

1 **Quality of life, school backpack weight, and nonspecific lower back pain in**
2 **children and adolescents**

3

4 **Short title**

5 Children's quality of life and low back pain

6

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5 RBM, AVL, AMMR and JVS participated in the design of the study, participated in the
6 exercise protocols, performed the statistical analysis and drafted the manuscript. RAM,
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8 helped to draft the manuscript. SPC and NFS participated in the draft of the manuscript
9 and revising it critically for important intellectual content. All authors read and
10 approved the final manuscript.

11

12 **Conflicts of interest**

13 The authors declare no conflicts of interest.

14

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1 **Resumo**

2 **Objetivo:** O propósito deste estudo é descrever e comparar a qualidade de vida (QoL), o
3 grau de deficiência, variáveis antropométricas e o peso de mochilas da escola, em
4 rapazes e raparigas com idades compreendidas entre 11-17 anos, com e sem dor lombar
5 não específica.

6 **Métodos:** Os participantes (N = 149) incluíram 86 raparigas (13.9 ± 1.9 anos) e 63
7 rapazes (13.7 ± 1.7 anos). A low back pain (LBP) foi avaliada com uma pergunta direta
8 e o grau de deficiência com o Questionário de Roland Morris (RMDQ). A QoL foi
9 avaliada pelo inventário de qualidade de vida Pediátrica (PedsQL). Foi utilizada a
10 análise multivariada de variância e covariância para testar as diferenças entre os grupos.

11 **Resultados:** As raparigas referiram maior deficiência (...!?!.) ($P = 0.01$). O peso das
12 mochilas da escola foi semelhante nos rapazes e raparigas ($P = 0.61$). A QoL das
13 raparigas foi menor nos domínios funcionamento físico ($P < 0.001$), funcionamento
14 emocional ($P < 0.01$), saúde psicossocial ($P = 0.02$), saúde física ($P < 0.001$) e no score
15 total PedsQL ($P < 0.01$). Independentemente do sexo, idade e estatura, os participantes
16 com LBP referem menor funcionamento físico ($P < 0.01$), o que influencia
17 negativamente a saúde física ($P < 0.01$).

18 **Conclusão:** Comparativamente aos rapazes, aAs raparigas revelaram maior grau de
19 deficiência e menor qualidade de vida nos domínios do funcionamento físico e
20 emocional, psicossocial, saúde física e no score total do PedsQL, embora o peso das
21 mochilas da escola seja similar. Os participantes com LBP têm funcionamento físico
22 mais pobre e menor saúde física, independentemente do sexo, idade e estatura.

23 **Palavras-chave:** qualidade de vida; dor lombar não-específica; crianças e adolescentes;
24 mochila de escola.

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1 Abstract

2 **Objective:** ~~The purpose of the present study is aimed to describe and to compare the~~
3 quality of life (QoL), ~~the~~ degree of disability, anthropometric variables, and school
4 backpacks' weight ~~in-between~~ boys and girls ~~ageding~~ 11-17 years-old ~~who~~
5 ~~referringreported or not~~ nonspecific low back pain (LBP), ~~and in those not referring~~
6 ~~nonspecific LBP.~~

7 **Methods:** ~~Participants~~ ~~The sample~~ (N = 149) ~~include-comprised~~ 86 girls (13.9 ± 1.9
8 years-old), and 63 boys (13.7 ± 1.7 years-old). The LBP was ~~evaluated-assessed by~~
9 ~~direct questionnaire with direct question~~, and the disability ~~with-using~~ the Roland
10 Morris Disability Questionnaire (RMDQ). The QoL was assessed by the Pediatric
11 Quality of Life Inventory (PedsQL). Multivariate ~~analysis-analyses~~ of variance and
12 covariance were used to assess differences between ~~the afore mentioned~~ groups.

13 **Results:** ~~The girls referred~~ ~~Females have reported~~ higher disability ~~than males~~ ($P =$
14 0.01). The school's backpack weight was similar in both boys and girls ($P = 0.61$). ~~In~~
15 ~~comparison with boys,~~ ~~t~~The QoL of the girls was lower in the domains ~~of~~ physical
16 ~~functioning~~ ($P < 0.001$), ~~and~~ emotional functioning ($P < 0.01$), psychosocial health
17 summary score ($P = 0.02$), physical health summary score ($P < 0.001$), and ~~in~~ the total
18 PedsQL score ($P < 0.01$). ~~Independently-After adjustments to confounding variables~~
19 ~~such as of the~~ sex, age, and stature, participants with LBP ~~referred-have reported poorer~~
20 ~~lower levels of~~ physical functioning ($P < 0.01$), which, ~~consequently,~~ impacts lower ~~on~~
21 physical health summary score ($P < 0.01$).

22 **Conclusion:** ~~The g~~Girls had higher disability and lower QoL ~~than boys~~ in the domains
23 of physical and emotional functioning, psychosocial health summary score, physical
24 health summary score, and ~~in-on~~ the total PedsQL score; ~~but~~ ~~however,~~ similar school's
25 backpack weight ~~was reported~~. Participants with LBP ~~have-revealed poorer-lower~~

1 physical functioning, and lower physical health summary score, independently of their
2 ~~the~~ sex, age, and stature.

3
4 **Keywords:** quality of life; nonspecific low back pain; children and adolescents; school
5 backpack.

7 **Introduction**

8 Quality of life (QoL) takes in-into account ~~the~~ subjective interpretations and the process
9 in which each one compares his current life with some identified criteria.¹ Research
10 Studies investigating sex differences in QoL (IN ADULTS OR YOUTH??) has
11 produced some equivocal results. While ~~some~~ several studies have found females ~~to~~
12 ~~report~~ reporting lower QoL,² others have not observed any differences between ~~the~~
13 ~~sexes~~ males and females.³ Accordingly, the effect of sex upon QoL remains unclear.
14 This subjective concept could ~~also~~ be also influenced by several health conditions
15 including the non-specific low back pain (LBP).³ Among adults, LBP is a common
16 disease, with 70-80% of the population experiencing at least one episode of LBP in their
17 lifetime,⁴ and 80-85% of LBP cases are considered as nonspecific.⁴ In children and
18 adolescents, the prevalence of LBP is ~~considered to be~~ quite similar ~~to~~ with that
19 observed in adults,⁵ ~~though some studies have reported. That said,~~ Thus, the
20 prevalence of LBP in children and adolescents remains high, varying between 30 and-
21 70%, depending on the pain definition ~~of pain~~, ~~the age of the~~ population age, and type
22 of the research design of the study.⁶

23 Health professionals and parents have highlighted ~~The the~~ regular wearing of
24 backpacks, for the purpose of carrying school materials and supplies, ~~has been~~
25 ~~highlighted by health professionals and parents~~, as a potential risk factor for LBP in

1 children and adolescent.⁷ ~~Although~~ ~~Despite of~~ ~~have not been scientifically reported,~~ the
2 critical load ~~at which the regular of~~ wearing ~~of a~~ backpack could ~~pose increase a the~~
3 risk for spinal problems ~~has not been identified it,~~⁸ ~~and~~ most researchers and health
4 practitioners agree ~~that with a limit for~~ the weight of a backpack ~~which~~ should not
5 exceed 10% of the student's body mass, ~~with and~~ the backpack weight's ~~being should~~
6 ~~be~~ equally distributed across both shoulders.⁸

7 ~~Several studies have shown that~~ Over 10-40% of adolescents ~~have~~ reported their
8 daily activities ~~are somewhat~~ being limited by LBP.⁹⁻³⁰ Further ~~research has revealed,~~
9 ~~that~~ LBP experienced in childhood is associated with chronic LBP in adulthood.⁸
10 ~~However, f~~ Few studies have ~~specifically, however,~~ used validated and standardized
11 instruments ~~specifically~~ to examine the LBP and its potential effect on QoL.¹⁰ Similarly,
12 the overall health status of adolescents who ~~usually~~ report LBP is unknown and it seems
13 to be difficult to define ~~the~~ boundaries of an ~~unique~~ experience ~~only~~, or the pain as
14 disease.⁷ The use of standardized QoL instruments may disclose the health status among
15 different general populations, individuals suffering pain, and subgroups of children and
16 adolescents reporting LBP.

17 ~~With this in mind~~ In the context of the preceding trends, the ~~purpose of the~~
18 present study ~~is aimed~~ to examine differences in QoL between children and adolescents
19 ~~who reporting reported or not LBP and those not reporting LBP. In addition, t~~The
20 purpose of this investigation ~~is was~~ to describe ~~and to compare~~ the degree of disability,
21 anthropometric variables, QoL, and school backpacks' weight in boys and girls ~~aging~~
22 ~~aged 11-17 years-old, referring nonspecific LBP, and in those not referring nonspecific~~
23 ~~LBP.~~

1 **Methods**

2 *Study design and participants*

3 The study was cross sectional in design. ~~Participants were~~The sample was recruited
4 from 12 classes in two schools ~~in of the Rio Branco city of Rio Branco, Brazil;~~
5 ~~including~~ a total of 324 students ~~that~~ were invited to participate in this study. All
6 students fulfilled an initial questionnaire to identify those reporting any episode of LBP
7 during the last year. A total of 149 children and adolescents aged between 11 and 17
8 years-old were identified, ~~agreeing and they agreed~~ to participate in the subsequent
9 analyses, comprising [86 (58%) females (58%) and 63 (42%) males (42%)]. The
10 inclusion criteria was an 'yes' answer to the following question: 'During the last year
11 did you feel any episode of discomfort on the low back, extending for the legs?'. The
12 exclusion criteria include idiopathic scoliosis, spondylitis, and hernia of intervertebral
13 ~~discus. Descriptive statistics for age, body weight, stature, body mass index, school~~
14 ~~backpack weight, disability, and QoL are presented in Table 1.~~

15 All ~~of the~~ participants agreed to take part in of this study and their
16 parents/guardians provided written informed approval, consistent with Helsinki
17 Declaration. All ~~of the~~ methods and procedures of this study were approved by an
18 Institutional Scientific Board of the University of Coimbra, Portugal. Clinical data were
19 recorded ~~through the use of~~ using structured questionnaires, ~~all of~~ which were
20 administered by trained research assistants.

21 After the recruitment period, ~~the~~ participants were invited to a preliminary
22 meeting in which they were informed about the nature, benefits and risks of the study.
23 In the second part of this meeting, participants completed the Roland-Morris Disability
24 Questionnaire (RMDQ), and the Pediatric Quality of Life Inventory (PedsQL). A
25 second meeting was then scheduled for the assessment of anthropometric variables. The

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1 weight of each participant's school backpack was measured on three separate days
2 within a week and then a mean value across all three days was calculated.

3

4 *Low back pain (LBP)*

5 The presence of acute LBP was evaluated with the following direct question at the time
6 of the assessment (Hestbaek, Leboeuf-Yde, Kuik, and Manniche (2006); Harreby et al.
7 (1999): "In the past month have you had low back pain which lasted for one day or
8 longer?". In case of 'yes', participants were proposed to signalize on a picture the site of
9 pain.¹⁰ Participants were also asked to complete a version of the RMDQ which had been
10 adapted and validated specific to the Brazilian population by Júnior and colleagues.¹¹
11 The RMDQ is a simple instrument consisting of 24 questions with dichotomous
12 responses (*yes/no*) and measures the degree of disability experienced by the participant.
13 The final score on the RMDQ represents the sum of 'yes' answers, with 0 corresponding
14 to a person without any complaints, while 24 corresponds to a person with very severe
15 limitations.

16

17 *Schober test*

18 ~~The p~~Participants were also asked to complete the Schober test. This test is used to
19 measure the mobility of the lumbar spine, and was first described by Schober.¹² The test
20 is carried out in standing position and in maximum forward trunk flexion, keeping the
21 knees extended. With the participant in the orthostatic position, parallel horizontal lines
22 are drawn 10 centimeters above and 5 centimeters below the lumbosacral junction. The
23 test was considered normal when there is variation of five or more centimeters between
24 the measures in orthostatic position and trunk flexion.

25

1 *Health-related quality of life (HRQoL)*

2 The HRQoL was assessed by a version of the PedsQL,¹³ that had been adapted and
3 validated for the Brazilian population by Klatchoian and colleagues.¹⁴ This
4 questionnaire can be used to assess HRQoL in healthy children and adolescents, and in
5 those with acute and chronic health conditions, and consists of 23 items comprising four
6 multidimensional scales: i) physical functioning (8 items); ii) emotional functioning (5
7 items); iii) social functioning (5 items); iv) school functioning (5 items). The four
8 multidimensional scales are grouped in three summary scores: i) psychosocial health
9 summary score (15 items); ii) physical health summary score (8 items); iii) total
10 PedsQoL score (23 items). Items are reversed scored and linearly transformed to a 0-
11 100 scale (0=100; 1=75; 2=50; 3=25; 4=0), so that higher scores indicate better
12 HRQoL.

13

14 *Anthropometrics and school backpack weight*

15 Stature was measured to 0.1 centimeter, using a standard stadiometer, with the
16 participants in the upright position, without shoes. Body weight was measured barefoot
17 in light clothing on a calibrated digital balance-beam scale (Filizola PL 200, Brazil)
18 with a precision to the nearest 100 grams. Body mass index (BMI) was determined by
19 calculating the ratio of the body mass in kilograms by stature in meters squared. The
20 anthropometric measurements were carried out in separate rooms, to ensure the
21 participants' privacy. School backpack weight was measured at three separate occasions
22 during the week with the same digital balance (Filizola PL 200, Brazil).

23

24 *Statistical analysis*

1 Means and standard deviations ($M \pm SD$) were calculated for the variables age, body
2 weight, stature, BMI, school backpacks' weight, RMDQ, Schober test, and HRQoL
3 scales and summaries. Normality of the distribution was verified for all ~~the~~ continuous
4 variables by ~~a-the~~ Kolmogorov–Smirnov test, while the homogeneity of variance was
5 ~~verified-checked with-by~~ the Levene's test. Comparisons between the groups with or
6 without LBP were performed ~~with-using a~~ multivariate analysis of variance
7 (MANOVA) and covariance (MANCOVA), controlling for sex, age and stature.
8 Comparisons between sexes were performed ~~with-using~~ MANOVA, and for the scales
9 of the HRQoL also with MANCOVA, adjusting for the degree of disability. All of the
10 analyses were performed using Statistical Package for the Social Sciences for Windows
11 (SPSS, Inc. Chicago, IL, USA), software version 19. The 0.05 level of confidence was
12 used as statistically significant for all analysis. Partial eta squared was used to evaluate
13 the magnitude of differences between groups; F values of 0.10, 0.25, and 0.40 were
14 interpreted as small, medium and large effects, respectively (Cohen 1998). ~~Translated~~
15 ~~into partial eta squared Expressed as partial eta squared~~, values of 0.01, 0.06, and 0.14
16 were, respectively, considered small, moderate and large effects.

17

18

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1 Results

2 The characteristics of the participants are described in Table 1. Both boys and girls aged
3 between 11 and 17 years-old reported similar mean values for age ($P = 0.214$). Mean
4 values for body mass ($P = 0.910$) and BMI ($P = 0.211$) were also similar in boys and
5 girls, though boys ~~reported higher stature~~ were taller than girls (1.59 ± 0.10 versus 1.56
6 ± 0.07). ~~Compared to boys, g~~Girls reported higher levels of disability as assessed by the
7 RMDQ ($P = 0.007$). Girls also reported lower levels of HRQoL than boys, as measured
8 by the PedsQL, and also in terms of the domains of ‘physical functioning’ ($P = 0.003$),
9 ‘emotional functioning’ ($P = 0.003$), ‘physical health summary score’ ($P = 0.003$), and
10 ‘total PedsQL score’ ($P = 0.016$). These lower scores on HRQoL reported by the girls
11 were independent of degree of disability.

12 Table 2 highlights ~~the~~ comparisons between participants with LBP ($N = 90$,
13 ~~including~~ 55 girls and 35 boys), and without LBP ($N = 59$, ~~including~~ 31 girls and 28
14 boys). The mean value for RMDQ was higher in those with LBP ($P < 0.001$), ~~as it was~~
15 ~~HRQoL~~, specifically in the domains of ‘physical functioning’ ($P < 0.01$), and ‘physical
16 health summary score’ ($P < 0.01$). The ‘total PedsQL score’ also shows s the same
17 ~~direction trend~~ of differences , but with a marginal p value though not at a statistically
18 ~~significant level~~ ($P = 0.056$). In participants with LBP, tThe lower HRQoL mean score
19 ~~in participants with LBP~~ is maintained similar after controlling for ~~the~~ potential
20 confounding effects of ~~the~~ sex, age and stature. No differences were observed ~~between~~
21 ~~the , between participants with LBP and without LBP groups (P > 0.05), , particularly~~ in
22 terms of school backpacks’ weight, in-on the Schober test, and in the PedsQL scales
23 ‘emotional functioning’, ‘social functioning’, ‘school functioning’, and ‘psychosocial
24 health summary score’, ~~between participants with LBP and without LBP.~~

25

1 Discussion

2 This study aimed to describe and to compare anthropometric variables, QoL and school
3 backpack's weight in boys and girls, aged 11-17 years-old, with and without non-
4 specific LBP, ~~studying in two schools of Rio Branco, Brazil.~~

5 ~~The b~~Boys were taller than the girls (Table 1), while the body weight and the BMI were
6 similar in both boys and girls. Of note, sex differences in stature ~~be~~are ~~merged~~d from 10
7 years of age,¹⁵ ~~;~~ ~~being~~ this process is related to the onset of adolescence, which has been
8 explained by hormonal influences that affect the females before than the males.¹⁶ The
9 pubertal growth spurt that occurs later and at greater intensity in males than in females
10 contributes to the higher stature and body weight observed in the boys after the
11 puberty.¹⁷

12 The Schober test has been widely used by several authors.¹⁸ ~~The to assess the~~
13 ~~mobility of the lumbar spine was evaluated by the Schober test that~~ assesses the extent
14 of the lumbar flexion, ~~and has been widely used by several authors.~~¹⁸ Consistent with
15 previous research,¹⁸ participants ~~in of~~ the current ~~study~~investigation with LBP obtained
16 similar values in the Schober test when compared with participants without LBP,
17 independently of the sex, age and stature (Table 2). ~~That said~~However., some studies
18 have found increased mobility to be associated with decreased LBP.¹⁹ The majority of
19 ~~the~~ students obtained ~~a Schober test~~ over than 15 centimeters in the Schober test, which
20 is a positive performance. The lack of differences in ~~the~~ ~~Schober~~ test across groups
21 could be associated with ~~the fact that the assessments~~ methodological procedures (e.g.,
22 those assessments were conducted during physical education classes). ~~As a~~
23 ~~consequence~~Consequently, students may have already been engaged in activity, and,
24 thus, improved their muscular temperature¹⁹ leading to enhancements in flexibility.
25 Actually, flexibility has also been shown to vary during the day, and ~~as it was not~~

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1 possible to administer all the Schober tests at the same time of the day, thus probably,
2 differences in the time of assessment ~~could-might~~ have influenced ~~the lack of~~
3 ~~comparison results differences~~ between students with and without LBP ~~of the present~~
4 ~~study, as it was corroborating results of previous observed by studies.~~²⁰

5 School backpacks were regularly ~~utilized-used~~ by the majority of ~~the~~ students
6 ~~who participateding~~ in the current ~~investigation study~~ (99%); ~~these results are, which is~~
7 consistent with levels of use observed in other studies ~~such as~~ (Heuscher and
8 colleagues²¹). ~~The latter study who~~ suggested that ~~augmenting increasing~~ the weight of
9 the school backpack is associated with ~~increased-higher~~ prevalence of LBP, ~~and~~
10 ~~therefore,~~ causing temporary or permanent postural maladaptation, muscle contracture,
11 and inflammation. ~~In the present investigation~~ ~~Finding from the present study revealed,~~
12 ~~that~~ 128 students (86%) ~~referred-had~~ at least one episode of LBP in their lives
13 attributable to the daily transport of the backpacks, which is consistent with values
14 reported in ~~another study~~ ~~esy.~~⁹ At the moment of the evaluation, 60% of ~~our~~ participants
15 ~~of the present study~~ (N = 90) ~~have~~ reported ~~experiencing~~ LBP; ~~We explored the~~
16 ~~relationship between the school backpacks' weight and LBP, but however,~~ no
17 differences were found between ~~the~~ groups with and without LBP. ~~While-Despite of~~
18 these results are in line with some previous studies,⁹⁻²² others have found associations
19 between LBP and the ~~usual~~ weight of the schools' backpack²³ ~~particularly when it was~~
20 considered the asymmetrical ~~ly~~ carrying on only one shoulder²⁴ ~~that two straps~~
21 ~~backpacks displays minimal energy expenditure comparing with other types of~~
22 ~~backpack, including the asymmetrically one shoulder backpacks, being these last one~~
23 ~~which is~~ associated with higher incidence of dorsal and lumbar pain.²³ In fact, the
24 absence of differences between participants with and without LBP in ~~our~~ ~~the present~~
25 study could be explained, at least in part, because only 18% of ~~the~~ students carry school

1 backpacks on one-shoulder, while 78% use it bilaterally; the remaining 4% of the
2 students use mix trolley and other kinds of school bags.

3 Another ~~important factor to consider~~ source of variation is the time spent
4 between home-and school, and the type of transportation. Prista and colleagues²⁵
5 observed that LBP appears in routes home-school longer than 30 minutes. ~~A large~~The
6 majority of ~~the~~-participants ~~in-of~~ the present study (89%) usually travel by car between
7 home and -school. The remaining 11% of ~~the~~-students, that usually go to school by
8 walking, do it in a short time journey, limiting the time of bearing weight on the back:
9 (34% walk for less than 15 minutes; 35% between 15-30 minutes; 31% over 30
10 minutes). This ~~certainly also~~-have certainly contributed to explain the lack of
11 association between LBP and the school backpacks' weight.

12 Although this study does not provide support for backpack use as risk factor for
13 short-term LBP, ~~we cannot~~ it could be not excluded ~~exclude~~-its long-term effects. In
14 fact, long-term consequences of carrying heavy backpacks by students include
15 discomfort, and back pain.²⁶ Therefore, Bauer and Freivalds²⁷ states that the weight of
16 the backpack should not exceed 10% of the body weight, ~~so that will not cause~~and
17 therefore, could positively contribute to avoid future health problems. ~~Our participants~~
18 ~~had~~-In the present study, the mean values for backpacks weight ~~of was~~ $4.04 \pm 1.24\text{kg}$,
19 and for body weight of $52.8 \pm 12.6\text{kg}$, which falls ~~within~~-above out of limits, and
20 probably also contribute ing to the absence of significant differences between
21 participants with and without LBP.

22 In the present study, girls reported lower mean values for HRQoL than boys in
23 'physical functioning', 'emotional functioning', 'psychosocial health summary score',
24 'physical health summary score', and 'total PedsQL score'. After controlling for the
25 degree of disability, These-those differences were maintained ~~even after controlling for~~

1 | ~~the degree of disability as measured by the RMDQ,~~ with exception ~~for~~ of the
2 | 'psychosocial health summary score' (Table 1). ~~It is our opinion that~~ (The lower
3 | HRQoL exhibited by the girls could be partially explained through the different
4 | recreational activities; ~~with the~~ boys ~~having~~ have more leisure time ~~than girls~~, while
5 | ~~girls~~ female adolescents are probably more focused ~~in~~ helping their mothers in
6 | household chores. Another possible explanation is ~~that~~ related to the onset of puberty
7 | and its associations ~~to~~ ed physique changes; ~~actually, in form and physique present~~
8 | females are facing great ~~greater~~ challenges ~~for the girls, with~~ because, for example, the
9 | onset of menstruation causing frequent complaints, ~~as it was~~ previously observed by
10 | Kolip.²⁸ Furthermore, ~~if~~ individual differences in biological maturation have been shown
11 | to account for the age related declines in HRQoL in UK adolescent females.²⁹ The
12 | hormonal fluctuations that occur in teenage girls may further contribute to changes in
13 | psychological well-being.²

14 | A person with symptoms of LBP is often partially and temporarily diminished to
15 | perform the everyday activities, which negatively impact ~~the on~~ QoL, and legitimizing
16 | *per se* the importance of quantify the subsequent functional disability.³⁰ However, this
17 | is not consensual with others ~~stating that the frequent symptoms of LBP in adolescents~~
18 | ~~have little effect on the HRQoL studies.~~¹⁰ The RMDQ was used in the present study to
19 | assess the degree of functional disability revealing, as expected, higher disability in
20 | those ~~who referring~~ referred LBP, independently of the sex, age and stature (Table 2).
21 | Of note, participants with LBP had lower HRQoL, but only in the dimensions of
22 | 'physical functioning' and 'physical health summary score'; these differences were
23 | ~~maintaining~~ maintained ~~these differences even~~ after controlling for the effects of the
24 | sex, age and stature. These findings highlight the negative impact of the LBP on the
25 | physical domain of the HRQoL in youth.

1 The current study ~~also~~ provides valuable information ~~in that it by suggests~~
2 ~~suggesting~~ that ~~the~~ weight of school backpacks' is ~~not un~~related to LBP, ~~even~~ when the
3 weight is within recommended values. ~~Also the study's~~In addition, ~~-~~findings suggest
4 that girls ~~report~~ have higher levels of disability than boys, and lower HRQoL,
5 particularly in the domains of physical and emotional functioning, which impacts the
6 total HRQoL score, ~~being these differences independent of the disability level.~~ Finally,
7 the present ~~this~~ study suggests that participants with LBP report lower perceived
8 HRQoL, specifically in the physical functioning domain. Collectively, these findings
9 are of importance, especially to ~~in that they~~ encourage parents and teachers to be aware
10 of risk factors associated with LBP. Moreover, ~~as occurrences of~~ LBP tend to be of low
11 intensity and frequency, ~~responsible and~~ adults should be aware that children should not
12 be exposed to excessive loads arising from school supplies, to contribute to a enhancing
13 ~~the chances that students will~~ of better experience ~~better~~ QoL of youth.

14

1 **Conclusion**

2 | ~~The g~~Girls reported higher disability levels and have lower QoL in the domains of
3 | physical and emotional functioning, psychosocial health summary score, physical health
4 | summary score, and in the total PedsQL score than boys. The school backpacks' weight
5 | was similar in both sexes, and is unrelated to LBP ~~when is within recommended values~~.
6 | After controlling for potential confounders, pParticipants with LBP have lower HRQoL,
7 | specifically in the domains of physical functioning, and lower physical health summary
8 | score, ~~with the differences being maintained even after controlling for the effects of the~~
9 | ~~sex, age, and stature~~.

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Table 1. Participants' characteristics and differences between sexes calculated with multivariate analysis, and adjusted for the Roland-Morris Disability Questionnaire (RMDQ)

	Total (N = 149)	Girls (N = 86)		Boys (N = 63)		Group Effect <i>P</i> Values	RMDQ-adjusted <i>P</i> Values
		Min-Max	M (SD)	Min-Max	M (SD)		
		Age (<i>years-old</i>)	13.8 (1.9)	11 - 17	13.9 (1.9)		
Body weight (<i>kg</i>)	52.8 (12.6)	34.0 – 102.9	52.7 (12.0)	28.8 – 92.6	52.9 (13.6)	0.910	-
Stature (<i>cm</i>)	1.57 (0.09)	1.38 – 1.76	1.56 (0.07)	1.35 – 1.81	1.59 (0.10)	0.040*	-
Body mass index (<i>kg/m²</i>)	21.2 (3.8)	15.5 – 36.5	21.5 (3.7)	13.5 – 32.1	20.7 (4.0)	0.211	-
School backpack weight (<i>kg</i>)	4.04 (1.24)	2.10 – 7.00	4.08 (1.15)	1.70 – 7.50	3.97 (1.35)	0.613	-
Roland-Morris (<i>0-24</i>)	5.2 (3.6)	0.0 – 18.0	6.0 (3.6)	0.0 – 14.0	4.2 (3.4)	0.007**	-
Schober test (<i>cm</i>)	15.6 (1.0)	12.5 – 18.0	15.7 (1.1)	13.5 – 17.5	15.4 (1.0)	0.101	-
PedsQL (<i>0-100</i>)							
Physical functioning	72 (16)	13 – 94	68 (17)	31 – 97	79 (13)	<0.001***	0.003**
Emotional functioning	63 (17)	20 – 90	59 (15)	15 – 100	69 (18)	0.001**	0.003**
Social functioning	81 (17)	25 – 100	79 (17)	45 – 100	83 (15)	0.094	0.454
School functioning	74 (16)	25 – 100	74 (15)	10 – 100	74 (16)	0.804	0.705

Psychosocial health summary score	73 (13)	43 – 95	70 (12)	30 – 98	76 (13)	0.021*	0.118
Physical health summary score	72 (16)	13 – 94	68 (17)	31 – 97	79 (13)	<0.001***	0.003**
Total PedsQL score	72 (13)	33 – 93	69 (12)	42 – 97	77 (12)	0.001**	0.016*

Data are expressed as Mean (SD)

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ Significant differences between girls/boys

Table 2. Multivariate analysis between groups, and adjusted for sex, age and stature

Variables	Total (N = 149)	With LBP (N = 90)	Without LBP (N = 59)	Group Effect <i>P</i> Values	Sex-adjusted <i>P</i> Values	Sex and age- adjusted <i>P</i> Values	Sex, age and stature-adjusted <i>P</i> Values
School backpack weight (<i>kg</i>)	4035 (1236)	3918 (1139)	4214 (1361)	0.154	0.141	0.118	0.124
Roland-Morris (0-24)	5.21 (3.62)	6.26 (3.79)	3.61 (2.65)	<0.001***	<0.001***	<0.001***	<0.001***
Schober test (<i>cm</i>)	15.6 (1.0)	15.6 (1.0)	15.4 (1.0)	0.168	0.211	0.204	0.196
PedsQL (0-100)							
Physical functioning	72 (16)	69 (17)	78 (14)	<0.01**	<0.01**	<0.01**	<0.01**
Emotional functioning	63 (17)	62 (18)	64 (16)	0.609	0.820	0.845	0.851
Social functioning	81 (17)	80 (18)	82 (15)	0.450	0.538	0.558	0.571
School functioning	74 (16)	74 (14)	74 (18)	0.876	0.892	0.912	0.921
Psychosocial health summary score	73 (13)	72 (13)	73 (13)	0.530	0.667	0.693	0.705
Physical health summary score	72 (16)	69 (17)	78 (14)	<0.01**	<0.01**	<0.01**	<0.01**
Total PedsQL score	72 (13)	71 (13)	75 (12)	0.056	0.092	0.089	0.094

Data are expressed as Mean (SD)

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ Significant differences between-subjects effects