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| **Author/ year** | **Participants** | **Mean age or age group** | **Sample size** | **Prevalence of back pain**  | **Weight of school bag (% BW)** | **Load Carried (kg)** | **Main Findings** |
| Adegoke 2015 | 15 Randomly selected secondary schools students in Ibadan, Nigeria (10-19 years) | Mean 14.23 (SD 2.27) years | 571 (boys 273, girls 298) | Lifetime = 331 (58%); 12-month = 250 (43.8%); 1-month = 146 (25.6%); Point = 84 (14.7%) | NR | NR | Children who perceived school bag as heavy associated with increased prevalence of back pain |
| Akdag 2011 | Randomly selected schools (8 government and 2 private) in the city of Denizli, Turkey  | 10-18 years | 222 (boys: 106, girls: 116) | 46.8% | NR | NR | No significant relation between bag handling and back pain |
| Alghadir 2017 | 8 secondary schools chosen from different places in Mansoura, Egypt | 12 to 16 years | 250 | 52% (n=130) | NR | NR | Schoolchildren who carried loads such as school bags of ≥5.7 kg and exceeded body weight by ≥6.6% showed higher ranges of LBP (41%–48%) but no significant associations |
| Amyra Natasha 2017 | Students attending a bridging programme (pre-university) in a Malaysian higher learning institution | 16-18 years | 101 | Lifetime 61.4% | 5.87% (IQR 3.48) | 3.5kg (IQR 1.86) - range 0-11kg | Backpack weight is not significantly correlated with low back pain score and Daily Pain Intensity. |
| Aprile 2016 | Pupils attending 39 different state schools in two different areas in Italy | 6 to 19 years | 5318 | >60% reported schoolbag related back pain | 11.3% (5–95 percentile range: 3.8%–22.3%) | 5.0kg (SD 1.9kg) | Schoolbag load is a weak predictor of back pain |
| Ayanniyi 2011 | Randomly selected schools, Ibadan metropolis, Nigeria (10-19 years) | Mean 15.0 (SD 1.7) years | 3185 | Back, neck and thoracic pain, lifetime = 1,863 (59%); point = 529 (17%) / low back pain only 25% (lifetime) | NR | NR | Back pain is common and mild in Nigerian adolescents |
| Balague 1995 | 2 Secondary schools in the canton of Fribourg, Switzerland (Age 12-17 years) | Mean 14 (range 12 to 17) years | 615 (52.5% girls) | Back pain, lifetime = 26%  | NR | NR | Psychosocial factors e.g. negative affect, being female influence likelihood of reporting LBP |
| Bejia 2005 | 2 Randomly selected preparatory schools in Monastir, Tunisia (11-19 years) | Mean 14.1 (SD 1.3) years | 622  | Low back pain, lifetime = 177 (28.4%) | In kids with back pain: mean 6.8% (SD 2.5%) of BW | NR | No association between school bag weight and back pain  |
| Cavlak 2006 | 10 Primary, secondary or high schools in Denizli, Turkey (10-18 years) | Mean 13.91 (SD 2.34) years | 624 (boys 289, girls 335) | Low back pain: point = 292 (46.7%) | NR | NR | No significant correlation between LBP and bag handling overall (p>0.05). However significant correlation between bag handling and LBP for girls (x2= 5.637; p=0.018) |
| Chiang 2006 | 1 School in Manchester, New Hampshire, US (13-14 years) | Mean 13.25 (SD 0.4) years | 55 (boys 21, girls 33) | LBP related to backpack use = 19 (34.5%) | 9.6% (SD:4.5) of body weight | Mean 4.9Kg (SD 2.3) | There was no significant difference when compare the mean backpack weight in the two groups (i.e. having LBP or not). There was no significant difference found in the raw bag weight and children with LBP or not. No significant association was found between LBP and time spent carrying backpack in the time categories. However, longer duration of bag carrying increased risk of LBP |
| De Paula 2012 | Children and adolescents overweight in primary and secondary schools in Vespasiano, Brazil (10-19 years) | Mean 14.01 (SD 2.12) years | 339 (boys 143, girls 196) | Back and shoulder pain: 71 (21%) (mean 14.22 ± 2.20 SD) with minimum of 2 and maximum of 72 months (mean, 2.66 ± 6.97 SD) of onset of symptoms | Mean % of body weight: 12.65% (SD 4.28) (Range 3.34 to 28.92%) | NR | No association between bag weight and pain |
| Dianat 2014 | 20 Randomly selected schools in Tabriz, Iran (12-14 years) | Mean 12.8 (SD 1.27) years | 586 (257 boys, 329 girls) | LBP: Preceding month 33% | Mean 7.1% (SD 2.81) of body weight (range, 1.6-18.4% BW) | Mean 2.8 (SD 0.94)kg (range, 0.86-6.5 kg) | Fewer complaints of back pain in satchel users vs backpack users |
| Dockrell 2015 | Convenience sample of 12 primary schools, Ireland (9-11 years) | Mean 10.6 years (SD 0.6) years | 529 (251 boys and 217 girls | 30% reported discomfort in the region of the back of kids who completed study; 15% reported schoolbag-related discomfort | Mean 12.6% (SD 4.29) of body weight | Mean 4.8kg (SD 1.47) | None of the physical factors (absolute or relative bag weight, carrying additional items, duration of carriage, method of travel to school) predicted backpack discomfort; History of back discomfort predicts backpack discomfort |
| Erne 2011 | 7 Primary schools in Aargau canton, Switzerland (10.5-13 years) (Year 5) | Mean 11.38 (SD 0.55) years | 189 answered (104 girls) | LBP: 14%/ back and neck pain: 15% | NR | Mean 3.39kg (SD 1.06) | The weight of the satchel was a significant risk factor in multiple logistic regression of LBP |
| Giusti 2008 | 2 (1 private and 1 public) schools in Pelotas, Brazil | Age 6-14 years | 463 (233 boys, 230 girls) | Pain reports collected but not reported | 38.2% (n=177) of the children have their backpack weighed more than 10% of their own body weight | Range: 1.5kg to 6.5kg | Private school children carry more weight to school but no association with back pain |
| Grimmer 2000 | 12 High schools in Adelaide, SA (12-18 years) | Mean 14.8 (SD 1.5) years | 1269  | LBP (last 2 weeks): 25.4% | 7.9 to 10.7% of BW (mean 9.2 (SD 0.99)) | Range from 4.9 to 6.5kg (mean 5.4kg (SD 0.50) | Bag weight and duration carried associated with LBP in some year groups but not consistently |
| Gunzburg 1999 | Primary school children (State school medical system) in Antwerp, Belgium (Age 9) | NR | 392 (202 boys, 190 girls) | LBP: Lifetime = 36% (n=142) | NR | NR | The way in which the school satchel was carried [in the hand or on the back] did not influence the prevalence of LBP. Children reporting LBP more often found their school satchels too heavy in comparison with the other children. |
| Harreby 1999 | 46 Schools, Sealand, Denmark (13-16 years) | 92.4% of them were either 14 or 15 years of age | 1389 (671 boys, 718 girls) | LBP, lifetime 58.9%; point 5.3%; 1-year 50.8%; 1-month 30.6%; 1-week 13.9% | NR | NR | 131 (18.5%) students reported that "carrying school satchel" provoke LBP |
| Haselgrove 2008 | Participants recruited from the Western Australian Pregnancy Cohort ‘Raine’ Study (Birth cohort study), Western Australia | Mean 14.1 (SD 0.2) years | 1202 | Lifetime LBP: 47% | NR | NR | Perceived school bag load, duration of carriage and method of transport to school are associated with back and neck pain |
| Johnson 2011 | Secondary schools in LFE central local government, Nigeria | Mean 14.01 (SD 2.17) years | 381 | LBP: Point: n=70 (18.37%) | Mean= 10.16 (3.87)% | Mean: 4.48kg (1.39) | No association between normal/ above normal bag weight % on reports of low back pain |
| Kaspiris 2010 | Children aged 7.5 to 14 years during their visit to a Pediatric Department | Mean 11.2 (SD 2.10) years | 692 | LBP: 153 (22.1%) | NR | NR | No statistically significant association for the child’s perception of the weight of the school bag and whether it is carried by hand or on the back or even by either of the parents. |
| Korovessis 2004 | Primary and high schools in the Prefecture of Achaia, Peloponessos, Greece | Mean 12 (SD 1.5) years | 3441 | 671 (21%) reported LBP during backpack carrying692 (21.4%) reported dorsal pain (thoracic) during backpack carrying291 (8.7%) reported simultaneously LBP and dorsal pain while backpack carrying | NR | Mean 4.6kg (SD 1.2) | No association between method of carrying bag (e.g. one or two shoulders) and back pain. No correlation was shown between LBP and backpack weight percentage. |
| Korovessis 2005 | High schools in the Prefecture of Achaia, Peloponessos, Greece (12-18 years) | Mean 15 (SD 2) years | 1263 | Back Pain: 27.7% | Mean 10.6% (SD 3.5%) of BW | NR | There was no statistically significant association between LBP and backpack's weight (%BW). |
| Korovessis 2010 | 5 Randomly selected high schools (Students aged 16±1 years) | Not reported (Range 15 to 17 years) | 711 invited, 688 answered | LBP: Last 6 months n=278 (41%) | NR | Backpack weight: Normal=283 (41.1%); Heavy=293 (42.6%); Very heavy=55 (8%) | No association. |
| Kovacs 2003 | Schools of the island of Mallorca (Ages of 13 and 15) | NR | 7048 | LBP: Lifetime 50.9% for boys and 69.3% for girls (total 60.6%.Point (7 days): 17.1% for boys and 33% for girls (total 25.5%) | NR | NR | There was no significant association observed between LBP and schoolbag use.  |
| Limon 2004 | Elementary schools within the central health district, Israel | NR | 155 schools invited, 101 schools answered (>10000 students) | NR | NR | NR | Authors did not correlate the variables with LBP prevalence |
| Macedo 2015 | 12 classes in two schools in Rio Branco, Brazil | Mean 13.8 (SD 1.9) years | 149 (boys 63, girls 86) | 90 students with back pain (60.4%) | NR | Mean 4.04 kg (SD 1.21 kg) | No significant difference between LBP and no LBP groups in relation to backpack load in kg |
| Macias 2008 | NR | Mean 13.2 (SD 0.8) years | 10 (boys 5, girls 5) | NR | NR | NR | No relevant data for the study |
| Minghelli 2014 | Public schools from all municipalities of the Algarve | 10-16 years | 966 (boys 437, girls 529) | LBP at the moment 15.7%; past year 47.2%; lifetime 62.1 % | Adequate weight (<= 10% of BW): 569 (58.9%); Excess of weight (>10% of BW): 397 (41.1%) | NR | No association between backpack weight and LBP. For the multivariate model way of carrying backpack was associated with LBP |
| Minghelli 2016 | Public schools, Algarve, Portugal | 10 to 16 years | 966 | Annual 47.2% | 41.1% had backpack weighing > 10% BW | 4.37kg (SD 1.51) | No association between heavy bags and LBP |
| Mirza 2015 | One of the private (Charitable) schools in Lahore (Amal School, Tulspura) during 4 weeks | 6-10 years: 71 (65.1%); 11-15 years: 38 (34.9%) | 109 girls | NR | 1 to 10% BW = 15 (13.4%); 10-15% BW = 34 (31.2%); 15-20% BW = 49 (45%); 20-50% = 11 (10%) | 1 to 4kg = 32 (29.4%)5 to 9kg = 73 (67%)10-14kg = 4 (3.7%) | No analysis on the association between back pain and backpack weight |
| Mohseni-Bandpei 2007 | 5000 Randomly selected state schoolchildren in urban area (11 to 14 years) | Mean 13.1 (SD 0.85) years | 4813  | LBP: point 15% ; last month 14.4%; previous 6-months 15.6%; last year 17.4% | NR | Mean 1.73 kg (SD 0.49) | No significant association between backpack and LBP |
| Moore 2007 | 531 Students from different public schools, Northern California (3 high schools (grades 9-12, ages 13-18), and 2 middle schools (grades 5-8, ages 8-13)) | NR | 531 (boys 244, girls 287) | 49.2% reported pain (anywhere); 15.7% neck pain; 37.2% upper back or shoulder; 27.6% lower back | Mean 10.7% of BW (SD 4.5), ranged from 1.8% to 33.3% | NR | Pain reporters (anywhere) had higher relative backpack weight compared to non-reporters. Those with upper and mid back pain had higher backpack weight but not back or neck pain |
| Murphy 2007 | 12 (out of 54) State secondary schools in Surrey, England (11-14 years) | Mean 12.8 (SD 0.9) years | 679 (boys 343, girls 336) | LBP: Last month 149 (22%); Lifetime 372 (55%) | Mean 7% of BW | Mean 3 kg | No association between backpack weight and LBP (month and lifetime prevalence) |
| Navuluri 2006 | 2 junior high schools in Hobbs, New Mexico, USA | Mean 13.1 years | 1260 invited, 59 answered | Children reporting back and neck pain: 44 (74.6%); Extremely weak to weak (0.3 - 2.5): n=12 (20.3%); Moderate to strong (3.0 - 6.0): n=26 (44.1%); Very strong to extremely strong: n=6 (10.2%) - data for back and neck pain together! | Mean 14.8% of BW | Mean 7.49 kg | No association |
| Negrini 2002 | The school catchment area of Bresso, Milan | Mean 11.6 (SD 0.34) years | 237 (111 with backpack weight analysis) | LBP: Lifetime: 47.7%; Point: 15.6% | NR | NR | No significant association for backpack weight and feeling the backpack heavy (perceived weight) |
| Noll 2016a | Public high school students that regularly practice sports, Brazil (14–20 years) | Mean 16.4 (SD 1.4) years | 251 young athletes answered | LBP (3 months prior to the study): 43.7% (n = 104) | NR | NR | No significant association between LBP and bag design or method of carrying |
| Noll 2016b | 11 schools of Teutonia, RS, Southern Brazil | 11 to 16 | 1720 | 3-month 55.7% | NR | NR | No association between carrying school supplies in backpack and LBP; no association between strap use and LBP |
| Noll 2016c | Public high school students state of Goiás, in the Brazilian Midwest, that regularly practice sports. | 14 to 20 | 251 | 3-month 43.7% | NR | NR | No association between schoolbag weight and backache |
| Onofrio 2012 | Students attending high schools (13-19 year) | Mean 15.9 (SD 1.2) years | 1233 | LBP last 30 days: 169 (13.7%) | NR | NR | No significant association between LBP and bag design or backpack weight |
| Pires Sanchez 2011 | Children (10-11 years) | NR | 721 | Back pain: Lifetime n=222 | NR | NR | No association |
| Poursadeghiyan 2017 | 16 girls primary schools in Ilam, Iran | NR | 244 | 5.3% | 66.4% carried <10% BW | NR | No association between schoolbag weight and backache |
| Rodriguez-Oviedo 2012 | Schools in Northern Galicia, Spain (Aged 12–17) | Mean 14 years | 1403  | LBP for more than 15 days (previous year): n=363 (25.9%) | >10% of the body weight: n=861 (61.4%); >15% of the body weight: n=253 (18.1%) | Mean 7 kg | Participants carrying school bags on the highest quartile had a 50% higher risk of back pain for more than 15 days |
| Sedrez 2015 | Students (7-18 years) | Mean 12.9 (SD 2.3) years | 59 | LBP in the last 3 months: n=44 (74.6%) | NR | NR | No association |
| Shehab 2005 | Kuwaiti children and adolescents (Aged 10-18 years) | Mean 14.4 (SD 2.5) years | 400 | LBP: Lifetime: 231 (57.8%) | NR | NR | There was no association of the method of carrying ‘school supplies’ with the presence of LBP |
| Sheir-Neiss 2003 | Children (Aged 12-18 years) | 12 to 18 | 1126, but 1122 with backpack data | Back pain: Point: n=835 (74.4%) | NR | NR | No association |
| Skaggs 2006 | A population-based sample of 1540 children in a large metropolitan area (11-14 years) | Mean 12.4 (SD 1.04) years (range 10-15) | 1540 | Back pain: Point: n=572 (37%) | Mean 7% of BW | Mean 4 kg | No association |
| Skoffer 2007 | Schoolchildren (Aged 14-17 years) | Not reported (Aged 14-17 years) | 555 invited, 546 answered | LBP: Lifetime n= 354 (64.8%); Previous 12 months: n= 329 (60.3%); Previous 3 months: 280 (51.3%) | NR | Median 4.0 kg (range 0-11 kg) | The weight of the school bag was not associated with LBP, but carrying the school bag on 1 shoulder was positively associated with LBP |
| Skoffer 2008 | Schoolchildren (9th grade) of 14 public schools in the municipality of Aarhus | NR | 555 invited, 546 answered | LBP: Lifetime n= 354 (64.8%); Previous 12 months: n= 329 (60.3%); Previous 3 months: 280 (51.3%) | NR | NR | Same data as Skoffer 2007 - but no data about backpack. |
| Spiteri 2017 | All schools in Malta | 8 to 13 years | 4005 | 32% reported the presence of low back pain | 71% carried >10% BW | median 5kg | Bag weight significantly contributes to back pain |
| Talbott 2009 | Three school districts (10–18 years) | NR | 870 | Pain: Point 292; LBP: n=97 (33.2%) | NR | NR | No association |
| Trevelyan 2011 | New Zealand intermediate school children (Aged 11–14 years) | NR | 245 | NR | Mean 4.92 % (SD 2.60) - range 0-15.44 kg | Mean 2.07 kg (SD 0.96) - range 0-5.25 kg | Although children who reported low back pain in the last month were found to carry heavier bags than those without back pain (2.21 kg vs. 1.97 kg), the relationship was not significant |
| Troussier 1994 | School children (Aged 6-20 years) | Mean 12.8 (SD 3.47) years | 1178 | Back pain: lifetime 22.6% | NR | NR | No variables correlated with back pain |
| Turk 2011 | 2 Schools in the city of Maribor, Styria region, Slovenia (Aged 11-18 years) | Elementary school: 13.6 years (SD 1.9); Secondary school: 17.5 years (SD 0.4) | 190 | LBP: Previous 3 months: Elementary school: n=43 (43%); Secondary school: n=40 (44%) | NR | NR | 44% of children mention back pain due to carrying a school bag but no association |
| van Gent 2003 | Young adolescents in the area of two Regional Health Centers in the Netherlands | 12 to 14 years | 745 | Back pain: previous 3 months 46.5% | Mean 14.7% (range 5.5-29.3%) of BW | Mean 7.8 kg (range 3.2-12.9 kg) | No association between schoolbag use and LBP; The overall way of carrying was not related to LBP. There was an association between the perceived weight of the bag and the occurrence of back complaints |
| Viry 1999 | Children (8th grade), France | Mean 14 (SD 0.6) years | 123 | Back pain: Point: 27.6%; Last 12 months: 82.9%; Frequency of pain: Once: 16.3%; More than one: 57.7%; Daily: 8.9% | Mean 19.3% (SD 6.8) of BW | Mean 9.6 kg (SD 2.9) | No association between LBP and % of body weight or method of carrying the schoolbag |
| Wall 2003 | A computerized medical records search was used to identify a retrospective cohort of patients with LBP | Average 14 (range 6 to 18) years | 346 (boys 109, girls 237) | All patients included had back pain | NR | NR | Only 1 child attributed back pain to wearing a backpack and only three patients stated that their back pain was made worse by carrying their backpack |
| Watson 2003 | Schoolchildren (Aged 11-14 years) | NR | 1446 | LBP: Last month: n=330 (23.9%) | Median 9.7% (IQR 7.1-12.6%) of BW | Median 4.5 kg (IQR 3.6 to 5.9 kg) | There was no relation between average load carried and the likelihood of reporting LBP. However, LBP was not significantly associated with either the type of bag carried or the method of carrying (data not shown). There was no significant relation between percentage body weight carried and the likelihood of reporting LBP |
| Watson 2002 | Children in the North-West of England (Aged 11–14 years) | 11 to 14 years | 1446  | LBP last month: n=330 (23.9%) | NR | NR | Of those with low back pain, 94% also reported having difficulty with at least one of the nine activities on the modified Hanover low back pain Disability Questionnaire. The activities which gave the most difficulty were carrying a school bag (65%) sitting at school (53%) and sports activities (50%) |
| Whittfield 2005 | 5 Randomly selected Auckland schools (from a list of co-educational secondary schools) | Mean 15.4 (1.0) years | 140 | Upper back: 36.4%; Lower back: 35% | Mean 11.7 (SD 4.3) | Mean 6.6 (SD 2.2) | No link was found between the weight of the bag carried and the incidence of pain |
| Whittfield 2001 | 5 Randomly selected Auckland schools (from a list of co-educational secondary schools) - (Same data as Whittfield 2005) | NR | NR | NR | NR | NR | No analysis on pain just descriptive study |
| Wirth 2013 | Children in Switzerland (Recruited throughoutby advertisements distributed in chiropractic practices) (Aged 6-16 years) | Mean 10.3 (SD 2.8) years | 1040 invited, 836 answered | LBP: 152 out of 808 (18.8%) - calculated for all age groups | NR | NR | No association between bag design and LBP |
| Yao 2012 | Elementary and secondary schools distributed in Guangzhou City | Mean 15.2 (SD 2.15) years | 1214 (607 cases and 607 controls) | LBP: 607 cases (with LBP) | NR | Cases <3kg: 127 (20.9%); 3.1-5.0 kg: 232 (38.2%); >5.0 kg: 248 (40.8%); Controls <3 kg: 158 (26%); 3.1-5.0 kg: 239 (39.4%); >5 kg: 210 (34.6%) | Duration of carrying schoolbag was associated with LBP (long duration) |