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Prevalence and patterns of physical activity among school aged adolescents in Pakistan: a systematic review and meta-analysis

Ayesha Imtiaz^a, Zia ulHaq^{a,b}, Saima Afaq^{a,c}, Muhammad Naseem Khan^{a,d} and Basharat Gillani^a

^aInstitute of Public Health & Social Sciences, Khyber Medical University, Peshawar, Pakistan; ^bDepartment of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, UK; ^cSchool of Public Health, Imperial College London, London, UK; ^dDepartment of Psychological Medicine, University of Liverpool, Liverpool, UK

ABSTRACT

Less than one fifth of Pakistani adolescents, aged 13–15, years achieve recommended activity levels. This systematic review and meta-analysis was conducted to determine a pooled estimate of the prevalence of PA, and to systematically evaluate the literature available on PA among adolescents in Pakistan. A systemic search of databases was conducted. In addition, hand search of references of all the included relevant publications was performed. Random effects meta-analysis was used to get weighted prevalence of PA among adolescents. Quality of undertaken studies was assessed using New-Castle Ottawa Scale. After removing duplicates, reviewing titles and abstracts and screening full texts, 15 articles were included for analysis. All studies were conducted in school setting, with a total sample size of 10,651. Weighted pooled prevalence of PA among adolescents was 36.0% with high heterogeneity (99.28%). Most of the studies met study quality assessment criteria except for comparability of subjects in different outcome groups and assessment of outcome. Prevalence of PA among adolescents is low in Pakistan. Formal strategies are needed for promoting PA among adolescents for their improved health and for reducing future burden of NCDs.

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KEYWORDS

Physical activity; adolescent; prevalence; Pakistan

Background

Regular physical activity (PA) is imperative for promoting physical and mental health and well-being in adolescence and preventing various health conditions (Centre for Disease Control and Prevention [CDC], 2018). Physical activity is associated with improved cardio-respiratory fitness, increased musculoskeletal strength, reduced symptoms of anxiety and depression and reduced risk of developing numerous non-communicable diseases. Increased physical activity also has societal benefits by increasing social interaction and community engagement (CDC, 2018; World Health Organization [WHO], 2016, 2018).

Promoting PA in early life is of greatest importance for healthy development of children and young people. Physically active students have demonstrated higher academic and cognitive performance (CDC, 2018; WHO, 2016, 2018). According to World Health Organization (WHO) 'children and adolescents aged 5–17 years should have least 60 minutes of moderate to vigorous intensity physical activity daily'. However, only one in five (20%) adolescents has recommended level of PA (WHO,

2018). Similarly, only 15.5% Pakistani adolescents aged 13–15 years had recommended activity levels, with girls being more physically inactive (WHO, 2009).

Whereas some studies on the prevalence of PA among Pakistani adolescents have been undertaken, a systematic review and meta-analysis on the prevalence and patterns of PA among Pakistani adolescents have, this far, not been undertaken. Two such reviews identified during literature search were without meta-analysis. The first of the aforementioned, which was a systematic review reporting on insufficient PA among South Asians aged 25–64 years, included only one study from Pakistan (Ranasinghe et al., 2013). The second was a narrative review determining PA rates among school-age children and adolescents in Asia. The said review contained two studies from South Asia, with one study being from India and the other from Sri Lanka. There was however no study from Pakistan in the review (Müller et al., 2013).

Objectives

The purpose of this systematic review and meta-analysis was to determine the prevalence of PA among adolescents, to determine the proportion of adolescents having PA in compliance with WHO recommendations and establish different prevailing PA patterns in the target population. Results from the studies included in meta-analysis were pooled together to get an average estimate of physical activity prevalence among adolescents in Pakistan. This review systematically evaluated, summarized and assessed the quality of literature available on PA amongst adolescents in Pakistan. In addition, comprehensive evidence on PA level of adolescents was shared with researchers, policy makers and healthcare professionals for incorporating research findings in relevant evidence-based policies and programmes.

Methods

A systematic review of published studies reporting physical activity among adolescents in Pakistan was undertaken between January 2019 and November 2019. The 'PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analysis) statement' for reporting systematic reviews and meta-analysis was used as a guide for reporting this systematic review (Moher et al., 2009) (Annexure 2).

Search strategy

A comprehensive literature search was conducted from 1 March 2019 to 30 April 2019. Databases such as MEDLINE, EMBASE, CINAHL Plus and Web of Science were searched systematically, using OVID and EBSCOhost search engines. Pak MediNet was used for searching articles published in Pakistani Medical Journals. Literature search was conducted through a combination of MeSH terms/key words for 'physical activity', 'adolescent' and 'Pakistan'. Additional studies were identified by screening reference lists of research articles included in the review. Detail of the search strategy is given in Annexure 1.

Articles retrieved from search of databases were pooled together and duplicates were removed. Articles were further screened by titles and abstracts using pre-defined inclusion criteria. Finally, the full text articles were screened and those not fulfilling eligibility criteria were excluded. Additional data was obtained through secondary search, including hand-searching of reference lists of selected articles. Furthermore, data was also retrieved by searching relevant web sites and online resources.

The literature search was independently carried out by three reviewers (AI, SA and SR). A final decision on inclusion of articles to be included in the review process was taken after exhaustive discussions through a consultative process.

Eligibility criteria

Inclusion criteria employed during the search process was: (i) an original research study presenting data on physical activity; (ii) cross-sectional studies/surveys or the first phase of experimental studies measuring PA; (iii) studies conducted in Pakistan or multicentre studies reporting separate data on PA of adolescents in Pakistan; (iv) government or organizational reports presenting original data on physical activity of adolescents in Pakistan; (v) studies conducted in institutional settings (public/private/combination thereof) or community settings,(rural/urban/combination thereof); (vi) studies assessing PA using subjective measures (e.g. questionnaires) and/or objective measures (e.g; accelerometer); (vii) school-aged adolescents between 10 and 19 years of age, boys, girls or both, living in Pakistan. Exclusion criteria employed in the search process was: (i) studies only published as comment, or review, editorials, commentaries, book chapters and book reviews; (ii) studies published only as abstracts or full text article not available; (iii) studies reporting only sedentary behaviours or time spent being sedentary; (iv) studies measuring PA in children and young people that do not separately present results for adolescents; and (vi) studies reporting on adolescent population with disabilities or illnesses that compromised their ability to undertake PA.

Operational definitions

Adolescent is defined as ‘an individual in the 10–19 year age group’(World Health Organization, 2019a). This study included adolescent population of middle or high school level age groups. A *Physically Active* adolescent is defined as ‘an individual having at least 60 minutes of moderate to vigorous-intensity physical activity daily’ (WHO, 2018) *Physical Activity* was measured as: time spent undertaking physical activity per day/week, steps/metres walked per day, amount of energy spent per day measured as calories and daily metabolic equivalent of activity (minutes or hours)”. *Prevalence of Physical Activity* among adolescents is measured as ‘proportion of adolescents who are physically active’. *Patterns of Physical Activity* included types (aerobics, exercises, sports), intensity (moderate to vigorous) and duration of physical activity with reference to World Health Organization (WHO) standards for measurement of physical activity (WHO, 2018, 2019c).

Data extraction

The principal reviewer (AI) extracted data from the studies included in this review by using a purpose-built proforma which was checked by a second reviewer (SA) for ensuring accuracy. Data extracted from each study included information on: (i) study details (authors, country/city, year of publication), (ii) methods (study design, study setting, sample size, sampling technique, sample characteristics (age in years/gender), data collection tool used, outcome measures, operational definitions and statistical analysis techniques) and (iii) number of participants, summary statistics, physical activity related data. Discrepancy in the extracted data was resolved through discussion and where required, by involving a third reviewer (BG).

Risk of bias (Quality assessment)

“Newcastle – Ottawa Quality Assessment Scale (adapted for cross sectional studies) was used to assess the quality of the studies included in the review (Modesti et al., 2016). The following three criteria were employed: (i) selection (representativeness of sample, sample size, non-respondent, ascertainment of the exposure (risk factor); (ii) comparability (control of confounding factors); (iii) Outcome (assessment of the outcome & statistical test used). The following maximum score was adopted for each criterion: (i) selection (5 stars); (ii) comparability (2 stars) and (iii) outcome (3 stars). Any disagreement on score was resolved through consensus and a final agreed-upon rating was assigned to each study. The studies included in review were rated based on total score as:

Very Good Studies (9–10 points), Good Studies (7–8 points), Satisfactory Studies (5–6 points) and Unsatisfactory Studies (0 to 4 points)".

Data analysis

Random effects model was used to find the weighted average prevalence of physical activity among adolescents with 95% CIs for the studies and was presented as forest plot. Heterogeneity was assessed using the Cochran Q and the I^2 statistic. Stata version 15 was used for statistical analysis.

Results

Study characteristics

Literature search using the above mentioned search criteria identified a total of 1198 articles in the respective sources, comprising of; Embase [n = 613], Medline [n = 357], CINAHL Plus [n = 111], Web of Science [n = 29] and Pak MediNet [n = 45]. Additionally, 43 records were identified through hand search [n = 33], other internet sources [n = 9] and World Health Organization website [n = 1]. After removing duplicates, 756 titles and abstracts were reviewed and 51 articles were selected for full text review. After a full text review, fifteen articles were included in qualitative synthesis (narrative review) and eight articles were included in meta-analysis. (Figure 1) (P#31)

All included studies were cross-sectional, conducted in school setting; (i) both public and private school [n = 7] (Afzal et al., 2018; Iqbal et al., 2017; Jabeen et al., 2018; K. Khan et al., 2016; Qureshi et al., 2011; Warraich et al., 2009); (ii) private schools only [n = 4] (Anwar et al., 2010; Chattha et al., 2019; Y. Khan et al., 2015; Rizwan et al., 2011); (iv) school setting not mentioned [n = 4] (Hakeem et al., 2002; Ishaque et al., 2012; Rehman et al., 2003; WHO, 2009). All studies were conducted exclusively in Pakistan except for one study, which was done both in Pakistan and the

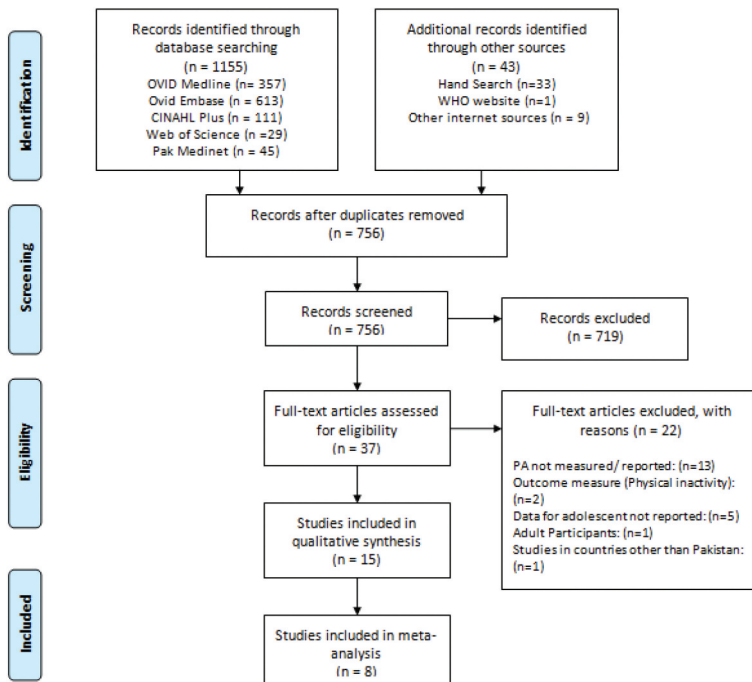


Figure 1. PRISMA Flow Diagram of the Literature Search Strategy.

United Kingdom (Hakeem et al., 2002). The studies were conducted between 2002 and 2019, in different cities of Pakistan: Karachi [n = 6] (Ishaque et al., 2012; Jabeen et al., 2018; K. Khan et al., 2016; Rehman et al., 2003; Rizwan et al., 2011; Warraich et al., 2009); Hyderabad [n = 1] (Ahmed et al., 2016); Okara [n = 1] (Afzal et al., 2018); Faisalabad [n = 1] (Qureshi et al., 2011); Gilgit [n = 1] (Y. Khan et al., 2015); Sialkot [n = 1] (Chattha et al., 2019); and Lahore [n = 1] (Anwar et al., 2010). Three studies were multi-centred, conducted in more than one city of Pakistan: Islamabad & Rawalpindi [n = 1] (Iqbal et al., 2017); Lahore and Kala Shah Kaku [n = 1] (Hakeem et al., 2002); and a third study titled Pakistan Global School-based Health Survey (GSHS) 2009 (WHO, 2009) which had nationwide coverage. Summary of the characteristic of the studies included in systematic review is given in Table 1 (P#34).

Operational definition and Data Collection Tool

Most of the studies [n = 12] included in the systematic review measured PA in terms of types, duration and intensities of activities based on data derived from questionnaires and calculated the proportions of children involved in activities of different time, duration and intensities. Two studies calculated mean physical activity score, using the Physical Activity Questionnaire (PAQ) for children (Jabeen et al., 2018) and adolescents (Y. Khan et al., 2015). PAQ is a seven days' recall questionnaire with 5 point Likert scale. PA is categorized as low (1), moderate (2–4) and high (>5) based on score derived from eight items in the questionnaire (Jabeen et al., 2018; Y. Khan et al., 2015). One study measured average time spent in physical activity using the Factorial Method (Hakeem et al., 2002). Operational definitions used for measuring physical activity varied widely in the included studies.

Validated questionnaires were used in six studies including 'School Health Action Planning and Evaluation System'¹¹ (SHAPES)' [n = 1]; 'Physical Activity Questionnaire for older children (PAQ-C)' [n = 1] (Jabeen et al., 2018); and 'Physical Activity Questionnaire for adolescents' (PAQ-A) [n = 1] (Y. Khan et al., 2015). A modified version of 'International Physical Activity Questionnaire' for children was used in one study to measure the PA (Rizwan et al., 2011). All these questionnaires were modified and pilot tested for local use. The 'Global School-based Student Health Survey Questionnaire' was used in two studies (Ishaque et al., 2012; WHO, 2009); however, the questionnaire was modified for local use in study by Ishaque et al. (2012). Eight studies used self designed questionnaires for assessment of PA [n = 8] (Afzal et al., 2018; Anwar et al., 2010; Chattha et al., 2019; Iqbal et al., 2017; K. Khan et al., 2016; Qureshi et al., 2011; Rehman et al., 2003; Warraich et al., 2009). One study used Factorial Method for determining physical activity level of adolescents, where all participants kept three-days' record (2 weekdays and 1 weekend day) of their activities, in specially designed diaries. Activities were then grouped according to their intensity and determined on the basis of 'Physical Activity Ratio (PAR)'. Overall PA level of each subject was calculated on the basis of average time spent per day in activities of varying intensity (Hakeem et al., 2002).

Findings of research studies

The sample size from 15 studies ranged from 116 to 5192. The total sample size of all included studies was 10,651. Study participants were school-aged adolescents between 10 and 18 years of age, from grade 6 to grade 10. Fourteen studies included both male and female students. (Afzal et al., 2018; Ahmed et al., 2016; Anwar et al., 2010; Chattha et al., 2019; Hakeem et al., 2002; Iqbal et al., 2017; Ishaque et al., 2012; Jabeen et al., 2018; K. Khan et al., 2016; Y. Khan et al., 2015; Rehman et al., 2003; Rizwan et al., 2011; Warraich et al., 2009; WHO, 2009); whereas one study had only male participants [n = 591] (Qureshi et al., 2011). There were 2,595 male and 1,607 female students. Three studies did not give number of male and female adolescents (Afzal et al., 2018; Hakeem et al., 2002; WHO, 2009).

Prevalence of physical activity

The overall proportion of physically active children ranged from 12.3% to 61.9%, however the proportion achieving recommended level of physical activity was reported in only two studies (K. Khan et al., 2016; WHO, 2009). According to Pakistan GSHS⁴ 2009, 15.5% (95% CI: 10.6–22.0) students were physically active for at least 60 minutes per day on five or more days during the preceding seven days (K. Khan et al., 2016; WHO, 2009). More boys were physically active 17.2% (95% CI: 11.3–25.3) than girls 12.7% (95% CI: 6.5–23.3). In a study by K. Khan et al. (2016); no participant had regular activity for more than one hour and 6.0% (n = 07) had daily activity of less than one hour. In a study by Y. Khan et al. (2015); mean physical activity score for students was 2.0867 (+ 1.04139), indicating moderate level of physical activity. Male students had higher physical activity levels as compared to female students.

Type of physical activity

In a study by Ahmed et al. (2016) more than half of the high school students (61.9%) did some type of exercise or sports activity when at home and participated in games in their neighbourhood, while 197 (39.3%) students had active mode of travel to school: they either went to school by walk or on a bicycle. Physically active students on the average spent 6.2 ± 5.9 and 5.3 ± 5.2 hours on moderate and hard PA, respectively. Findings from study by Rizwan et al. (2011) indicated that of the total 339 students between 11 and 17 years, 202 (59.6%) had physical education of more than 30 minutes duration per class, 114 (33.6%) students had unscheduled physical activity for 20 minutes or more per day at school, while 85 (25.1%) had physical activity of 20 minutes or more per day outside of the school. Chattha et al. (2019) found that only 12.3% students exercised for more than 150 minutes/week. In a study by Rehman et al. (2003) 63% considered themselves to be active, 31% students spent their leisure time in indoor games and 53% in playing outdoors, whereas 65% had school-based activities.

Intensity/level of physical activity

Ahmed et al. (2016) found that two-third (n = 374: 74.7%) high school students did moderate exercise per week and 338 (67.5%) students did hard exercise per week. Similarly, 76 (15.2%) students did exercise for flexibility of muscles and 64 (12.8%) students did muscle-strengthening exercise for more than 4 days a week. The students spent a mean time of 6.2 ± 5.9 hours in moderate physical activities and 5.3 ± 5.2 hours in hard physical activities. Jabeen et al. (2018) reported that no student had high physical activity level. Activity level of 151 (69.9%) students was moderate, while 65 (30%) students had low physical activity. Overall, more public school adolescents had moderate physical activity (83:77.6%) as compared to private school-adolescents (68:62.4%). In a study by K. Khan et al. (2016), no participant had strenuous activity for more than one hour whereas 2.6% (n = 03) had daily activity of less than one hour. Chattha et al. (2019) reported in their study that one in ten (10.8%) students went to school by foot, 4.2% by cycle and 85% by motor vehicle.

Eight studies assessed the association of physical activity in children with different outcomes including overweight/obesity [n = 4] (Chattha et al., 2019; Qureshi et al., 2011; Rizwan et al., 2011; Warraich et al., 2009); socio-economic status [n = 1] (Iqbal et al., 2017); both with obesity & socio-economic status [n = 1] (Ishaque et al., 2012); levels of urbanization [n = 1] (Hakeem et al., 2002); and psychological well being [n = 1] (Y. Khan et al., 2015). Detailed results are given in summary Table 1. (P# 34,35)

Table 1. Summary of the characteristics of studies included in Systematic Review assessing the prevalence of physical activity among adolescents in Pakistan.

| Author [yr], city, setting (school) | Sample characteristics | Assessment tools | Measure of PA | Results |
|--|--|---|---|---|
| 1 Ahmed et al. (2016), Hyderabad ¹¹ , Public and Private | N (boys/girls) = 501 (255/246) Mean Age: 13.8 ± 1.6 years Grade: 6th – 10th Sampling: Simple Random | Structured questionnaire adapted from the School Health Action Planning and Evaluation System (SHAPES). | Exercise type & duration/day in last 1 week. Moderate PA: walking, brisk walking, yoga, dancing & skipping; Hard PA: sports like body building, racket games, swimming and running. Commuting to school: Active by walking or cycling and inactive by car, bus or other transport. | PA Prevalence: 61.9%, Time (hrs) spent on moderate PA: 6.2 ± 5.9, hard PA: 5.3 ± 5.2. Typical week of moderate exercise (%) : Yes: 374 (74.7), No: 127 (25.3); Typical week of hard exercise (%) : Yes: 338 (67.5), No: 163 (32.5); Individual exercises after school (%) : Yes: 310 (61.9), No: 191 (38.1); Games outside school (%) : Yes: 296 (59.2), No: 204 (40.8). |
| 2 Anwar et al. (2010), Lahore ¹⁸ , Private | N (boys/girls) = 293 (131/162) Mean Age: 12.8 ± 4.5 years Grade: 6th & 7th Sampling: multistage cluster | Self-designed and pretested questionnaire | Participation in sports | N (%) participating in field sports/week: Obese: No sports: 17 (48.6), < 3 hrs: 12 (34.3), 3 – 6 hrs: 4 (11.4), > 6 hrs: 2 (5.7); Overweight: No sports: 28 (43.8), < 3 hrs: 22 (34.4), 3–6 hrs: 9 (14.1), > 6 hrs: 5 (7.8). Normal: No sports: 14 (11.1), < 3 hrs: 37 (26.8), 3–6 hrs: 54 (39), > 6 hrs: 33 (24). |
| 3 Hakeem et al. (2002), Lahore, Kala-Shah-Kaku ²² , schools | N = 407 Age: 10–12 years Grade: 6th and 7th Sampling: School Purposive, Students: Census | Factorial Method | Mean time spent in physical activity | Time spent in light activities (standing-light work/play): 2.23 hrs – 4.44 hrs Time spend in active games: 0.87–0.9 hrs Rural boys had lower PAL than the urban. Urban: boys had higher PAL than girls Rural: girls had higher PAL than boys |
| 4 Iqbal et al. (2017), Islamabad and Rawalpindi ¹² , Public and Private | N (boys/girls) = 332 (263/69) Age: 11–16 years Sampling: Simple Random | Self-designed structured questionnaire | Mode of transport used (walk, bicycle, car). Use of stairs instead of elevator (Frequency) Activities during leisure time (indoor, sports, sleep) (Frequency) | Low SES students n(%) : Mode of transport: walk-time: 37 (33.3); Daily Exercise: 44 (39.6) Middle SES students n(%) : Mode of transport: walk-74 (66.7), bicycle- 9 (8.1); Sports during leisure time: 56 (50.5); Daily Exercise: 43 (38.7) High SES students n(%) : Mode of transport: walk-48 (43.6), bicycle-21 (19.1); Sports during leisure time: 58 (52.7); Daily Exercise: 39 (35.5) |
| 5 Ishaque et al. (2012), Karachi ²³ , Schools | N (boys/girls) = 431 (247/184) Mean age: 13.4 ± 1.6 yrs Sampling: Convenience | Modified/adapted Global School-based Student Health Survey (GSHS) | No. of hours spent during Physical activity per day | Participants with Hours of PA per day (n): Overweight: < 3 hours: 100, > 3 hours: 22 Obese: < 3 hours: 265, > 3 hours: 44 |
| 6 Jabeen et al. (2018), Karachi ¹³ , Public and Private | N (boys/girls) = 216 (85/131) Age: 10–17 years Grade: 6th 8th Sampling: Simple random | Physical Activity Questionnaire for older children (PAQ-C) Questionnaire | Mean PA scores PA: 2–4 High PA: 5 or more | PA levels n(%) : High (> 5): 0, Moderate (2–4): 151 (69.9), Low PA levels (1): 65 (30.1), Public school-moderate: 83 (77.6%) Private school-moderate: 68 (62.4%) |

(Continued)

Table 1. (Continued).

| Author [yr], city, setting (school) | Sample characteristics | Assessment tools | Measure of PA | Results |
|--|---|---|---|---|
| 7 Y. Khan et al. (2015), Gilgit City, ¹⁹ Private | N (boys/girls) = 345 (154/191) Mean age: 14.6 ± 1.3 yrs Grade: 6th–10th Sampling: Simple random | Physical activity questionnaire for adolescents (PAQ-A) | Mean PA scores | Physical Activity Score: Mean (SD): 2.08(1.04) Males: 2.1 (1.02), Females: 2.06 (1.06) |
| 8 Rehman et al. (2003), Karachi, ²⁴ Schools | N(boys/girls) = 234 (140/94) Age: 14.9 ± 0.57 yrs. Grade: O' level Sampling: Convenience | Questionnaire (Details not given) | Leisure time activities | Students considered themselves active: 63% Leisure time activity (%) : Indoor games: 31, Outdoor games: 53, School based activity: 65, |
| 9 Rizwan et al. (2011), Karachi, ²⁰ Private | N(boys/girls) = 339 (181/158) Age: 11–17 years Sampling: Simple random | Modified International Physical Activity Questionnaire | Physical education: (PE class frequency = 2 days/week), Unscheduled PA at school: other than that provided in the PE classes, Outside school PA: daily duration of active physical activity outside school | Duration of activity per PE class n(%) : >30 min/class: 202 (59.6), < 30 min/class: 137 (40.4), Unscheduled PA at school n(%) : > 20 min/day: 114 (33.6), <20 min/day: 225 (66.4), Out of school activity n(%) : ≥20 min/day: 85 (25.1), < 20 min/day: 254 (74.9) |
| 10 Warraich et al. (2009), Karachi, ¹⁴ Public and Private | N (boys/girls) = 284 (175/109) Age: 11–17 years Grade: 6th–8th Sampling: Census | Self-designed and pretested questionnaire | Number of times a sport is played per week (defined as > 30 minutes of activity) Punctuality in school physical education classes | Kids playing cricket 7 days a week: 30% Obese kids playing cricket 7 days a week: 6% Obese kids not playing cricket at all: 47% |
| 11 WHO (2009), Pakistan, ⁴ Schools | N = 5192 Age: 13–15 years Grade: 8th–10th Sampling: Simple random | GSHS Questionnaire Physical activity | % of students physically active, for at least 60 minutes/day on 5 or more days during the past seven days % of students who went to PE class on 3 or more days each week during the school yr | % (95%CI) of active students for at least 60 mins/day : overall: 15.5 (10.6–22.0), Boys: 17.2 (11.3–25.3), Girls: 12.7 (6.5–23.3), % (95%CI) of students attending PE on > 3 days : overall: 14.1 (11.4–17.3), Boys: 17.5 (13.8–22.0), Girls: 8.8 (5.0–15.2) |
| 12 Afzal et al. (2018), district Okara, ¹⁵ Public and Private | N = 850 Mean age: 15 ± 1.3 years Grade: 9th and 10th Sampling: Multistage stratified random | Self-designed questionnaire | Type of PA: like floor exercises, jogging, tennis, badminton, football etc. Household activities like preparing food, going for shopping, cleaning of house, laundry or ironing etc. | % of students with no activity whole week: Public: 38%, Private: 63% |
| 13 Chattha et al. (2019), Sialkot, ²¹ Private | N (boys/girls) = 520 (307/213) Mean Age: 12.8 + 1.5 yrs Grade: 6th–8th Sampling: (Not explained) | Self-designed structured questionnaire | Mode of transport to school Duration of exercise per week | Mode of transport to school (%) : walk: 10.8, Bicycle: 4.2, car: 85 Exercise per week (%) : overall: < 30 minute: 47.9, >150 minutes: 12.3 Obese (n = 79): <30 minutes: 11.5, >150 minutes: 0.2 |

(Continued)

Table 1. (Continued).

| Author [yr], city, setting (school) | Sample characteristics | Assessment tools | Measure of PA | Results |
|--|--|---|--|--|
| 14 Kiran K. Khan et al. (2016), Karachi ¹⁶ , Public and Private | N (boys/girls) = 116 (66/50) Mean Age: 16.2 + 1.4 yrs Sampling: Convenience | Self-designed Semi-structured questionnaire | Daily physical activity Leisure time activity | Duration of Normal Physical Activity/day n(%): > 1 hour: 00 (0), >30 < 1 hour: 7 (6.0), < 30 mins: 41 (35.0), < 15 mins: 43(37), Duration of Strenuous PA/day n(%): > 1 hour: 00 (0), >30 < 1 hour: 3 (2.6), < 30 mins: 30(26.0), < 15 mins: 50(43.0) Mean BMI of boys playing outdoor games > 2 hrs: Public: 20.91 + 2.13, private: 22.67 + 2.78 |
| 15 Qureshi et al. (2011), Faisalabad ¹⁷ , Public and Private | N (public/private) = 591 (297/294), All boys Grade: 6th-10th Sampling: Schools – Simple random, Students – Census | Semi-structured questionnaire | Duration of playing outdoor games daily | |

Meta-analysis

The weighted pooled prevalence of physical activity among adolescents was 36.0% [95% CI: 22%, 50%]. There was significant heterogeneity amongst studies documenting physical activity prevalence in adolescents ($I^2 = 99.28\%$; $p < 0.001$) (Figure 2) (P#32).

The operational definition used for measuring prevalence of PA was proportion of adolescents who had PA of at least 60 minutes per day (WHO, 2018). However, the studies included in meta-analysis did not have a standard operational definition for measuring PA. PA definitions used for studies included in the meta analysis are: (i) 'Percentage of students who were physically active for a total of at least 60 minutes/day for 5 days or more during the preceding 7 days'⁴ (WHO, 2009); (ii) Exercise or participation in sports/games at home and in the neighbourhood (Ahmed et al., 2016); (iii) moderate PA levels based on physical activity score (Qureshi et al., 2011); (iv) exercise for >150 minutes/week (Warraich et al., 2009); (v) activities during leisure time (K. Khan et al., 2016; Rizwan et al., 2011); (vi) daily physical activity of >20 minutes/day outside school (participation in sports to the extent that the participant would get out of breath) (Chattha et al., 2019); (vii) daily normal physical activity ranging from 30 to 60 minutes (Ishaque et al., 2012). (Table 2) (P#36)

Risk of bias (Quality assessment)

'Newcastle – Ottawa Quality Assessment Scale (for cross-sectional studies)' was used to assess the quality of studies included in the review (Modesti et al., 2016). Quality assessment was carried out by three independent reviewers (AI, BG, SA). Any disagreement was resolved through consensus and a final agreed-upon rating was assigned to each study, based on which the studies were rated as 'Very Good Studies' [$n = 2$] (Hakeem et al., 2002; Jabeen et al., 2018); 'Good Studies' [$n = 4$] (Ahmed et al., 2016; Y. Khan et al., 2015; Rizwan et al., 2011; WHO, 2009); 'Satisfactory Studies' [$n = 7$] (Afzal et al., 2018; Anwar et al., 2010; Iqbal et al., 2017; Ishaque et al., 2012; Qureshi et al., 2011; Rehman et al., 2003; Warraich et al., 2009); and 'Unsatisfactory Studies' [$n = 2$] (Chattha et al., 2019; K. Khan et al., 2016). Based on the scores in each criteria of the quality assessment scale, the studies were grouped as having <50%, 50–60%, 70–80% and > 80% score (Figure 3) (P#33). Risk of bias across the assessed studies could not be analysed due to the limited number of studies in the meta-analysis.

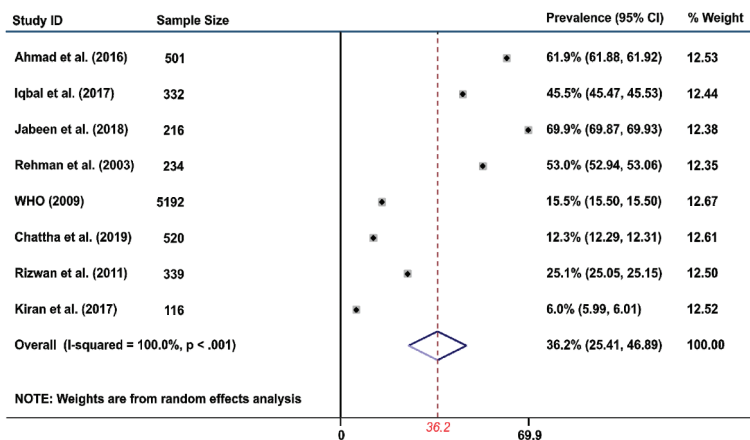


Figure 2. Forest plot of prevalence, with 95% confidence intervals (CIs) of physical activity among adolescents in Pakistan.

Table 2. Operational definitions of Physical activities for studies included in Meta-analysis.

| S# | Author [yr] | Sample size (N) | Physical activity operational definition | Proportion |
|----|-------------------------------|-----------------|--|----------------|
| 1 | WHO, 2009 | 5192 | %age of students who were physically active for a total of at least 60 mins/day on ≥ 5 days during the past 7 days (10.6–22.0) | 15.5% |
| | Ahmed et al., 2016 | 501 | Exercise or participation in sports/games at home and in the neighbour hood | 61.9% |
| 3 | Chattha et al., 2019 | 520 | Exercise for >150 minutes/week | 12.3% |
| 4 | Iqbal et al., 2017 (n = 151) | 332 | Activities during leisure time | 45.5% |
| | Mean Physical Activity scores | 569.9% | Jabeen et al., 2018 (n = 151) | 216 |
| 6 | Rizwan et al., 2011 | 339 | Outside school activities: daily duration of active physical activity outside school (participation in games like football, cricket, badminton, rope skipping, jumping, swimming, to the extent that participant would get out of breath) ≥ 20 min/day | 25.1% (n = 85) |
| 7 | Rehman et al., 2003 | 234 | Leisure time activity (outdoor games) | 53% |
| 8 | K. Khan et al., 2016 | 116 | Daily Normal physical activity b/w 30–60 min | 6% (n = 7) |

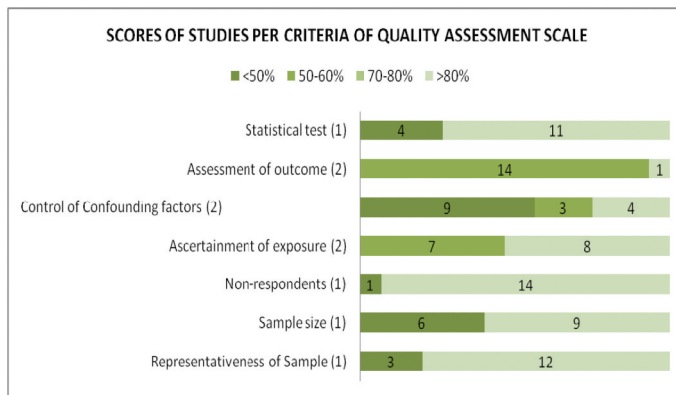


Figure 3. Grading of studies included in systematic review on basis of score per criteria of quality assessment scale.

Discussion

This systematic review aimed at analysing, summarizing and assessing the quality of evidence available regarding Physical Activity (PA) of adolescents in Pakistan. Towards the end, fifteen articles analysing PA among Pakistani adolescents were identified. All studies were conducted in school settings and included both public and private schools. Participants were mainly students ranging from grade 6 to grade 10, including both males and females. For the purpose of this study, age of adolescents was presented either as mean age or age range, making it difficult to arrive at any conclusion. However, most of the students were between 11 and 17 years of age.

Results of this systemic review showed that the proportion of physically active adolescents in Pakistan range from 6% to 70%. As per the meta-analysis, the weighted pooled prevalence of physical activity was 36% (95% CI: 22%–50%), almost two times the prevalence of physical activity estimated by the Pakistan Global School Health Survey (15.5%) (WHO, 2009).

Mixed results were observed while comparing our findings with reports from other regions/countries. According to the World Health Organization (WHO), at the global level, 81% of school-going adolescents aged 11–17 years did not have the recommended level of daily PA. Regional data showed that adolescents in Eastern Mediterranean Region (88%) were least physically active, followed by the African Region (85%) and the Western Pacific Region (85%), respectively. Adolescent boys were more active than girls, both at global and regional levels (WHO, 2019b). A systematic review by Lu et al. (2017) in China reported that among Chinese adolescents, the recommended PA prevalence rates vary from 4.7% to 63.4%. Another systematic review on prevalence of PA among South Asian children in UK reported PA prevalence of 45.2% for Pakistani, 40.0% for Indian and 32.8% for Bangladeshi children. In comparison, White British children had PA prevalence rates of 51.4%. (Bhatnagar et al., 2015). A study conducted in 2005 in hundred largest cities of the United States of America reported 48% adolescents aged 14–17 years to be physically active (Dumith et al., 2010).

According to the 2001 National Health Interview Survey in Taiwan, 80% adolescents reported some physical activity; however, only 28.4% of the participants had levels of PA according to recommended guidelines (Chen et al., 2007). A study conducted in Southern Brazil in 2008 reported that 48.2% (95%CI: 46.7; 49.7) of adolescents had the least recommended PA level of 300 mins./week, with PA levels among boys (62.6%) being better than girls (34.5%) (Dumith et al., 2010). However, when making any such comparisons, it is important to give due consideration to variations in the population sample and study methodology, including operational definitions of physical activity and data collection tools used.

Unfortunately, from the papers included in this review, limited information is available regarding gender-wise prevalence of PA for facilitating comparisons with other studies. However, results also showed that boys were more active than girls, as reported in studies included in the review (Hakeem et al., 2002; Y. Khan et al., 2015; WHO, 2009). A study conducted in thirty five countries in Europe and North America established a mean PA prevalence of 35.3% among boys, ranging from 22.6% in Italy to 57.1% in the United States. Similarly, girls had a mean PA prevalence of 22.3%, with France having the lowest PA rates (11.2%) and United States, the highest (41.8%). Another study conducted in the United States in 2005 found 57% adolescents boys and 40% adolescent girls aged from 14 to 17 years to be physically active (Dumith et al., 2010). The aforementioned results were consistent with findings of other past studies on the subject matter (Bauman et al., 2008; Bhatnagar et al., 2015; Chen et al., 2007; Dumith et al., 2010; Lu et al., 2017; Sun et al., 2014).

Regular PA has well documented health benefits for adolescents (CDC, 2018; WHO, 2016, 2018). However, low PA is reported globally as well as in Pakistan. Low physical activity among school-aged adolescents may be due to more time being spent on education related activities, which are considered to be more meaningful and useful for students (Müller et al., 2013; Wang et al., 2012). Secondly, the significance of physical activity for health and wellbeing is less recognized in developing countries. There is, therefore, less focus on physical activity promotion, particularly at the school and community levels (Anderson et al., 2009). Low PA among adolescents may also be due to limited number role models for young people from amongst their parents and other segments of society that have influence on adolescents (Biddle et al., 2011; Ranasinghe et al., 2013).

In addition, high or rising gross national product, inaction in leisure time, sedentary behaviour, both in school and at home, and an increase in the use of 'passive' modes of transportation are suggested to contribute to insufficient PA. Environmental factors linked to urbanization such as fear of violence & crime, traffic congestion, air pollution, and lack of sports and recreation facilities are other contributing factors (WHO, 2018). While decline in PA is anticipated as countries develop and

use of technology increases, governments must ensure facilities that promote active modes of transportation, sports, and recreation in the community and educational institutions (WHO, 2019b).

The 'Global Strategy on Diet, Physical Activity and Health', adopted by the World Health Assembly in 2004, describes the actions required to increase physical activity worldwide. Eighty percent of WHO Member States had developed policies and plans to promote PA, though only 56% of the countries had operationalized these in 2013 (WHO, 2018). Much is needed to be done in Pakistan as well in this regard.

All the included studies were conducted in school-settings, yet there was high heterogeneity among studies included in the meta-analysis. There was wide variation in methodologies of the studies included in the review. Studies were conducted in different cities, at different timings, with sample sizes varying from 116 to 5192. Most research studies used self-designed or poorly validated questionnaires for measuring physical activity. There was wide variations in operational definitions of physical activity contained in the studies. All the studies included in the review were cross-sectional studies. As per the quality assessment criteria used, less than half of the studies were of good quality (Modesti et al., 2016). Studies that had poor methodology and used subjective measures for outcome assessment compromised the quality of research findings. All these factors accounted for high heterogeneity in the meta-analysis.

At present, quality evidence about the epidemiology of physical activity in adolescents in Pakistan is limited and even less is known about the reasons for low physical activity and how physical activity behaviour has changed with time. High quality longitudinal studies using objective measure of PA such as accelerometer or other objective measures are required to better understand the low level of physical activity and its relationship with the rapidly changing living environment (Lu et al., 2017). There is also a need for the development of a standardized, validated questionnaire for assessing physical activity in this particular age group. The said questionnaire should be designed in due consideration of the local context.

Strengths and limitations

Per our information, this is the first systematic review analysing, summarizing and assessing the quality of evidence available regarding physical activity of adolescents in Pakistan. A systematic literature search was conducted using multiple databases. A secondary search of reference lists was also undertaken, although research published in the 'grey' literature may have been missed out. The large sample size of adolescents, including both male and female students from public and private schools, were the strengths of the review. Though the systematic review was mainly conducted by one author, the development of search strategy, article screening and quality assessment were carried out by independent reviewers and findings were then compared. Any disagreements were resolved through discussion.

Availability of a limited number of good quality studies is one of the limitations of this review. All of the reviewed studies were cross-sectional. Furthermore, failure of the studies to adjust for important confounding variables limited the generalizability of results that would have otherwise been highly valuable in physical activity research. The authors could not retrieve full texts of sixteen articles as they were not available on databases. All the studies were conducted in school-setting and estimates of PA were for school going adolescents only. The initiative therefore lacks data for adolescents in other segments of population.

Conclusion

It is the first ever systematic review and meta-analysis conducted to investigate the prevalence of physical activity among adolescents in Pakistan. The review indicated that Pakistani adolescents have a low level of PA. Findings of this review also suggested that the PA-related behaviour of Pakistani adolescents is not yet fully understood due to unsatisfactory research quality and inconclusive findings. It is also evident that there is a significant gap in the literature on physical activity

among adolescents in Pakistan, which remains an issue of great significance for the health and wellbeing of our future generations.

Implications for future research

Future research is required to improve our understanding of PA behaviours of adolescents and also, regarding factors influencing those behaviours. All studies included in the review were conducted in school setting, thereby necessitating a more comprehensive review that also encompasses the physical activity of adolescents that do not attend schools. Researchers and policy makers can use evidence generated by this review to further investigate physical activity-related behaviours and factors related thereto and to develop policies and programs to promote physical activity in Pakistan's young population, thereby contributing to improved physical and mental health and a reduction in the burden of non-communicable diseases.

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Authors' contribution

Dr Ayesha Imtiaz: Principal investigator and author, concept, design, literature search, article screening, quality assessment, manuscript writing, critical review, meta-analysis

Dr Zia ul Haq: Design, developing search strategy, critical review, meta-analysis

Dr Saima Afaq: Design, literature search, article screening, quality assessment, critical review

Dr Muhammad Naseem Khan: Literature search, quality assessment, critical review

Dr Basharat Gellani: Developing search strategy, quality assessment, critical review, meta-analysis

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ORCID

Saima Afaq  <http://orcid.org/0000-0002-9080-2220>

Muhammad Naseem Khan  <http://orcid.org/0000-0002-0484-0985>

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Annexures

Annexure 1. Search Strategy

| S# | Search terms |
|----|---|
| 1 | <p>Physical activity ('Physical activity' OR 'Physically active' OR 'Physical exertion' OR 'Physical fitness' or 'Physical education' OR 'Activity level' OR 'Motor activit*' OR 'Leisure activit*' OR Recreation OR 'Recreational activit*' OR household activit* OR daily activit* OR 'Activit* of daily living' OR 'Habitual activit*' OR 'Energy expenditure' OR Calorimetr* OR acceleromet* OR pedomet* OR Exercise* OR 'Physical Exercise*' OR 'Acute Exercise*' OR 'Isometric Exercise*' OR isotonic exercise* OR isokinetic exercise* OR 'Muscle stretching exercise*' OR 'Muscle strengthening exercise*' OR 'Bone strengthening exercise*' OR 'Aerobic Exercise*' OR 'Exercise Training*' OR 'Resistance train*' OR 'Moderate physical activit*' OR 'Vigorous physical activit*' OR 'Moderate to vigorous physical activit*' OR MVPA OR 'Lifestyle' OR Aerobics OR Sport* OR Game* OR Yoga OR Gardening OR Run* OR Jog* OR Swim* OR Walk* OR 'Stair* climb*' OR Danc* OR Cycle* OR Bicycl* OR skat* OR skiing OR mountaineering OR bowling)</p> |
| 2 | <p>Adolescent Child* OR 'Adolescen*' OR '10 – 19 years' OR 'Female Adolescent' OR 'Male Adolescent' OR Youth* OR Young* OR Teen* OR Teenager* OR Student* OR School* OR 'Middle School' OR 'High School' OR 'Secondary School'</p> |
| 3 | <p>Place Pakistan OR Pakistan* OR Punjab OR Sindh OR Balochistan OR Baluchistan OR NWFP OR 'North West Frontier Province' OR KP OR 'Khyber Pakhtunkhwa' OR Gilgit OR 'Gilgit Baltistan' OR 'Azad Jammu Kashmir' OR AJK OR 'Azad Kashmir' OR Peshawar OR Lahore OR Karachi OR Hyderabad OR Quetta OR Islamabad OR Rawalpindi OR 'Federally Administered Tribal Area' OR FATA</p> |

DATABASES SEARCH HISTORY

| S# | Search terms | Results |
|----|---|-----------|
| 1 | <p>Search Engine: Ovid Database: MEDLINE Search Type: Advanced Date: 06.04.2019 Limits: Time Coverage: 1947–2019 April05 Language: English Fields: Title and abstracts</p> | |
| 1 | ('Physical activity' or 'Physically active' or 'Physical exertion' or 'Physical fitness' or 'Physical education' or 'Activity level' or 'Motor activi*' or 'Leisure activit*' or Recreation or 'Recreational activit*' or household activit* or daily activit* or Activit* of daily living or Habitual activit* or 'Energy expenditure' or Calorimetr* or acceleromet* or pedomet* or Exercise* or 'Physical Exercise*' or 'Acute Exercise*' or 'Isometric Exercise*' or isotonic exercise* or isokinetic exercise* or 'Muscle stretching exercise*' or 'Muscle strengthening exercise*' or 'Bone strengthening exercise*' or 'Aerobic Exercise*' or 'Exercise Training*' or 'Resistance train*' or 'Moderate physical activit*' or 'Vigorous physical activit*' or 'Moderate to vigorous physical activit*' or MVPA or 'Lifestyle' or Aerobics or Sport* or Game* or Yoga or Gardening or Run* or Jog* or Swim* or Walk* or 'Stair* climb*' or Danc* or Cycle* or Bicycl* or skat* or skiing or mountaineering or bowling).m_titl. | 364,437 |
| 2 | (Child* or Adolescen* or '10 – 19 years' or 'Female Adolescent' or 'Male Adolescent' or Youth* or Young* or Teen* or Teenager* or Student* or School* or 'Middle School' or 'High School' or 'Secondary School').m_titl. | 1,100,575 |
| 3 | (Pakistan or Pakistan* or Punjab or Sindh or Balochistan or Baluchistan or NWFP or 'North West Frontier Province' or KP or 'Khyber Pakhtunkhwa' or Gilgit or 'Gilgit Baltistan' or 'Azad Jammu Kashmir' or AJK or 'Azad Kashmir' or Peshawar or Lahore or Karachi or Hyderabad or Quetta or Islamabad or Rawalpindi or 'Federally Administered Tribal Area' or FATA).m_titl. | 12,782 |
| 4 | 1 and 2 and 3 | 21 |
| 5 | ('Physical activity' or 'Physically active' or 'Physical exertion' or 'Physical fitness' or 'Physical education' or 'Activity level' or 'Motor activi*' or 'Leisure activit*' or Recreation or 'Recreational activit*' or household activit* or daily activit* or Activit* of daily living or Habitual activit* or 'Energy expenditure' or Calorimetr* or acceleromet* or pedomet* or Exercise* or 'Physical Exercise*' or 'Acute Exercise*' or 'Isometric Exercise*' or isotonic exercise* or isokinetic exercise* or 'Muscle stretching exercise*' or 'Muscle strengthening exercise*' or 'Bone strengthening exercise*' or 'Aerobic Exercise*' or 'Exercise Training*' or 'Resistance train*' or 'Moderate physical activit*' or 'Vigorous physical activit*' or 'Moderate to vigorous physical activit*' or MVPA or 'Lifestyle' or Aerobics or Sport* or Game* or Yoga or Gardening or Run* or Jog* or Swim* or Walk* or 'Stair* climb*' or Danc* or Cycle* or Bicycl* or skat* or skiing or mountaineering or bowling).ab.ti. | 1394,709 |

(Continued)

(Continued).

| S# | Search terms | Results |
|-----|---|----------|
| 6 | (Child* or Adolescen* or '10 – 19 years' or 'Female Adolescent' or 'Male Adolescent' or Youth* or Young* or Teen* or Teenager* or Student* or School* or 'Middle School' or 'High School' or 'Secondary School').ab,ti. | 2199,220 |
| 7 | (Pakistan or Pakistan* or Punjab or Sindh or Balochistan or Baluchistan or NWFP or 'North West Frontier Province' or KP or 'Khyber Pakhtunkhwa' or Gilgit or 'Gilgit Baltistan' or 'Azad Jammu Kashmir' or AJK or 'Azad Kashmir' or Peshawar or Lahore or Karachi or Hyderabad or Quetta or Islamabad or Rawalpindi or 'Federally Administered Tribal Area' or FATA).ab,ti. | 29,949 |
| 8 | 5 and 6 and 7 | 357 |
| II | Search Engine: Ovid Database: EMBASE Date: 06.04.2019 Limits: Time Coverage: 1947–5 April 2019 Language: English Fields: Title and abstracts | |
| 1 | ('Physical activity' or 'Physically active' or 'Physical exertion' or 'Physical fitness' or 'Physical education' or 'Activity level' or 'Motor activi*' or 'Leisure activit*' or Recreation or 'Recreational activit*' or household activit* or daily acivit* or Activit* of daily living or Habitual activit* or 'Energy expenditure' or Calorimetr* or acceleromet* or pedomet* or Exercise* or 'Physical Exercise*' or 'Acute Exercise*' or 'Isometric Exercise*' or isotonic exercise* or isokinetic exercise* or 'Muscle stretching exercise*' or 'Muscle strengthening exercise*' or 'Bone strengthening exercise*' or 'Aerobic Exercise*' or 'Exercise Training*' or 'Resistance train*' or 'Moderate physical activit*' or 'Vigorous physical activit*' or 'Moderate to vigorous physical activit*' or MVPA or 'Lifestyle' or Aerobics or Sport* or Game* or Yoga or Gardening or Run* or Jog* or Swim* or Walk* or 'Stair* climb*' or Danc* or Cycle* or Bicycl* or skat* or skiing or mountaineering or bowling).ti. | 450,563 |
| 2 | (Child* or Adolescen* or '10 – 19 years' or 'Female Adolescent' or 'Male Adolescent' or Youth* or Young* or Teen* or Teenager* or Student* or School* or 'Middle School' or 'High School' or 'Secondary School').ti. | 1373,538 |
| 3 | (Pakistan or Pakistan* or Punjab or Sindh or Balochistan or Baluchistan or NWFP or 'North West Frontier Province' or KP or 'Khyber Pakhtunkhwa' or Gilgit or 'Gilgit Baltistan' or 'Azad Jammu Kashmir' or AJK or 'Azad Kashmir' or Peshawar or Lahore or Karachi or Hyderabad or Quetta or Islamabad or Rawalpindi or 'Federally Administered Tribal Area' or FATA).ti. | 175,84 |
| 4 | 1 and 2 and 3 | 27 |
| 6 | ('Physical activity' or 'Physically active' or 'Physical exertion' or 'Physical fitness' or 'Physical education' or 'Activity level' or 'Motor activi*' or 'Leisure activit*' or Recreation or 'Recreational activit*' or household activit* or daily acivit* or Activit* of daily living or Habitual activit* or 'Energy expenditure' or Calorimetr* or acceleromet* or pedomet* or Exercise* or 'Physical Exercise*' or 'Acute Exercise*' or 'Isometric Exercise*' or isotonic exercise* or isokinetic exercise* or 'Muscle stretching exercise*' or 'Muscle strengthening exercise*' or 'Bone strengthening exercise*' or 'Aerobic Exercise*' or 'Exercise Training*' or 'Resistance train*' or 'Moderate physical activit*' or 'Vigorous physical activit*' or 'Moderate to vigorous physical activit*' or MVPA or 'Lifestyle' or Aerobics or Sport* or Game* or Yoga or Gardening or Run* or Jog* or Swim* or Walk* or 'Stair* climb*' or Danc* or Cycle* or Bicycl* or skat* or skiing or mountaineering or bowling).ab,ti. | 1877,548 |
| 7 | (Child* or Adolescen* or '10 – 19 years' or 'Female Adolescent' or 'Male Adolescent' or Youth* or Young* or Teen* or Teenager* or Student* or School* or 'Middle School' or 'High School' or 'Secondary School').ab,ti. | 3003,569 |
| 8 | (Pakistan or Pakistan* or Punjab or Sindh or Balochistan or Baluchistan or NWFP or 'North West Frontier Province' or KP or 'Khyber Pakhtunkhwa' or Gilgit or 'Gilgit Baltistan' or 'Azad Jammu Kashmir' or AJK or 'Azad Kashmir' or Peshawar or Lahore or Karachi or Hyderabad or Quetta or Islamabad or Rawalpindi or 'Federally Administered Tribal Area' or FATA).ab,ti. | 44,770 |
| 9 | 6 and 7 and 8 | 613 |
| III | Search Engine: Web of Science Database: Web of Science Core Collection –1900 _ 2019 Search Type: Advanced Date: 16.04.2019 Limits: Time Coverage: 1900-current Fields: Title only | |

(Continued)

(Continued).

| S# | Search terms | Results |
|----|---|-----------|
| 1 | TI = (Physical activity OR Physically active OR Physical exertion OR Physical fitness OR Physical education OR Activity level OR Motor activi* OR household activit* OR daily activit* OR Activit* of daily living OR Habitual activit* OR Leisure activit* OR Recreation OR Recreational activit* OR Aerobics OR Energy expenditure OR Calorimetr* OR acceleromet* OR pedomet* OR Exercise* OR Physical Exercise* OR Acute Exercise* OR Isometric Exercise* OR isotonic exercise* OR isokinetic exercise* OR Muscle stretching exercise* OR Muscle strengthening exercise* OR Bone strengthening exercise* OR Aerobic Exercise* OR Exercise Training* OR Resistance train* OR Moderate physical activit* OR Vigorous physical activit* OR Moderate to vigorous physical activit* OR MVPA OR Lifestyle OR Sport* OR Step* OR Game* OR Yoga OR Gardening OR Run* OR Jog* OR Swim* OR Walk* OR Stair* climb* OR Danc* OR Cycl* OR Bicycl* OR gymnastics OR skat* OR skiing OR mountaineering OR bowling) Indexes = SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, ESCI Timespan = All years | 835,267 |
| 2 | TI = (Child* OR Adolescen* OR 10 – 19 years OR Female Adolescent OR Male Adolescent OR Youth* (10–19 years) OR Young*(10–19 years) OR Teen* OR Teenager* OR School* OR Student* OR Middle School OR High School OR Secondary School) Indexes = SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, ESCI Timespan = All years | 1,644,648 |
| 3 | TI = (Pakistan OR Pakistan* OR Punjab OR Sindh OR Balochistan OR Baluchistan OR NWFP OR North West Frontier Province OR KP OR Khyber Pakhtunkhwa OR Gilgit OR Gilgit Baltistan OR Azad Jammu Kashmir OR AJK OR Azad Kashmir OR Peshawar OR Lahore OR Karachi OR Hyderabad OR Quetta OR Islamabad OR Rawalpindi) Indexes = SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, ESCI Timespan = All years | 34,176 |
| 4 | #3 AND #2 AND #1 Indexes = SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH, ESCI Timespan = All years | 29 |
| IV | Search Engine: EBSCOhost Database: CINHAL Plus Search Type: Advanced Date: 06.04.2019 Limiters: Published: 1947–2019 Search Mode: Boolean/Phrase Fields: Title and abstracts | |
| 51 | TI = (Physical activity OR Physically active OR Physical exertion OR Physical fitness OR Physical education OR Activity level OR Motor activi* OR household activit* OR daily activit* OR Activit* of daily living OR Habitual activit* OR Leisure activit* OR Recreation OR Recreational activit* OR Aerobics OR Energy expenditure OR Calorimetr* OR acceleromet* OR pedomet* OR Exercise* OR Physical Exercise* OR Acute Exercise* OR Isometric Exercise* OR isotonic exercise* OR isokinetic exercise* OR Muscle stretching exercise* OR Muscle strengthening exercise* OR Bone strengthening exercise* OR Aerobic Exercise* OR Exercise Training* OR Resistance train* OR Moderate physical activit* OR Vigorous physical activit* OR Moderate to vigorous physical activit* OR MVPA OR Lifestyle OR Sport* OR Step* OR Game* OR Yoga OR Gardening OR Run* OR Jog* OR Swim* OR Walk* OR Stair* climb* OR Danc* OR Cycl* OR Bicycl* OR gymnastics OR skat* OR skiing OR mountaineering OR bowling) | 171,083 |
| 52 | TI = (Child* OR Adolescen* OR 10–19 years OR Female Adolescent OR Male Adolescent OR Youth* OR Young* OR Teen* OR Teenager* OR School* OR Student* OR Middle School OR High School OR Secondary School) | 462,343 |
| 53 | TI = (Pakistan OR Pakistan* OR Punjab OR Sindh OR Balochistan OR Baluchistan OR NWFP OR North West Frontier Province OR KP OR Khyber Pakhtunkhwa OR Gilgit OR Gilgit Baltistan OR Azad Jammu Kashmir OR AJK OR Peshawar OR Lahore OR Karachi OR Hyderabad OR Thatta OR Quetta OR Islamabad OR Rawalpindi OR Federally Administered Tribal Area OR FATA) | 3,116 |
| 54 | S1 AND S2 AND S3 | 9 |
| 55 | AB = (Physical activity OR Physically active OR Physical exertion OR Physical fitness OR Physical education OR Activity level OR Motor activi* OR household activit* OR daily activit* OR Activit* of daily living OR Habitual activit* OR Leisure activit* OR Recreation OR Recreational activit* OR Aerobics OR Energy expenditure OR Calorimetr* OR acceleromet* OR pedomet* OR Exercise* OR Physical Exercise* OR Acute Exercise* OR Isometric Exercise* OR isotonic exercise* OR isokinetic exercise* OR Muscle stretching exercise* OR Muscle strengthening exercise* OR Bone strengthening exercise* OR Aerobic Exercise* OR Exercise Training* OR Resistance train* OR Moderate physical activit* OR Vigorous physical activit* OR Moderate to vigorous physical activit* OR MVPA OR Lifestyle OR Sport* OR Step* OR Game* OR Yoga OR Gardening OR Run* OR Jog* OR Swim* OR Walk* OR Stair* climb* OR Danc* OR Cycl* OR Bicycl* OR gymnastics OR skat* OR skiing OR mountaineering OR bowling) | 335,862 |
| 56 | AB = (Child* OR Adolescen* OR 10–19 years OR Female Adolescent OR Male Adolescent OR Youth* OR Young* OR Teen* OR Teenager* OR School* OR Student* OR Middle School OR High School OR Secondary School) | 539,862 |
| 57 | AB = (Pakistan OR Pakistan* OR Punjab OR Sindh OR Balochistan OR Baluchistan OR NWFP OR North West Frontier Province OR KP OR Khyber Pakhtunkhwa OR Gilgit OR Gilgit Baltistan OR Azad Jammu Kashmir OR AJK OR Peshawar OR Lahore OR Karachi OR Hyderabad OR Thatta OR Quetta OR Islamabad OR Rawalpindi OR Federally Administered Tribal Area OR FATA) | 3,668 |

(Continued)

(Continued).

| S# | Search terms | Results |
|----|---|---------|
| S8 | S5 AND S6 AND S7 | 111 |
| V | Database: PAKMEDINET Pakistan Medical Journals Articles Search Type: Simple Search Terms: PakMediNet (MeSH) Keyword Index Date: 23.02.2019–08.04.2019 | |
| 1 | Physical activity, children, Pakistan | 10 |
| 2 | Physical activity, children, Pakistan, prevalence | 3 |
| 3 | Physical activity, children, Pakistan, cross sectional study | 3 |
| 4 | Physical activity, children, Pakistan, cross sectional survey | 1 |
| 5 | Physical activity, School, Pakistan | 12 |
| 6 | Physical activity, Secondary School, Pakistan | 1 |
| 7 | Exercise, children, Pakistan | 9 |
| 8 | Exercise, children, Pakistan, prevalence | 1 |
| 9 | Exercise, children, Pakistan, cross sectional study/survey | 2 |
| 10 | Physical activity, adult children | 2 |
| 11 | Exercise, adult children, Pakistan | 1 |
| 12 | Motor activity, adult children, Pakistan | 1 |

Annexure 2. PRISMA Checklist

| Section/topic | # | Checklist item | Reported on page # |
|------------------------------------|----------|---|---|
| TITLE | | | |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | 1 |
| ABSTRACT | | | |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | 3 |
| INTRODUCTION | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | 4,5 |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | 5 |
| METHODS | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g. Web address), and, if available, provide registration information including registration number. | Supplementary File 1 |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | 6,7 |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | 5,6 |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | Annexure 1 (p37-43) |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | 6 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | 6,7 |
| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | 7,8 |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | 8 |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | 7 |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis. | 8 |
| Section/topic | # | Checklist item | Reported on page # |
| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | - |
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | - |
| RESULTS | | | |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | Figure 1 (p#31) |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | 9 Table 1 (p# 34,35) |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | 18 Figure 3 (P# 33) Supplementary File 2 |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | Figure 2 (p # 32) |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | 13 – 15 |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | - |

(Continued)

(Continued).

| Section/topic | # | Checklist item | Reported on page # |
|---------------------|----|--|--------------------|
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | - |
| DISCUSSION | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | 20–23 |
| Limitations | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | 24 |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | 24,25 |
| FUNDING | | | |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | 26 |

From: Moher et al. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med* 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: www.prisma-statement.org