A review of the international scientific literature on active school transport interventions

Anna Gannett¹, Paula Hooper², Julie Saunders², Gina Trapp¹

¹Telethon Kids Institute

² The University of Western Australia

Email for correspondence (presenting author): anna.gannett@telethonkids.org.au

1. Introduction

Active School Transport (AST) includes any active mode of travelling to or from school, the most common being walking or riding a bike. Numerous benefits of AST include improved children's health (Faulkner *et al.*, 2009; Larouche *et al.*, 2014), improved community livability (Marshall *et al.*, 2010; Garrard, 2011), and reduced costs associated with health and traffic (WA Department of Transport, 2020).

Concerningly, Western countries have experienced consistently declining rates of AST over the past 40 years (van der Ploeg *et al.*, 2008; Active Healthy Kids Australia, 2015). The Global Physical Activity Report Card evaluated children's active transport prevalence (which include AST) across 57 countries and awarded an average score of C- (meaning that less than 50% of students are using active transport), showing that there is considerable room for improvement (Aubert *et al.*, 2022).

Addressing the declining rates of AST requires an understanding of the factors influencing AST behaviour. Various individual, social, environmental, and policy factors have been cited in the scientific literature to be associated with AST (Pikora *et al.*, 2003; McMillan, 2005; Panter, Jones and van Sluijs, 2008). As such, it is important that future AST interventions target these influencing factors.

Understanding what interventions have been trialled and which ones have been successful will help to inform future AST policy and practice. To the authors knowledge, no review to date has compiled the findings of all AST interventions conducted worldwide. The aim of this paper was to review the international scientific literature to identify and describe what AST-related interventions have been performed worldwide, how well have they been evaluated and how effective have they been at increasing AST.

2. Method

2.1. Search process

The literature search was conducted in January 2022 using the Pubmed and Web of Science databases. The Boolean search terms used for each database were based on the methods used in previous literature reviews of AST interventions (Chillón *et al.*, 2011; Villa-González *et al.*, 2018) and included:

(((adolescen* OR child OR children OR youth OR student* OR pupil OR pupils) AND (bike OR bikers OR biking OR bicycle* OR cycle OR cycling OR cyclist* OR commute* OR commuting OR transportation OR travel*)) AND (intervention* OR implement* OR evaluat* OR change OR pilot OR project OR environment* OR engineer* OR encourage* OR planning OR impact OR "walk to school" OR "Safe Routes to School" OR "walking school bus" OR "walking school buss" OR "walking school buses")) AND (school) OR (review)

To identify relevant articles, all titles and abstracts were initially screened by two members of the research team independently. From this initial short-list, the full text version of each article was then reviewed to ensure it met inclusion criteria. Any discrepancies between the two reviewers were discussed and resolved by consensus.

2.2. Inclusion criteria

Relevant articles were selected based on 1) A focus on an AST intervention (note: interventions focusing on active transport to kindergarten or university were not included), and 2) inclusion of at least one outcome measure (e.g., AST/active transportation, physical activity).

2.3. Data extraction

A range of information was extracted from each relevant article, selected based on data extracted in previous literature reviews (Chillón *et al.*, 2011; Villa-González *et al.*, 2018). Each intervention was characterised by location (i.e. country) and target population. The interventions were classified into five categories developed from the Active Living by Design Community Action Model: Preparation, Promotions, Programs, Policies, and Physical, with the possibility of being classified into more than one category (Brennan, Brownson and Hovmand, 2012). The effectiveness of each intervention was also evaluated, with a focus on whether it increased AST or physical activity levels. Additionally, the effect size of each intervention was categorized as "trivial," "small," "moderate," "large," or "very large" using Cohen's d measure of effect size, if reported (Cohen, 1988). Finally, the study assessed the quality of the intervention as "weak," "moderate," or "strong" using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool, if reported (Effective Public Healthcare Panacea Project, 2022).

3. Results

3.1 Search results

We identified 8 review papers that had been published previously on this topic (i.e., 8 literature reviews detailing what AST interventions have been conducted to date internationally). Between them, they contained a total of 58 articles covering 56 AST interventions (after removing duplicates and articles that did not meet the inclusion criteria).

We identified a further 11 articles covering 11 AST interventions that had not been included in the 8 review papers (primarily because the 8 review papers only covered up to the year 2017 and our search was performed in 2022). Thus, this review included 67 AST interventions. Please contact the corresponding author for a full list and detailed information about each intervention included in this review.

3.2. Location of AST interventions

Most AST interventions were conducted in the USA (39%, n=26), followed by Australia (12%, n=8) and New Zealand (10%, n=7). Other countries where interventions were conducted included Canada (9%, n=6), UK (9%, n=6), Spain (4%, n=3), Belgium(3%, n=2), Denmark (3%, n=2) and Norway (3%, n=2). Only a single intervention (1%) was conducted in each of the following countries: China, Germany, Ireland, Netherlands, and Sweden.

The majority of interventions (63%, n=42) targeted primary school students only, followed by a combination of both primary and secondary school students (28%, n=19). Only 9% (n=6) of interventions targeted secondary school students. Note: Primary school students included up to Year 6 (or 12 years old if Year group was not reported) and secondary school students included Year 7 up to Year 12 (or 13 years old to 18 years old if Year group was not reported).

3.4. Intervention classification

The classification and main components of the 67 identified AST interventions are summarised in Table 1. Program and promotion AST interventions were the most common (both 63%, n=42), followed by physical (45%, n=30) and preparation (27%, n=18). Only six AST interventions were classified as policy (9%). Among the intervention main components, curriculum-based interventions were most common (27%, n=18), followed by awareness campaigns (21%, n=14).

Classification ^a	Intervention	Main component ^a
(n, %)		n (%)
Program	Curriculum-based	18 (27%)
(n=42, 63%)	Walking School Bus	10 (15%)
	Bike skills and safety training	7 (10%)
	Bike Train	2 (3%)
	Drop-off zones	3 (4%)
	Crossing guards	2 (3%)
Promotion	Awareness Campaign	14 (21%)
(n=42, 63%)	Special Event Days	13 (18%)
	Competition/Incentives	12 (18%)
	Grant Program	2 (3%)
	Participatory parent mapping (Our Voice)	1 (1%)
Physical	Traffic calming (devices and signage)	9 (13%)
(n=30, 45%)	Shared path	7 (10%)
	Bike storage	5 (7%)
	Pedestrian crossings	8 (12%)
	Bike repair station	1 (1%)
Preparation	Safe Routes to School	10 (15%)
(n=18, 27%)	School Travel Planning	6 (9%)
	School planning	2 (3%)
Policy	Whole-school physical activity policy	1 (1%)
(n=6, 9%)	Complete Streets resolution	2 (1%)
	Restriction of school choice	1 (1%)
	Prohibiting on-site parking for drop-offs	2 (3%)

Table 1. AST intervention classification and main components

^a Percentages do not add up to 100% because some interventions had multiple components

3.6. Effectiveness of the intervention

Around two thirds (64%, n=43) of the interventions reported an increase in some form of AST, whilst one third (34%, n=23) of the interventions had no effect on AST or physical activity. More specifically for AST interventions reporting an increase, it was measured by overall AST (42%, n=28), walking only (10%, n=7), cycling only (6%, n=4) or physical activity (6%, n=4). One intervention did not report results about changes to AST or physical activity.

3.7. Effect size of the intervention

The overall effect size was reported using Cohen's d for 36 of the interventions by existing reviews of AST interventions. Over half (58%, n=21) of the effect sizes reported were considered trivial. One third (31%, n=11) of interventions had an effect size of small. One intervention (3%) had an effect size of moderate (Vanwolleghem *et al.*, 2014). Only 3 interventions (8%, n=3) had an effect size of large (McKee *et al.*, 2007; Sirard *et al.*, 2008; Wen *et al.*, 2008).

3.8. Quality of the intervention

Quality was reported using the EPHPP quality assessment tool for 48 of the interventions by existing reviews of AST interventions. Over three quarters of the interventions (81%) received a rating of weak. The remaining interventions were rated as moderate (4%, n=2) and strong (15%, n=7).

4. Discussion and Conclusion

This review analysed 69 peer-reviewed articles on active school transportation (AST) interventions, covering a total of 67 interventions. The majority of these interventions were conducted in the United States and focused on primary school students exclusively. Although over half of the AST interventions reported an increase in AST and/or physical activity, the overall effect size of these interventions was mostly trivial or small.

In the quality assessment, more than 80% of the AST evaluations were rated as weak. Future studies should employ more robust evaluation designs. Some characteristics of studies with a "strong" quality rating were comparison groups, large samples (i.e. multiple schools or age groups), and reliable AST measures (Livingston *et al.*, 2011; Cuffe *et al.*, 2012; Faulkner *et al.*, 2014; Ragland *et al.*, 2014). Some strategies to improve confidence in the results of the evaluation could include randomisation of the intervention (i.e. by school or students if possible) and using valid and reliable measures for AST participation.

The most common types of AST interventions classified by the Active Living by Design Community Action Model were program and promotion, followed by physical and preparation interventions. The most frequent components of AST interventions were curriculum-based, followed by awareness campaigns. Interventions with multiple classifications can target individual, social, and environmental factors related to AST participation. For example, combining classroom activities, parent involvement, and built environment changes had a large effect size for one intervention (Wen *et al.*, 2008). Safe Routes to School programs aim to target individual, social, and environmental factors as well, but schools vary in how many and which types of interventions they implement and how effectively they increase AST (McDonald *et al.*, 2014). Given the overall results in this review of effect size and study quality, there is not enough evidence to provide conclusive recommendations for what combination of intervention components is most effective, but there is a need to trial more strategic and comprehensive interventions at schools.

This review only includes AST interventions reported in the scientific peer-reviewed literature. Therefore, other AST interventions conducted and reported on outside of the peer-reviewed literature were not included. Despite this limitation, the report provides valuable insights into the effectiveness and quality of AST interventions. This review expands on previous AST intervention literature reviews by consolidating results from previous reviews and including recent interventions. Overall, this review highlights the need for further research and evaluation to develop effective strategies to promote AST and physical activity.

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