Standing desks in schools: what are the effects? A summary of reviews

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ABSTRACT

Introduction: Average life expectancy is shortened by prolonged sitting, and is associated with approximately 30 chronic non-communicable diseases (NCDs), including musculoskeletal pain. Despite the relatively small evidence base, comprising only two systematic reviews, the literature is supportive of the use of standing desks as a means of reducing prolonged sitting time. This summary of reviews was conducted to collate research findings related to the impact of standing desks on sedentary behaviour, physical activity, musculoskeletal symptoms and academic outcomes in school learners. An overview of the current literature on the effects of standing desks in the school environment is presented.

Methods: An electronic search of databases for systematic reviews reporting on the effectiveness of standing desks on school learners was conducted.

Main findings: The two reviews that were used for this overview both concluded that integrating standing desks into schools has the potential to increase standing time and energy expenditure as well as to reduce sitting time among school learners, thus decreasing sedentariness in schools.

Conclusion: Although introducing standing desks might have beneficial consequences, there is little information to support the effects on musculoskeletal symptoms such as pain or on posture, factors which should be addressed in future studies.

INTRODUCTION

Prolonged sitting shortens life expectancy, as it is associated with approximately 30 chronic non-communicable diseases (NCDs), including hypertension, cardiovascular disease, some cancers, diabetes, obesity, depression, and musculoskeletal pain.[1] An association between sitting and disease was first described by Morris et al. in 1953.[2] A few decades later, Hu et al. (2001)[1] concluded that sedentary lifestyle, characterised by prolonged television watching, was associated with an increased incidence of diabetes.

Worldwide, the effects of NCDs on mortality are increasing, compared to infectious diseases. Deaths resulting from NCDs increased from approximately eight million in 1990 to 52.8 million in 2013, representing 65% of all deaths.[3] In South Africa, approximately 40% of deaths are currently due to NCDs.[4] A recent meta-analysis showed an association between sitting and NCDs; even after potential confounding factors such as age, sex and smoking were taken into account.[5] Even in individuals who met the guidelines for physical activity, excessive sitting was an independent risk factor (irreversible by physical activity), for the development of NCDs. In adults, every two hours of sitting increases the risk of obesity by 5% and that of diabetes by 7%.[6] In high income countries (HICs), the hazard ratio for myocardial infarction, coronary heart disease and all-cause mortality of high daily sitting duration (>10 hours per day) and being physically active, is 2.29 compared to 1.42 when sitting for fewer than six hours a day and being physically active. This hazard ratio is higher than that for other major mortality risk factors for the same morbidities and mortality (tobacco: 1.18, inactivity: 1.08, alcohol: 1.02).[7,8] Sitting for prolonged durations is a global health burden as it affects more than half of the world population's health.[9]

The 2013 Burden of Disease study highlighted the global burden of low back pain.[10] In contrast to 2004, when low back pain was ranked 105 out of 136 conditions, low back pain is now the leading cause of disability globally, ahead of 290 other conditions (such as diabetes and chronic obstructive pulmonary disorder). It was estimated to be responsible for 58.2 million years lived with disability in 1990, increasing to 83 million in 2010.[10]

Not only does prolonged sitting present a general health risk, but it is also named among the risk factors for spinal pain. Although the aetiology of spinal pain is multifactorial, prolonged sitting (particularly at school), poor posture, and frequent and extended computer use, are common risk factors for adolescent spinal pain. It is recognised, internationally, that adolescent spinal pain is associated with sitting in end-range spinal posture and with heavy school bag carriage.[12-18] There is also evidence that spinal pain experienced during adolescence often progresses to chronic pain during adulthood, thereby potentially increasing years lived with a disability.[15-18] At some stage, approximately 70% of South African school learners experience musculoskeletal discomfort.[11] The South African Department of Health has prioritised health in schools, as the Convention on the Rights of the Child states that children's needs must receive the highest priority.[19] The decision to reintegrate and strengthen healthcare in schools is an attempt to improve access to early interventions and provide screening to a large proportion of South Africans who have historically had poor access to healthcare and health-promoting programmes.[20]

Health promotion in schools is an efficient and cost-effective approach to prevent early onset of disability, and to improve health literacy and awareness in young people, so that they can make evidence-informed decisions that can become ingrained while approaching adulthood. Although there are multiple programmes to promote physical activity in South African youth, there are no strategies to address the relatively new pressuring risks associated with increased sedentariness in schools.

Sedentariness is defined as “any waking behaviour, characterised by an energy expenditure of ≤ 1.5 metabolic equivalents (METs) while in a sitting, reclining or lying posture”.[20] Currently, there is no published information regarding objective measures of sedentary behaviour during class time at school, from any of the low and middle income countries (LMICs). However, a large review, reporting on physical activity and sedentary behaviour among sub-Saharan Africa school-aged children, found that children are sedentary for up to six hours outside of normal school hours.[21] Governments in some HICs have already adjusted their guidelines for healthy lifestyles to include recommendations aimed at reducing sedentariness in the workplace, having identified it as an independent risk factor for disease.[22,23] In work environments, it is recommended that office workers accumulate at least two hours of daily standing and light physical activity during work hours,[24] even though the effects thereof have not been fully studied. There is an urgent need for evidence about the effects of reduced sedentariness, so that policymakers can make informed decisions.

Two systematic reviews that examined the effects of standing desks in classrooms were published in 2016. The findings reported in these two reviews were collated and compared, with a view to inform future research in this emerging field. This was achieved by summarising the impact of standing desks on sedentary behaviour, physical activity, musculoskeletal (MSK) symptoms and academic outcomes. This paper is the first step in a series of planned research activities (including conducting qualitative and intervention studies) that will contribute to the formulation of evidence-based guidelines for classroom ergonomics for South African schools.

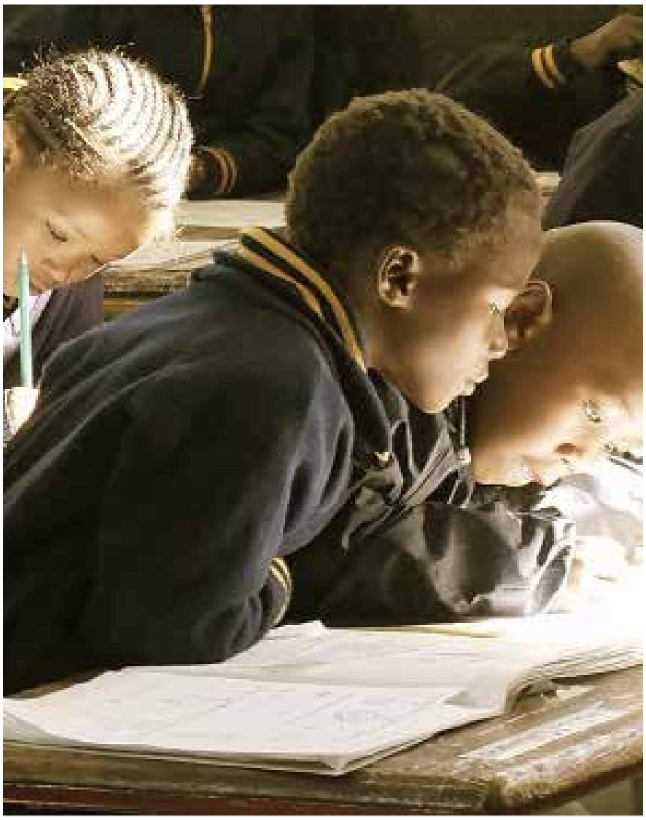
METHODS

Search strategy

The following medical electronic databases were searched from January 2016 to July 2016: Pubmed, CINAHL, Cochrane Library, Scopus, Science Direct and Google Scholar. A combination of the search terms, ‘standing desk’, ‘adjustable workstation’, ‘adjustable desk’, ‘schools’, and ‘classroom’ were used with the appropriate truncations and Boolean operators (AND and OR). Pearling (checking the reference lists of identified studies) and manual searching (of journals predating electronic databases or not appearing in electronic databases) were also conducted. Two reviewers (SvN and DF) independently screened the selected titles and abstracts for eligibility, whilst a third reviewer was available if disagreement arose (QAL).

Inclusion criteria: Any systematic review reporting on primary intervention studies on the effect of standing desks on school learners (5-18 years old); full text, and published in English.

Exclusion criterion: Primary intervention studies not included in a systematic review.



Full-text articles were retrieved for those studies that met the inclusion and exclusion criteria. For those in which insufficient information was available in the title, abstract and keywords were used to determine eligibility.

Data extraction

One reviewer (SvN) extracted the data by using a standard data-extraction form. Information on study design, population and outcomes was recorded. If information was missing, it was requested from the first author of the paper via e-mail. A second reviewer (DF) audited the data extraction process. The third reviewer (QAL) was available to facilitate consensus.

Quality assessment

The quality of all retrieved reviews was independently evaluated by two reviewers, (SvN and QAL), using the Assessment of Multiple Systematic Reviews (AMSTAR) protocol.[25-26] This is an 11-item tool that measures the review’s design, its search strategy, the inclusion and exclusion criteria, the quality assessment of included studies, the methods used to combine the findings, the likelihood of publication bias, and the statements of conflicts of interest. The maximum score is 11; scores of 0-4 indicate low quality, 5-8 indicate moderate quality, and 9-11 indicate high quality. If the total scores of the independent evaluation differed by one or two points, then the average was calculated. If the differences were greater, then a third reviewer (DF) conducted an additional independent evaluation. The differences were discussed and agreement was reached on the final score. We did not attempt to pool the results from systematic reviews; comparison groups were different and, more importantly, the variables, their definitions and adjustment methods differed across reviews.

RESULTS

Review selection

The computer-generated search resulted in seven references in PubMed; 5 in CINAHL, 2 in the Cochrane Library; 32 in Scopus; 20 in Science Direct, and 114 in Google Scholar. The most frequent reasons for exclusion were that the study was a primary intervention or was conducted in an adult population. After exclusion, two systematic reviews were included in the review.[27-28] Figure 1 illustrates the review selection process.

Review characteristics

The two systematic reviews included in this study reported on eight[27] and ten[28] primary intervention studies, respectively. The first review was by Minges et al.[27], and the second was by Sherry et al.[28], published in February and April 2016, respectively. Sherry et al. included an additional paper that was not in the review by Minges et al. review, namely, Cardon et al. (2004). Minges et al. included two papers that were not included by Sherry et al., namely, Benden et al. (2012) and Dornhecker et al. (2015). The sample sizes ranged from eight to 337 participants. Intervention follow-up duration extended to 1.5 years. Table 1 shows the characteristics of the two systematic reviews.

Table 2 summarises the intervention methodology of each study that was included in the two reviews. This includes a summary of the implementation of standing desks in the classroom, whether or not the standing desks were adjusted by the learners themselves, the intervention period, the data collection intervals, and the measuring tools used in each study.

Methodological quality assessment

Both reviews were of moderate quality, according to the AMSTAR protocol (scores were 5 and 8 out of 11, respectively). Neither review reported on the type of literature that was included, for instance whether grey or unpublished literature was considered as part of the search criteria

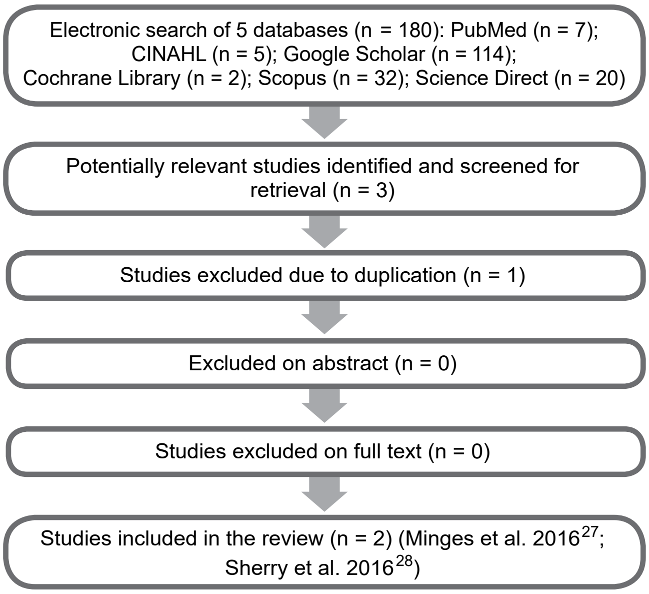


Figure 1. Flow diagram visualising how review studies were selected for inclusion

Table 1. Summary of the study elements

	Authors	
Study element	**Sherry et al. 2016[28]**	**Minges et al. 2016[27]**
Objective(s)	To examine the effects of interventions that have implemented standing desks within the school classroom	To examine the impact of school-based standing desk interventions on sedentary behaviour and physical activity, health-related, academic and behavioural outcomes in school learners
Studies included in review (*indicates a study that was included in only that review)	Clemes et al., 2015[29] Aminian et al., 2015[30] *Dornhecker et al. 2015[31] Benden et al., 2014[32] Benden et al., 2013[33] Hinckson et al., 2013[34] Koepp et al., 2012[35] *Benden et al., 2012[36] Benden et al., 2011[37] Lanningham-Foster et al., 2008[38]	Clemes et al., 2015[29] Aminian et al., 2015[30] Benden et al., 2014[32] (with consolidated data from Benden et al., 2013[33]) Hinckson et al., 2013[34] Koepp et al., 2012[35] Benden et al., 2011[37] Lanningham-Foster et al., 2008[38] *Cardon et al., 2004[39]
Outcomes measured	• Step count • Stepping time • Standing time • Sitting time • Sit-to-stand counts • Energy expenditure or physical activity • Pain and fatigue • Posture • Academic performance / classroom behaviour / concentration	• Step count • Stepping time • Standing time • Sitting time • Sit-to-stand counts • Energy expenditure or physical activity • Pain and fatigue • Academic performance / classroom behaviour / concentration
Study designs	RCT (n = 3); non-RCT (n = 7) pre-post intervention, no control (n = 1)	Quasi-experimental (n = 4); RCT (n = 3) pre-post intervention, no control (n = 1)
Participants ages (years)	6-12	8-12
Sample size	8-326	8-337
Quality assessment	10 studies were scored low quality [29-35, 37-39] One study scored medium quality[36]	Not reported

Table 2. Summary of interventions

Authors	Implementation	Desk adjusted for user	Methods	Intervention period	Data collection intervals	Measurement tool
Benden et al. 2011[37]	Traditional desks replaced with standing desks in two intervention classrooms. One standing desk per child, whether participating in the study or not	No	Participants allowed to sit or stand at their discretion	9 months	4 intervals during school	BodyBugg Armband (BodyMedia Inc., Pittsburgh, PA)
Benden et al. 2012[36]	Entire class switched to standing desks. Number of children per desk not reported	Not reported	Participants allowed to sit or stand at their discretion	5 months	4-week intervals	Not reported
Benden et al. 2014[32]	Every learner in experiment class received a standing desk	Not reported	Not reported	9 months	4-week intervals	SenseWear Armband (BodyMedia, Inc., Pittsburgh, PA)
Benden et al. 2013[33]	One standing desk per intervention class participant. No details reported regarding desk allocation of learners not participating in the study or traditional desk availability within the intervention class	Yes	Not reported	Single time point	Single time point	Not reported
Hinckson et al. 2013[34]	Eight standing workstations across two classes (five and three, respectively). Each class included a central circle workstation and semi-circle workstations placed around the room. No details of desk in the study. Exercise balls, beanbags, and mats were made available for children to sit when tired. Control groups retained their traditional desks	Yes	Standing desks discussed with teachers and pupils	4 weeks	Baseline and week 4	ActivPAL accelerometers (PAL Technologies Ltd Glasgow; Switzerland); Nordic Musculoskeletal questionnaire; Pedometer; classroom behaviours reported by teacher observations
Koepp et al. 2012[35]	A standing desk was allocated to each study participant. This included every learner in the class	Yes	Not reported	5 months	Baseline (September - December 2009) and post-intervention	Not reported
Lanning-ham-Foster 2008[38]	All traditional desks were replaced with standing desks, but the number of learners per desk was not disclosed. Four to five traditional tables and chairs were retained as an alternative option for participants	Yes	Not reported	12 weeks	Week 1: traditional classroom; weeks 2-3: activity-permissive classroom; weeks 4-12: standing desk classroom	A triaxial accelerometer
Clemes et al. 2015[29]	UK: Three traditional desks replaced with six adjustable standing desks, used by six learners who could adjust the desks freely. The entire class was rotated between these six desks and traditional desks every day. AUZ: All traditional desks in the classroom replaced with standing desks, one per learner	No	Intervention teachers from both countries received training in sedentary behaviour reduction strategies. Pupils initially encouraged to increase standing by 30 minutes a day and to gradually increase this time during the intervention period	9 weeks	Baseline and weeks 9-10	ActivPAL accelerometers (PAL Technologies Ltd Glasgow; Switzerland)
Aminian et al. 2015[30]	All traditional desks replaced with five standing workstations: one circular desk in centre of class, three semi-circular desks and one for computers. Semi-circular desks shared by four to five children. Exercise balls, beanbags, and mats made available for children to sit when tired. Control classrooms retained traditional sitting desks	Yes	Not reported	5 months	Baseline, week 5, and week 9	ActivPAL accelerometers (PAL Technologies Ltd Glasgow; Switzerland); modified Nordic musculoskeletal questionnaire; teachers used the strengths and weaknesses of ADHD symptoms and normal-behaviours rating scale for behavioural screening
Dorn-hecker et al. 2015[31]	Standing desks were installed in the intervention class. One desk per learner. Desk allocation for learners not taking part in the study and presence of traditional desks in the classroom not reported	Yes	Not reported	5 months	Not reported	Not reported
Cardon et al. 2004[39]	Type of desk: 'Moving school' with a variety of resources that enabled ergonomic–physiologic learning. Movement is encouraged by work organisation (e.g., information stations) and creating circumstances that encourage movement (e.g., standing desks). The intervention classroom is equipped with ergonomic furniture allowing varying working postures and contributing to physiologically correct sitting with movement, called dynamic sitting. All tables had an inclinable top, and standing desks and floor space are available for variations in the daily working routine (e.g., mats on the floor)		Not reported	1.5 years	Not reported	Portable ergonomic observations method; accelerometers; self-reported back and neck pain questionnaire

(i.e. the status of the included literature), nor did either review list studies that were excluded. Minges et al. [27] did not document study selection and data extraction, nor did they document the assessment of the scientific quality of the studies included, or assess the likelihood of publication bias. The AMSTAR Appraisal for each review is shown in Table 3.

Table 4 indicates the various outcomes measured by the studies included in the two reviews. Both reviews included studies that reported statistically significant increased standing time and decreased sitting time as a result of the interventions.[27-28] One review included a single study that reported a negative effect on the outcome measures of pain/fatigue/discomfort and academic performance.[27]

DISCUSSION

There is an emerging body of evidence pertaining to standing desks in school classrooms. This paper presents an overview of the evidence base, identifies gaps in research, and describes future research directions to advance the field.

Only two systematic reviews have been published [27,28] reporting on a total of 11 primary studies. Nevertheless, it appears that the use of standing desks in school classrooms has potential health benefits. Both reviews cautioned against over-generalising the findings of the primary studies, due to the relatively small sample sizes, and the fact that many were pilot studies.

The two reviews had low to moderate methodological appraisal scores. Neither provided a full list of studies excluded, or reasons for excluding studies. This is important to ensure transparency of the selection process and to reduce selection bias. In addition, the reviews did not state whether they searched the grey literature. It is possible that potentially eligible research, in the format of conference proceedings, theses, etc., was not considered for inclusion in the reviews. These shortcomings compromise the validity the overall findings.

Both reviews concluded that integrating standing desks in schools has the potential to increase energy expenditure as well as standing time of school learners, despite the relatively small evidence base. There was also an increase in the reported number of times a learner transitioned from sitting to standing and vice versa (sit-to-stand count), thus potentially decreasing sedentariness during school hours. One study reported an overall reduction in sedentariness of 59 minutes during waking hours,[34] and another reported a reduction of 64 minutes during school hours.[30] These findings are in line with adult studies that found a reduction of 77 minutes per eight-hour work day, when using standing desks.[40]

Table 3. AMSTAR Appraisals of the two systematic reviews [25]

AMSTAR Criterion	Minges et al. 2016[27]	Sherry et al. 2016[28]
1. Was an ‘a priori’ design provided?	Yes	Yes
2. Was there duplicate study selection and data extraction?	No	Yes
3. Was a comprehensive literature search performed?	Yes	Yes
4. Was the status of publication (e.g. grey literature) used as an inclusion criterion?	No	No
5. Was a list of studies (included and excluded) provided?	No	No
6. Were the characteristics of the included studies provided?	Yes	Yes
7. Was the scientific quality of the included studies assessed and documented?	No	Yes
8. Was the scientific quality of the included studies used appropriately in formulating conclusions?	No	Yes
9. Were the methods used to combine the findings of studies appropriate?	Yes	Yes
10. Was the likelihood of publication bias assessed?	No	Yes
11. Was the conflict of interest included?	Yes	Yes
Score	**5/11**	**8/11**

See website for a more detailed table

Another outcome linked to reduced sedentariness is ‘step count’. A discrepancy in the reporting of step time was noted. Both reviews reported a significant increase in step time during the spring semester leg of the Benden et al. (2014 study). All other studies reporting step counts found an increase (although not statistically significant) after the introduction of standing desks in schools.[29,30,34-36] The diverse assessments and measurements, and low statistical power of most of the included studies, may explain these findings relating to step count.

Improvements in outcomes that are linked to reduced sedentariness represent a potentially positive overall health outcome, as demonstrated in adult reference groups.[6] Benden et al. (2011) illustrated the potential health benefits of reducing sedentary time: accelerometer data established that students burned 32 calories more per hour after introducing standing desks.[37] During a typical school day this could equate to 225 additional calories burned, which is equivalent to walking, skateboarding or

Table 4. Outcome measures of studies included in reviews

Authors	Outcome: Standing time	Sitting time	Step count	Increased energy expenditure/ physical activity	Sit-stand counts	Posture	Pain/fatigue/ discomfort	Academic engagement/ classroom behaviour/ concentration
Minges et al. 2016	↑↑[2,39] ↑[30,34,37]	↓↓[29,39] ↑[30,34]	↑↑[32,38] ↑[29,30,34,35]	↑[35,37,38]	↓[30,34]		↓[30] x[39]	↑[30,37,35,39]
Sherry et al. 2016	↑↑[29] ↓[30,34]	↓↓[29] ↑[30,34]	↑↑[32] ↑[29,30,34-36]	↑[32,36-38]	↓[30,34]	↑[33]	↓[30,33,35]	↑[30,31,35]

↑↑: statistically significant increase; ↑: increase but not statistically significant; ↓↓: statistically significant decrease;
↓: decrease but not statistically significant; x: negative finding

roller-skating for one hour.[41] This is particularly beneficial, as the promotion of healthy lifestyle habits during the formative years may ultimately lead to decreased financial burden related to NCDs in adulthood.

Standing desks have the potential to improve posture and musculoskeletal health if used appropriately. Posture, as an outcome of using standing desks in schools, was, however, only measured in one study (Benden et al., 2013) which was included only in the review by Sherry et al. Benden et al. reported an improvement in posture when using a standing desk, by using a portable observation tool and comparing the postures of the two different classroom set-ups (i.e. traditional vs standing classroom). Both of the reviews reported on musculoskeletal pain/discomfort, which was included in four papers.[30,33,35,39] Three papers found improvements in pain/discomfort, but in none were the improvements statistically significant.[30,33,35] Cardon et al. (2004) found a slight (not statistically significant) increase in back pain in the intervention group, compared to the control group.[39]

Since adolescent spinal pain is a strong predictor of chronic spinal pain in adults, preventive strategies should target adolescents; the cost of pain management can be a lifelong burden.[12] Research published in 2007 showed that 70% of South African high school learners suffered from musculoskeletal symptoms.[17] While the aetiology of spinal pain is multifactorial, prolonged sitting, particularly at school, and poor sitting postures are common risk factors of adolescent spinal pain.[15-18] High school learners sit for long periods at school desks in static postures.[42] Static sitting, compounded with poor spinal alignment, could explain the high prevalence of adolescent spinal pain.[42,46] School furniture should thus ideally facilitate good postures (sitting or standing).[18,44-46]

It is important that standing desks be practical when introducing them into a classroom environment, and should not be detrimental to classroom behaviour. None of the studies included in the reviews reported negative results with regard to learning-related outcomes, such as concentration and classroom behaviour.[30,31,35,39] Academic achievements were, however, not measured in any of the studies included in the reviews. This should be included in future studies to provide evidence of the impact of standing desks on academic performance.

All the studies included in the two reviews were conducted in HICs. Researchers planning similar interventions in LMICs, such as South Africa, will need to assess the feasibility of such projects. The challenges facing schools in South Africa include poor teacher performance, poor learner academic performance, learner behavioural challenges, large class numbers, insufficient resources, and inadequate infrastructure. With this in mind, researchers planning intervention programmes in South African schools will need to consider these challenges and aim to provide context-appropriate interventions. Despite these challenges, standing desks should be considered in schools of LMICs to reduce sedentariness of learners, for improved health benefits, and to potentially improve academic performance.

Recommendations

Methodological recommendations

Methodologically robust randomised control trials (RCTs) are needed. Specific methodological factors to be addressed include adequate statistical power and appropriate statistical analysis which includes an intention to treat. The impact of standing desks in different gender, age and race sub-groups should be studied. Sherry et al.[28] suggested that future studies should seek to implement standing desks over a full academic year and within schools of lower socio-economic status, as this is a key demographic group in which to improve health inequalities and, possibly, academic achievement.

Qualitative research is also needed to assess the perceptions of educators, administrators, learners and parents about the integration of standing desks into schools.

Success indicators

Currently there is no information about factors associated with successful implementation of standing desks in the classroom, such as the degree of teacher instruction, and development of resources to teach learners about the benefits of standing and reducing sedentary behaviour. These should be included in future studies to assess whether they have an impact on the successful implementation of standing desks.

Study contexts/settings

Studies need to be conducted in Africa and other LMICs. All studies in the reviews implemented standing desks in primary schools; additional research needs to be conducted in secondary/high schools. Although this might be more challenging, logistically, it is important to determine the impact of these interventions in the final phase of learners' school education, as reducing sedentary behaviour is important as adolescents move into adulthood.

Outcome assessment

The current evidence indicates that standing desks are practical and not detrimental to a child's ability to learn. However, according to Sherry et al. (2016),[28] it is important that academic achievement is captured as an outcome measure in further standing desk research to provide direct evidence on the impact on learning. Academic performance could be an important outcome of successful implementation of standing desks in schools.

Standing desks interventions

Static standing for long periods has the potential to increase neck and back pain and can result in a reduction in blood pressure.[36] Minges et al. suggested that standing positions, the frequency of standing transitions (e.g. shifting weight from one foot to the other), and having a resting bar or pendulum for the foot, as important considerations for future studies, as well as for policy and practice.[27]

CONCLUSION

There is an emerging body of evidence regarding the benefits of standing desks in schools. The current evidence base is still relatively small, consisting of two systematic reviews of 11 studies in total, albeit encouraging preliminary findings were reported. Both reviews concluded that integrating standing desks into schools has the potential to increase standing time and energy expenditure, as well as to reduce sitting time among school learners, thus decreasing sedentariness in schools. However, there is a paucity of data to support their effects on musculoskeletal symptoms such as pain, and on posture, factors that should be addressed in future studies.

ACKNOWLEDGEMENTS

This research was funded by the National Research Foundation (NRF)

LESSONS LEARNED

- Using standing desks at schools can potentially increase standing time in the classroom.
- Using standing desks at school can potentially increases energy expenditure.

DECLARATION

The authors declare no conflicts of interest.

REFERENCES

1. Hu FB, Leitzmann MF, Stampfer MJ, et al. Physical activity and television watching in relation to risk for type 2 diabetes mellitus in men. Arch Intern Med. 2001; 161(12):1542-1548.
2. Morris JN, Heady JA, Raffle PA, et al. Coronary heart-disease and physical activity of work. Lancet. 1953; 265:1111-1120.
3. Abubakar II, Tillman T, Banjeree A. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015; 385(9963):117-171.
4. Nojilana B, Bradshaw D, Pillay-van Wyk V, et al. Emerging trends in non-communicable disease mortality in South Africa, 1997-2010. S Afr Med J. 2016; 106(5):477-484.
5. Wilmot EG, Edwardson CL, Achana FA, et al. Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. Diabetologia. 2012; 55(11):2895-2905.
6. Hu FB, Li TY, Colditz GA, et al. Television watching and other sedentary behaviours in relation to risk of obesity and type 2 diabetes mellitus in women. Jama. 2003; 289(14):1785-1791.
7. Chau JY, Grunseit A, Midthjell K, et al. Sedentary behaviour and risk of mortality from all-causes and cardiometabolic diseases in adults: evidence from the HUNT3 population cohort. Br J Sports Med. 2015; 49(11):737-742.
8. Petersen CB, Bauman A, Grønbæk M, et al. Total sitting time and risk of myocardial infarction, coronary heart disease and all-cause mortality in a prospective cohort of Danish adults. Int J Behav Nurtr Phys Act. 2014; 11(1):13.
9. Levine JA. Sick of sitting. Diabetologia. 2015; 58(8):1751-1758.
10. Hoy D, March L, Brooks P, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. Ann Rheum Dis. 2014; 73(6):968-974.
11. Smith L, Louw Q, Crous L, et al. Prevalence of neck pain and headaches: impact of computer use and other associative factors. Cephalalgia. 2009; 29(2):250-257.
12. Adeyemi AJ, Rohani JM, Abdul Rani M. Back pain arising from schoolbag usage among primary schoolchildren. Int J Ind Ergon. 2014; 44(4):590-600.
13. Ismail SA, Tamrin SB, Hashim Z. The association between ergonomic risk factors, RULA score, and musculoskeletal pain among school children: a preliminary result. Glob J Health Sci. 2009; 1(2):73-84.
14. Wiklund M, Malmgren-Olsson EB, Ohman A, et al. Subjective health complaints in older adolscents are related to perceived stress, anxiety and gender – a cross-sectional school study in Northern Sweden. BMC Public Health. 2012; 12:993.
15. Feldman, DE, Shrier, I, Rossignol, M, Abenhaim, L. Risk factors for the development of low back pain in adolescence. Am J Epidemiol. 2001; 54(1): 30-36.
16. Prins Y, Crous LC, Louw QA. A systematic review of posture and psychosocial factors as contributors to upper quadrant musculoskeletal pain in children and adolescents. Physiother Theory Pract. 2008; 24:221-242.
17. Smith L.Computer-related musculoskeletal dysfunction among adolescent school learners in Cape Metropolitan region. Master's thesis (unpublished). Tygerberg: Stellenbosch University; 2007.
18. Brink Y, Louw QA. A systematic review of the relationship between sitting and upper quadrant musculoskeletal pain in children and adolescents. Man Ther. 2013; 18:281-288.
19. South Africa. National Departments of Health, Basic Education. Integrated School Health Policy. 2010.
20. Tremblay MS, Aubert S, Barnes JD. et al. Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. Int J Behav Nutr Phys Act 2017; 14(1):75.
21. Muthuri SK, Francis CE, Wachira LJ, et al. Evidence of an overweight/obesity transition among school-aged children and youth in sub-Saharan Africa: a systematic review. PLOS One. 2014; 27;9(3):e92846.
22. Tremblay MS, Shephard RJ, Brawley LR, Cameron C, Craig CL, Duggan M, et al. Physical activity guidelines and guides for Canadians: facts and future. Can. J. Public Health 98 (Suppl. 2). Appl Phys Nutr, Met. 2007; 14;32(S2E):S218-224.
23. A report on physical activity for health from the four home countries' chief medical office. UK, 2011.
24. Buckley JP, Hedge A, Yates T, et al. The sedentary office: a growing case for change towards better health and productivity. Expert statement commissioned by Public Health England and the Active Working Community Interest Company. Br J Sports Med. 2015; 49:1357-1362.
25. Shea BJ, Grimshaw JM, Wells GA, et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol. 2007a; 7:10.
26. Shea BJ, Bouter LM, Peterson J, et al. External validation of a measurement tool to assess systematic reviews (AMSTAR). PLoS One 2007b; 2: e1350.
27. Minges KE, Chao AM, Irwin ML, et al. Classroom standing desks and sedentary behavior: a systematic review. Pediatrics. 2016; 137(2):e20153087.
28. Sherry AP, Pearson N, Clemes SC. The effect of standing desks within the school classrooms: a systematic review. Prev Med Rep. 2016; (3): 338-347.
29. Clemes S, Barber S, Bingham D, et al. Reducing children's classroom sitting time using sit-to-stand desks: findings from pilot studies in UK and Australian primary schools. J Public Health. 2015; 38(3):526-533.
30. Aminian S, Hinckson E, Steward T. Modifying the classroom environment to reduce sitting and increase standing time in children. Build Res Inf. 2015; 43(5):631–645.
31. Dornhecker M, Blake JJ, Benden M, Zhao H, Wendel M. The effect of stand-biased desks on academic engagement: an exploratory study. Inter J Health Promo Edu. 2015; 53(3):271-280.
32. Benden ME, Zhoa H, Jeffrey CE, Wendel ML, Blake JJ. The evaluation of the impact of a stand-biased desk on energy expenditure and physical activity for elementary school students. Int J Environ Res Public Health. 2014; 11:9361-9375.
33. Benden ME, Pickens A, Shipp E, Perry J, Scheider D. Evaluating a school based childhood obesity intervention for posture and comfort. Health. 2013: 5;54-60.
34. Hinckson EA, Aminian S, Ikeda E, Stewart T, Oliver M, Duncan S, et al. Acceptability of standing workstations in elementary schools: a pilot study. Prev Med. 2013; 56(1):82-85.
35. Koep GA, Snedden BJ, Flynn L, Puccinelli D, Huntsman B, Levine JA. Feasibility analysis of standing desks for sixth graders. 2012. ICAN. 2012; 4(2): 89-92.
36. Benden ME, Wendel ML, Jeffrey CE, Zhao H, Morales ML. Within-subjects analysis of the effects of a stand-biased classroom intervention on energy expenditure. J Exerc Physiol Online. 2012; 15(2):9-19.
37. Benden ME, Blake JJ, Wendel ML, Huber JC. The impact of stand-biased desks in classrooms on calorie expenditure in children. Am J Public Health. 2011; 101(8): 1433-1436.
38. Lanningham-Foster L, Foster RC, McCrady SK, et al. Changing the school environment to increase physical activity in children. Obesity. 2008; 16:1849-1853.
39. Cardon G, De Clercq D, De Bourdeaudhuij I, et al. Sitting habits in elementary schoolchildren: a traditional versus a 'moving school'. Patient Educ Couns. 2004; 54(2):133–142.
40. Neuhaus M, Eakin EG, Straker L, et al. Reducing occupational sedentary time: a systematic review and meta-analysis of evidence on activity-permissive workstations. Obes Rev. 2014; 15(10):822-838.
41. Council on Sports Medicine and Fitness; Council on School Health. Active healthy living: prevention of childhood obesity through increased physical activity. Pediatrics. 2006; 117(5):1834–1842.
42. Hakala PT, Rimpelä AH, Saarni LA, et al. Frequent computer-related activities increase the risk of neck-shoulder and low back pain in adolescents. Eur J Public Health. 2006; 8;16(5):536-541.
43. Parcells C, Stommel M, Hubbard RP. Mismatch of classroom furniture and student body dimensions: empirical findings and health implications. J Adol Health. 1999; 30;24(4):265-273.
44. Milanese S, Grimmer K. School furniture and the user population: an anthropometric perspective. Ergon. 2004; 15;47(4):416-426.
45. Trevelyan FC, Legg SJ. Back pain in school children – where to from here? Appl Ergo. 2006; 31;37(1):45-54.
46. Grimmer KA, Williams MT, Gill TK. The associations between adolescent head-on-neck posture, backpack weight, and anthropometric features. Spine. 1999; 1;24(21):2262.