

Schoolbag weight and the effects of schoolbag carriage on secondary school students

S. Dockrell^a, C. Kane^a, E. O’Keeffe^a

^a *School of Physiotherapy, Trinity Centre for Health Sciences, Trinity College Dublin,*

Abstract

This study investigated the weight of schoolbags and the factors related to schoolbag carriage on first year secondary school students. Students in two Community Schools in Dublin completed an author-assisted questionnaire. Measurements of body weight and schoolbag weight were taken and completion of a daily Body Discomfort Chart (BDC) survey was conducted over the five-day period of one school week. Fifty-seven students, mean age 13.1 years, successfully completed the five days of objective testing. The mean schoolbag weight was 6.2kg, and over the course of the week, 68% of the schoolbags weighed >10% body weight. The mean percentage body weight carried in schoolbags was 12%. The majority of students used backpack-style schoolbags (95%), but only 65% carried them on their back over two shoulders. The reported discomfort was higher for girls (80%) than boys (63%) on the initial questionnaire, but over the study period, equal numbers of boys and girls reported discomfort due to carrying their schoolbags (59%). Girls reported fewer areas of discomfort but higher VAS intensities than boys.

Keywords: Children, schoolbag weight, material handling, discomfort.

1. Introduction

There is ongoing concern regarding the weight of childrens’ schoolbags and the negative consequences of such heavy loads on the developing spine. There is particular concern for the junior students in secondary schools, as the spine is at a critical stage of development in children between 12 – 14 years of age. This is also the stage at which the bag weight to body weight ratio is likely to be high as some students are still quite small but carry loads similar to larger and older children.

1.1. Weight of schoolbags

It has been suggested that schoolbags represent a considerable daily ‘occupational load’ for

schoolchildren [1]. A general guideline of 10% body weight, initially proposed by Voll and Klimt in 1977 [2], continues to be the recommended guideline when carrying a backpack style schoolbag. The findings of more recent studies may challenge this guideline [3,4]. The weight carried by students varies from day to day and studies have reported different results with regard to the average schoolbag weight [5,6,7,8,9,10]. The different age ranges of students included in the studies may explain some of this variation, but irrespective of age there is a considerable number of schoolchildren carrying in excess of 10% of their body weight.

1.2. Schoolbag carriage and its association with musculoskeletal discomfort

Musculoskeletal symptoms are believed to be multifactorial, and Whittfield et al [7] state that the carriage of heavy schoolbags is a suspected 'contributory factor', and therefore represents an 'overlooked daily physical stress' for schoolchildren. Risk factors for musculoskeletal discomfort associated with schoolbag carriage include the combined effects of heavy loads, load shape and size, time spent carrying the load and position of the load on the body [11]. A number of studies investigated the link between schoolbag use and musculoskeletal pain. Some have reported that carrying a heavy schoolbag contributes to musculoskeletal pain [9,12,13] while others have found differently [8,14].

Some studies on musculoskeletal discomfort related to schoolbag carriage identified a significantly higher reporting of pain by girls than boys [9,14]. Negrini and Carabalona [13] found no significant gender difference.

The aim of this study was to investigate the weight of schoolbags and the effects of schoolbag carriage on first year secondary school students. The specific objectives were:

- ❑ to measure the weights of schoolbags
- ❑ to determine percentage bodyweight carried
- ❑ to determine types of bags and methods of carriage
- ❑ to record reported discomfort due to schoolbag carriage

2. Methodology

This study was conducted with an author-assisted questionnaire, a body discomfort survey, and objective testing of schoolbag and body weight.

2.1. Sample selection

A convenience sample of two Community Schools was included to in the study. Permission was sought from both principals. The Research Ethics Committee, Trinity College, Dublin granted ethical approval. Informed consent was sought from the students and their parent/guardian. Inclusion criteria were (1) first year student in the participating schools and (2) parental and student consent received prior to commencement of the study. Exclusion criterion

were (1) unable to stand on the weighing scales and (2) unable to carry a schoolbag to school.

2.2. Tools of assessment

2.2.1. Weighing scales

A solar-powered Seca electronic scales (model number: 7701321004) was used for the objective testing. The scales were calibrated prior to the study.

2.2.2. Author-assisted questionnaire

The author-assisted questionnaire sought general information including type of schoolbag used, method of carriage and any discomfort experienced due to carrying their schoolbag.

2.2.3. Body discomfort chart & visual analogue scale

The daily reported discomfort was recorded on a Body Discomfort Chart (BDC) [15]. A Visual Analogue Scale (VAS) was used to determine the perceived intensity of discomfort [16].

2.3. Procedure

Following a pilot study, the main study took place over a period of seven school days. On day 1, the initial meeting with the students took place. An explanation of the study was given and consent forms were handed out to all first year students. The venue for objective testing was agreed with the principal on this visit to the school. On day 2 the author-assisted questionnaire was completed with students. A code number was put on the corresponding questionnaire, Body Discomfort Chart and data collection forms for each student.

Weighing was conducted on days 3 to 7 of the study. This was done first thing every morning over five consecutive days of a school week as the students arrived to school, before they went to their first class. Shoes and coats were removed before weighing commenced. Students' body weight was determined and following this they were weighed with their schoolbag on their back and then with any additional bags.

A brief questionnaire seeking information on students' subjective daily view of their bag weight and their perceived level of discomfort secondary to schoolbag carriage was completed each morning of days 3 to 7 at the weighing session. Students were then asked to mark on a VAS how they would rate the intensity of their discomfort between 'no discomfort' and 'worst possible discomfort'.

To minimise disruption to classes, all weighing and completion of the BDC survey was finished as close to the beginning of class time as possible.

3. Results

3.1. Participation rate

Of the 270 consent forms issued, 26% (n=70) were returned. Of those who consented 81.5% (n=57) completed all measurements and were included in the study. This included 32 boys and 25 girls of mean age 13.1 years.

3.2. Weight of schoolbags

Schoolbag weight ranged from 1.6 - 11.3kg over the 5 days. It was found that, on average, boys carried heavier (3.1-11.3kg) schoolbags than girls (1.6-10.7kg). The weekly mean schoolbag weight was 6.2kg. Overall, schoolbags weighed heaviest on Friday (mean weight 6.7 kg) and were the lightest on Tuesday (mean weight 5.8kg). See Fig. 1.

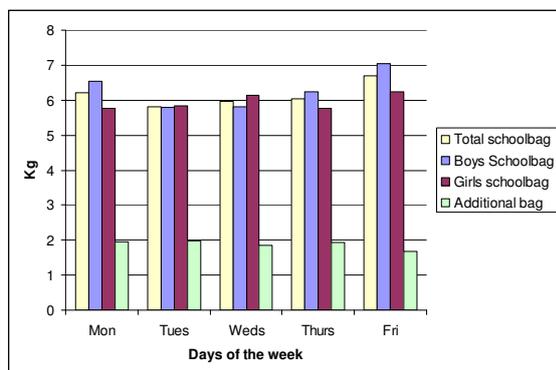


Figure 1: The mean schoolbag weight (kg)

3.3. Schoolbag weight as a percentage of body weight

The mean schoolbag weight as a percentage of mean body weight carried by the students was 12%. Percentage body weight carried in schoolbags ranged from 3%-30% over the course of the five days of weighing. Boys carried a slightly larger proportion of their body weight (mean: 13%, range: 4%-30%) than girls (mean: 11%, range: 3%-25%). See Fig. 2. The mean percentage body weight carried by those who had an additional bag was 18%. The loads carried

with regard to % body weight guideline are shown in Fig. 3.

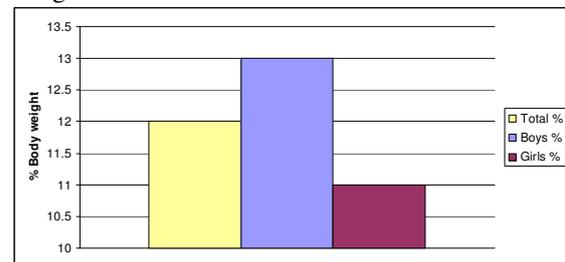


Figure 2: Mean schoolbag weight expressed as a % mean body weight

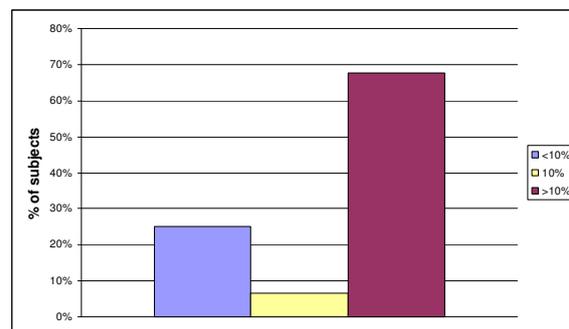


Figure 3: The % students carrying <10%, 10% and >10% of their body weight

3.4. Types of schoolbags

Almost all students, 95% (n=54), used backpack-style schoolbags with two straps, but only 65% carried their schoolbags on their backs using two straps.

3.5. Schoolbag related musculoskeletal discomfort

Girls reported more discomfort due to carrying a schoolbag in the initial questionnaire than boys, however when asked on a daily basis, 59% of both boys and girls reported discomfort. The number of reports of discomfort increased as the week continued. The greatest number reported discomfort due to carrying their school bag on Friday (see Fig. 4). The majority of discomfort (65%) was reported in the shoulder region, followed by 30% reported in the back with negligible percentages reported elsewhere.

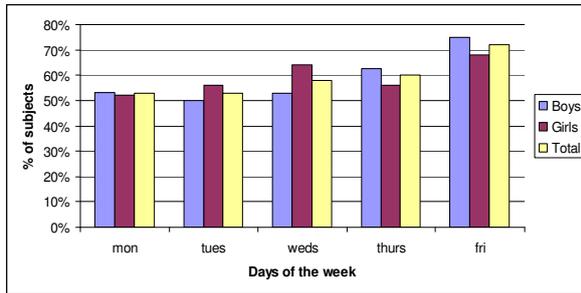


Figure 4: Daily reports of discomfort

4. Discussion

4.1. Participation rate

Of the 270 consent forms issued, 26% (n=70) were returned completed and were eligible for inclusion in the study. In school 1 the response rate was 51.5% (n=36) and in school 2 the response rate was 17% (n=34). The lower response rate in school 2 may be attributed to a week of school holidays immediately before the study began and therefore students forgot to return consent forms issued before the holiday. Thirteen students did not complete all seven days of the study. This gave a total of 57 who completed the study; 47% from school 1 (n=27) and 53% from school 2 (n=30).

4.2. Weight of schoolbags

The mean weight of schoolbags in the study was 6.2kg. The mean weight in our study is lighter than that found by Whittfield et al [7] who measured both third (7kg) and sixth formers (6.3kg), and Sheir-Neiss et al [9] who measured students aged 12-18 years (8.3kg). Negrini and Carabona [13] and Negrini et al [1] both measured students with a mean age of 11.6 years and found that their mean schoolbag weight was 9.06kg and 9.3kg respectively. In this study the weight of schoolbags varied from one student to another and for the same student over the week. The wide range of bag weights (1.6kg – 11.3kg) may be explained by the fact that some school children bring more books to school each day than others. In addition, some empty schoolbags may have been heavier than others, but empty schoolbags were not weighed.

The mean schoolbag weight differed slightly according to gender. Boys carried a mean weight of 6.3kg compared to girls who carried a mean weight

of 6kg. These findings differ from those found by others [6] where girls carried heavier schoolbags than boys by, on average, 0.25kg. The boys' schoolbag weights ranged from 3.1-11.3kg and the girls' ranged from 1.6 -10.7kg. Day of the week was found to be a factor determining the average schoolbag weight. The schoolbags were heaviest on Fridays with a mean weight of 6.7kg and lightest on Tuesdays with a mean weight of 5.8kg. This reflects the varied demands on school children on a day-to-day basis.

The number of additional bags carried by the students varied from day to day. A greater number of boys than girls carried an additional bag and this is perhaps due to a higher level of sports participation by boys. However, no evidence was found to suggest that carrying an additional bag resulted in a lighter schoolbag (for example, fewer books might be needed if physical education classes were scheduled).

4.3. Schoolbag weight as a % of body weight

Over the course of the five days of weighing, the weight of schoolbags ranged from 3% -30% body weight (30% was carried on one occasion). The mean schoolbag weight as a percentage of mean body weight carried by the students was 12%. Other studies had similar findings, [7,8,9,10]. In contrast, Forjuoh et al [6] found a lesser percentage (8.2%) and Negrini et al [1] found a considerably higher percentage of 22% body weight. Boys carried a greater percentage of their body weight (mean: 13%, range: 4%-30%) than girls (mean: 11%, range: 3%-25%). It is of some concern that, over the course of the five days of weighing, the majority of the schoolbags (68%) weighed more than the proposed approximate guideline of 10% body weight.

4.4. Types of schoolbags and methods of carriage

The most popular style of schoolbag was found to be a backpack-style bag with two straps (95%) similar to that found by others [7,17]. It is encouraging that the majority of the students in the study opted to use the backpack for school since it has been shown to be the most appropriate design for use [11,17]. However, it is disappointing that only 65% of students carry their schoolbag on the back over two shoulders. This finding is in agreement with others [7,10,12].

4.5. Discomfort due to schoolbag carriage

From the author-assisted questionnaire it was found that 70% of students reported discomfort due to carrying their schoolbag. This high proportion of reported discomfort is similar to the 74.4% finding of Sheir-Neiss et al [9]. More girls (80%) reported discomfort than boys (63%), similar to that found by van Gent et al [8], Grimmer and Williams [12] and Puckree et al [14]. However, unlike the results of the questionnaire, when asked on a daily basis in the BDC survey, 59% of both boys and girls reported discomfort. The reason for this inconsistency between the general questionnaire and the BDC survey, may be attributed to difficulty with recall. The results from the daily BDC survey may be considered more accurate as immediate recall is involved. The highest reporting of discomfort was on Friday and the least on Tuesday. This corresponds to the findings for mean schoolbag weight where the heaviest mean weight was recorded on Friday, and the lightest mean weight on Tuesday.

4.6. Distribution and intensity of discomfort

Overall, 65% of the reported discomfort was in the shoulder. Thirty percent of the reported discomfort was in the back. High levels of discomfort were also reported by van Gent et al [8] where 43.6% of their subjects complained of neck and/or shoulder pain and by Puckree et al [14] where 86.9% of their subjects reported pain in the areas of shoulder, neck and back. Although girls reported fewer areas of discomfort than boys, the intensity of their discomfort was found to be higher.

5. Conclusion

The aim of this study was to investigate the mean weight of schoolbags and the effects of schoolbag carriage on first year secondary school students. Backpack-style bags with two straps were found to be the most popular style of schoolbag for both boys and girls. The most common method of carriage was on the back, over two shoulders. The mean weight of schoolbags was found to be 12% of body weight and the mean load carried was 18% of body weight when additional bags were considered. It is of some concern that throughout the school week, a total of 68% of schoolbags weighed greater than the approximate guideline of 10% bodyweight with the

maximum schoolbag weight, on one occasion, found to be 30% of the carrier's bodyweight. There is a need for further research to form the basis for recommendation and implementation of a more definite guideline.

The levels of reported discomfort were high, and increased as the week progressed. The discomfort was mostly reported to be in the shoulder region, followed to a lesser degree by discomfort in the back. The association between level of discomfort and load carried requires further analysis.

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