilized by the Childs (girls and boys) evaluated in the five elementary schools. Table 2 presents this analysis.

Table -2: Correlation analysis of health symptoms and weight of back packs of Childs in five elementary schools of Tijuana (2025)

Schools	1		2		3		4,		5	
Health Symptoms	Girls	Boys								
Pain of Arms	19-25	15-25	18-25	16-25	17-25	15-25	19-25	17-25	18-25	15-25
Pain of Back	22-25	20-25	19-25	16-25	19-25	17-25	20-25	21-25	20-25	18-25
Pain of Hands	16-25	11-25	14-25	10-25	18-25	15-25	18-25	16-25	13-25	10-25
Pain of Head	17-25	14-25	21-25	15-25	19-25	16-25	18-25	15-25	17-25	16-25
Pain of Legs	16-25	14-25	18-25	19-25	15-25	13-25	18-25	13-25	15-25	11-25
Pain of Neck	20-25	16-25	18-25	14-25	19-25	16-25	21-25	19-25	20-25	15-25
Pain of Shoulders	18-25	13-25	16-25	12-25	17-25	14-25	20-25	17-25	18-25	15-25
Pain of Waist	21-25	15-25	18-25	13-25	18-25	15-25	17-25	15-25	21-25	18-25

Table 2 represents the principal actions of the occurrence of the health symptoms presented in the Childs (girls and boys) in these elementary schools, in this scientific study, where was observed that the major effects of these health symptoms occurred in girls. This means that in sometimes boys not consider important any comment about any type of pain in the parts of body evaluated.

4. CONCLUSIONS

This investigation was relevant to the elementary schools evaluated, and can be to any type of school, where are necessary carry scholar backpacks with high weight to diverse type of educative activities in any type of schools. This is important to families, educative institutions and any society, because a lot Childs (girls and boys), was attended medically in some health institutions public or private, concerning to fathers of Childs of the elementary schools analyzed and other type of educative institutions. This is the first part of a scientific study, which was determined that the bad planification of the scholar activities in some educative institutions, as these elementary educative places, can generates that Childs carry with scholar books or scholar utensils that can not use in any day, originating more weight to his scholar backpacks.

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