Community Preventive Services Task Force

Physical Activity: Interventions to Increase Active Travel to School

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Finding and Rationale Statement
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CPSTF Finding and Rationale Statement

Context

Physical activity among children is a public health priority (USDHHS, 2008a). The U.S. Department of Health and Human Services recommends that young people ages 6–17 years participate in at least 60 minutes of physical activity daily (USDHHS, 2008b, 2018b). Regular physical activity in childhood and adolescence improves strength and endurance, helps build healthy bones and muscles, helps control weight, reduces symptoms of anxiety and depression, and may improve cardiovascular health (USDHHS, 2008a, 2018). Most children in the United States, however, are not active enough to achieve health benefits (Janssen et al., 2010; Andersen et al., 2006).

Walking or bicycling to and from school provides children and adolescents with an opportunity to be physically active every day. Interventions to promote and support active travel to school may be one part of a broader school and community approach to increase the number of children who obtain recommended levels of daily physical activity.

Intervention Definition

Active travel to school (ATS) interventions make it easier for children and adolescents to commute to school actively (e.g., walking and biking). Interventions facilitate ATS by targeting the physical or social safety of common routes to school or by promoting safe pedestrian behaviors. Interventions must include one or more of the following components:

- Engineering – operational and physical improvements to the built environment infrastructure
- Education – materials and activities to teach the importance of active transportation; walking and cycling safety training sessions
- Encouragement – events and activities to promote active transportation
- Enforcement – partnerships with local law enforcement to ensure traffic laws are obeyed in school neighborhoods; crossing guard programs

Interventions, such as U.S. Safe Routes to School programs, may also include the following cross-cutting considerations:

- Evaluation – data collection and program monitoring to inform future intervention components
- Equity – efforts to ensure that intervention components reach everyone within a school community and address potential barriers to participation for certain groups (e.g., low-income, people of color)

Intervention components are typically selected or modified to address specific school and neighborhood barriers to active travel. Programs may be combined with other school- and community-based interventions to increase opportunities for physical activity.

CPSTF Finding (August 2018)

The Community Preventive Services Task Force (CPSTF) recommends interventions to increase active travel to school. Sufficient evidence of effectiveness shows interventions increase walking among students and reduce risks for traffic-related injury.

Studies included in the systematic review of evidence found meaningful increases in the proportion of students who regularly walk to or from school. There was not enough evidence, however, to show that school travel led to increases in students' overall daily physical activity. Included studies that examined traffic-related injuries associated with Safe

Routes to School Programs in the United States found meaningful reductions in injury rates in school neighborhoods attributable to street-level engineering improvements.

The CPSTF finds the economic benefits exceed the cost for active travel to school interventions based on evidence from a systematic economic review. Included studies of U.S. Safe Routes to School programs reported economic benefits of averted injuries because of street-level engineering improvements.

Rationale

Basis of Finding

The CPSTF finding is based on evidence from a systematic review of 52 studies (search period through March 2018) that evaluated the impact of active travel to school interventions on students' commuting patterns. The Community Guide review combined studies from a published systematic review (Chillon et al. 2011; 11 studies; search period through January 2010) and evidence from an updated search for evidence (41 studies; search period January 2010 to March 2018) conducted using the same search terms.

The Community Guide review focused on two primary outcomes: (1) active travel to school, and (2) pedestrian and bicycling injuries. For each outcome, results from the subset studies from U.S. Safe Routes to School (SRTS) programs were also examined.

Forty of the fifty-two included studies assessed active travel outcomes. Twenty-six studies (29 study arms) evaluated differences or changes in the proportion of students who walked or bicycled to school and reported a median increase of 5.9 percentage points (interquartile interval [IQI]: 0.2 to 10.5 percentage points). The remaining 14 studies used different measures to evaluate active travel and most reported favorable, though not statistically significant, outcomes (Table 1).

A subset of 12 studies evaluated the effectiveness of U.S. Safe Routes to School programs. The proportion of students engaged in active travel to school increased by a median of 6.5 percentage points (IQI: 0.3 to 9.5 percentage points; 9 studies). The three remaining studies used different measures of change and reported favorable, though not statistically significant, changes in active travel for school (Table 1).

Table 1: Active Travel to School Outcomes

Outcome Measure	Results[ab] by Study Design
Change in proportion of students engaging in active travel: all modes combined (26 studies)	Greatest suitability of study design[c] (16 studies, 19 study arms) • Median increase of 5.7 percentage points (IQI: 0.0 to 11.6) Least suitable study design[d] (10 studies) • Median increase of 6.2 percentage points (IQI: 2.0 to 9.5) Combined study design (26 studies, 29 study arms) • Median increase of 5.9 percentage points (IQI: 0.2 to 10.5) • Relative Percent change: Median increase of 26.2% (IQI: 4.1 to 75.9)

Outcome Measure	Results[ab] by Study Design
Change in active travel outcomes from studies using different measurements (14 studies)	Greatest suitability of study design[c] • Favorable and significant outcomes (1 study) • Favorable outcomes (5 studies) • Mixed results (2 studies) • No change (2 studies) Least suitable study design[d] • Favorable outcomes (2 studies) • Mixed results (2 studies)
Subset Analyses: Studies of U.S. Safe Routes to School Programs	
Change in proportion of students engaging in active travel (9 studies)	Greatest suitability of study design[c] (4 studies) • Median increase of 0.4 percentage points (IQI: 1.5 to 6.0) Least suitable study design[d] (5 studies) • Median increase of 9.0 percentage points (IQI: 6.7 to 12.7) Combined study design (9 studies) • Median increase of 6.5 percentage points (IQI: 0.3 to 9.5) • Relative Percent change: Median increase of 27.2% (IQI: 6.6 to 71.9)
Change in number of students engaging in active travel (3 studies)	Greatest suitability of study design[c] • Favorable outcomes (1 study) Least suitable study design[d] • Favorable outcomes (2 studies)

[a]Results shown in table were those reported at the end of each intervention

[b]Unit of outcome reported as days or days/week

[c]Includes the following study designs: group and individual RCT, other design with concurrent comparison, before-and-after with comparison group

[d]Includes the following study design: before-and-after without comparison group

IQI = interquartile interval

Seven studies evaluated the effectiveness of one or more intervention components on pedestrian and bicycling injuries. Five studies evaluated state or city SRTS programs that were funded to implement street-level engineering improvements. These studies evaluated different levels of scale, used different comparison jurisdictions and populations, and evaluated changes in reported pedestrian and bicycling injuries based on state or city records. The strongest study design compared SRTS funded school jurisdictions (census tracts) with non-funded census tracts in New York City.

Over a 10-year period, reported injuries decreased by 44% (95% CI: 17% to 65%) in census tracts funded for SRTS engineering projects. The remaining four SRTS studies included state-level evaluations in Texas and California, a multi-state (18 states) analysis, and a street-level study in California. Two additional studies examined specific activities including the impact of school crossing guard expansion in Toronto (no impact on injuries) and a bicycle safety course in Denmark (mixed results) (Table 2.)

Table 2: Traffic-related Pedestrian and Bicycling Injury Outcomes

Outcome Measure	Results
U.S. Safe Routes to School programs: Effectiveness of one or more components on pedestrian and bicycling injuries (5 studies)	One city-wide study (NYC): • 44% reduction in school-aged pedestrian injury rates (95% CI: 17% to 65%) • Decrease of 3.4 percentage points for school-aged pedestrian injury rates (per 10,000 population) One state-wide study (Texas): • 14% reduction in school-age pedestrian and bicyclist injury rates (IRR=0.86, 95% CI 0.75 to 0.98); • Decrease of 21.0 percentage points for school-aged pedestrian injury rates (per 100,000 population) One multi-state study (18 states): • 23% reduction in school-age pedestrian and bicyclist injury rates (IRR: 0.77, 95% CI: 0.65 to 0.92) • Injury rate change estimates for each state: 4 states found a favorable (significant) reduction, 7 states founds a favorable (non-significant) change, and 7 states found no change Two state-wide studies (California): • One study showed a 53% reduction in collisions in SRTS project areas (IRR=0.47 [95% CI: 0.20, 1.12] p=0.09) • One study showed a 13% reduction in collisions in SRTS project areas and a 15% reduction in non-SRTS areas
Effectiveness of crossing guard implementation (1 study)	No change in pedestrian injury rates at school when crossing guards were on duty.
Effectiveness of cycling skills intervention (1 study)	No change in serious injuries or total injuries; reduction of 4.2 percentage points in the incidence rate of traffic injuries.

IRR= incidence rate ratio
CI= 95% confidence interval

Five of the included studies examined amounts of moderate to vigorous physical activity (MVPA) children engaged in during active travel and reported mixed results (2 studies found significant increases; three reported no change). Another five studies examined the impact of active travel interventions on total daily MVPA or total physical activity and showed mixed results (3 studies found favorable outcomes; 2 reported no change).

Six included studies focused on bicycling to school and showed mixed results (one found favorable and significant outcomes; one found favorable outcomes; one found mixed results, two showed no change; and one found unfavorable outcomes). One additional bicycle-focused study reported on cardiorespiratory endurance and showed no change.

Applicability and Generalizability Issues

Twenty-four of the included studies were conducted in the United States. The remaining studies were conducted in the United Kingdom (10 studies), Australia (5 studies), Canada (3 studies), Belgium (2 studies), Denmark (2 studies), New Zealand (2 studies), and 1 study each in Ireland, the Netherlands, Norway, and Spain.

Most of the studies providing information on school type were conducted in elementary schools (25 studies), or evaluated interventions delivered to both elementary and middle schools (14 studies). Seven studies included schools across all grade levels. Only one study reported outcomes for high school students. Subset analyses showed the greatest effects at elementary schools compared to middle and high schools. Of the studies providing information on school funding, most were conducted in public schools (28 studies), while three were done in combinations of public, private, or charter schools.

The majority of studies were conducted in urban (12 studies) or mixed urban-suburban communities (18 studies). None of the included studies specifically examined interventions implemented in rural communities. Nine of the included studies examined distance traveled to school. They used different measures and comparisons, however, making it difficult to draw any conclusions about the relationship between active travel to school interventions and distance students travel to school.

Most of the included studies evaluated more than 1000 students (22 studies), followed by studies of 101-1000 participants (16 studies), and 100 participants or less (10 studies) with four studies not reporting.. Most studies ran longer than 12 months (22 studies), while some ran for 4-12 months (12 studies), or 3 months or less (15 studies). Duration could not be determined for 3 studies.

Across all studies, students' mean age was 9.8 years and 52.8% of participants were girls. Demographic characteristics were not routinely reported and none of the included studies examined intervention effectiveness by socioeconomic status, race or ethnicity.

Overall, studies found active travel interventions to be effective regardless of the component or combinations of components selected and implemented (e.g., encouragement, education). However, the subset of study interventions that included an engineering component found a larger change in the proportion of students using active travel (5.9 percentage point increase) compared to interventions without an engineering component (4.8 percentage point increase) across similar baselines.

Data Quality Issues

Almost all of the included studies evaluated schools selected for intervention or awarded funding for interventions (SRTS programs). Intervention and comparison schools frequently differed on active travel rates at baseline. Measurement of changes in active travel to school were based mainly on individual self-reports or classroom-based tallies. Most studies showed differences in rates as reported by students, teachers, and parents. Studies that measured physical activity used unclear definitions for MVPA and typically evaluated small numbers of recruited participants; many also reported a follow-up of less than 3 months.

Potential Benefits

None of the included studies reported or examined potential benefits of active travel to school interventions. The CPSTF notes benefits could include increases in physical activity among parents or community residents attributable to intervention activities or engineering improvements. Other postulated benefits could include reductions in vehicle miles traveled and air pollution.

Potential Harms

Injuries associated with active travel to school were considered as a primary outcome in this review but were restricted to traffic-related, reportable pedestrian and cycling injuries. Studies did not evaluate other injury outcomes such as falls, or violence related to active travel through school neighborhoods. None of the included studies reported or examined other CPSTF postulated harms of active travel to school interventions including increases in exposure to air pollution, and traffic congestion in neighborhoods during the school commute (e.g., vehicles stopped at crosswalks).

Economic Evidence

Evidence from the systematic economic review showed the economic benefits exceed the cost for interventions. This evidence was from studies of interventions in which improvements in existing infrastructure enhanced the safety and ease of active travel to school.

The economic review included 10 studies (search period January 1990—July 2018). Studies were based in the United States (3 studies), the United Kingdom (2 studies), Australia (3 studies), Canada (1 study), and Japan (1 study). All the studies evaluated interventions targeting elementary and middle school students. All three U.S. studies evaluated SRTS projects.

All 10 of the included studies provided data on intervention cost. Seven of the studies provided economic benefits because of the intervention and summary benefit to cost ratios, and two provided estimates for cost per disability adjusted life year (DALY) averted. All monetary values are expressed in 2017 U.S dollars.

The economic review team assessed the quality of estimates based on the following:

- Whether or not drivers of cost or drivers of benefit were included in the estimate; and
- How well measurement and estimation methods met idealized criteria:
    - Economic outcomes calculated from a societal perspective
    - Benefits derived from observed changes in walking or bicycling
    - Model parameters drawn from research literature and relevant to the local area
    - Appropriate time horizons used to calculate benefits

Intervention Cost

All 10 of the included studies reported intervention cost, with the majority reporting how much was received in funding. The economic review considered the drivers of cost to be engineering (infrastructure), enforcement, education, encouragement and promotion, and planning.

The three U.S studies reported mean intervention cost per school for SRTS projects of $171,863, $147,126, and $87,150, with all three receiving fair quality assessments. Intervention costs ranged widely in studies conducted outside of the United States — from $3,351 per school (Australia) to $636,622 per project (United Kingdom). A common component in the ATS projects evaluated in the included studies was engineering or infrastructure improvements to streets, sidewalks, or pathways for pedestrians and bicyclists. The greater project costs in the United Kingdom were for larger scale, new or

improved sidewalks, roadways, or pathways that may have served more than one school. Two of the seven estimates for intervention cost from studies outside of the United States were assessed to be of good quality and the remaining were assessed to be of fair quality.

Intervention Benefit and Benefit-Cost Ratios

Two studies from the United States and seven studies from outside of the United States estimated the economic benefits because of the intervention. The economic review considered the drivers of economic benefits to be reductions in automobile use, pedestrian and bicyclist injuries and fatalities, school busing, private cost of travel time for parents, pollution, congestion, and greenhouse gases, and averted healthcare costs due to increased physical activity.

The two U.S. studies modeled benefits from observed reductions in injuries and fatalities and observed increases in walking and bicycling; their estimates were assessed to be of fair quality. The study from Japan estimated intervention benefit based on community residents' willingness to pay; the estimate was assessed to be of fair quality. Two of the Australian studies modeled reductions in healthcare cost and DALY averted due to averted obesity; these estimates were assessed to be of limited quality and were excluded from further consideration. The remaining four studies, all from outside the United States, reported economic benefits that were modeled from observed increases in walking and bicycling and resulting reductions in use of private automobiles and other motorized transport, pollution, congestion, and greenhouse gas emissions, traffic-related injuries and fatalities, and healthcare costs. These estimates were assessed to be of good quality.

One study estimated the benefit to cost ratios for SRTS programs in the United States were 0.74:1.0 (1 year horizon) and 1.46 (2 year horizon). The second U.S study estimated a ratio of 1.74:1.0 (2 year horizon). The two estimates were assessed to be of fair quality. Estimated benefit to cost ratios from the five remaining studies were all greater than 1.0, with a median of 5.2:1.0 over a median time horizon of 10 years. One estimate received a good quality assessment; the remaining four were assessed to be of fair quality.

Related Reviews and Recommendations

Safe Routes to School programs meet CDC's High-Impact in 5 years [https://www.cdc.gov/policy/hst/hi5/saferoutes/index.html] criteria based on an assessment of effectiveness in increasing active travel for school and a determination of economic value based on reductions in pedestrian and bicycle injury rates. County Health Rankings [http://www.countyhealthrankings.org/take-action-to-improve-health/what-works-for-health/policies/safe-routes-to-schools] identifies Safe Routes to School programs as being scientifically supported on the basis of evidence demonstrating increases in active travel to school and reductions in injuries.

Three recent, external systematic reviews examined the effectiveness of active travel to school interventions or the quality of evidence published since the Chillon et al. review in 2010 (Pang et al. 2107, Larouche et al. 2018, Villa-Gonzalez et al. 2018). Findings from all three reviews were similar, noting heterogeneity in study designs, intervention activities, and target communities, and modest impacts on rates of active travel for school. Each review provided an agenda for future research to strengthen the evidence base.

Considerations for Implementation

Intervention implementation in the United States has been driven largely by available federal and state funding for Safe Routes to School programs. Although the overall results do not provide clear guidance on differential effectiveness of specific intervention components or combinations of components, the subset of studies evaluating SRTS programs provide large-scale, real-world evidence on effectiveness applicable to most U.S. communities and populations. SRTS

programs emphasize the selection of components to address school and neighborhood-specific barriers to active travel. Implementation guidance is available through several organizations:

- Safe Routes to School National Partnership [https://www.saferoutespartnership.org/]
- National Center for Safe Routes to School [http://www.saferoutesinfo.org/]

Additional implementation guidance and technical assistance may be available from state and local SRTS programs (for example: http://www.fdot.gov/Safety/2A-Programs/Safe-Routes.shtm; http://www.dot.ca.gov/hq/LocalPrograms/saferoutes/sr2s.htm; multi-state: https://www.fhwa.dot.gov/environment/safe_routes_to_school)

Guidance is also available for settings and populations with additional barriers to program implementation or participation (e.g., community concerns about bullying or crime).

- Using Safe Routes to School to Combat The Threat Of Violence [http://www.saferoutespartnership.org/sites/default/files/pdf/Street-Scale-Using-Safe-Routes-to-School-to-Combat-Threat-of-Violence.pdf]

Low-income communities and schools in rural areas also have unique barriers to participation. The following resources provide information to help program planners identify and address some of these barriers.

- Implementing Safe Routes to School in Low-Income Schools and Communities [http://www.saferoutespartnership.org/sites/default/files/pdf/LowIncomeGuide.pdf]
- On the Move: Safe Routes to School Policies in Rural School Districts [https://changelabsolutions.org/sites/default/files/SRTS-Policies-Rural_School_Districts-FINAL_20140611.pdf]
- Rural Communities: A Two Pronged Approach for Improving Walking and Bicycling [http://saferoutespartnership.org/sites/default/files/pdf/Lib_of_Res/SR2S_Rural_2pronged approach_20150331.pdf]

Program planners should consider baseline and follow-up assessments of physical and social barriers specific to the school and neighborhood when selecting and implementing intervention components and activities.

Evidence Gaps

Additional research and evaluation are needed to answer the following questions and fill existing gaps in the evidence base.

- What is the relationship between changes in active travel to school and overall measures of total daily physical activity and MVPA? Studies should examine the impact of changes in active travel on the proportion of students who meet recommended levels of daily MVPA.
- How effective are interventions in different U.S. populations and settings (e.g., low income or rural communities)? Future studies could inform prioritization of programs and program components in rural settings (for example, states could focus funding on elementary schools in smaller towns).
- How does intervention effectiveness vary by students' demographic characteristics? Where feasible, studies should collect information about study participants, including parental income, educational attainment, and race/ethnicity. When this is not possible, studies should report information about school or community demographics.

- What is the relationship between local built environment improvements and pedestrian and cycling injury rates? Assessments should consider overall impact on safety for both students and community residents.
- How does the distance students travel between their homes and schools impact intervention effectiveness? Additionally, what is the impact when school buses are offered versus not offered (e.g., buses required for students who live further than one mile from school)? More comparative study designs are needed as most of the evidence has been cross-sectional.
- What are the drivers of economic benefits that result when travel mode shifts from private automobile use to walking or bicycling? U.S studies did not include many of the drivers of economic benefits beside reduced injuries and fatalities.
- What effect do SRTS projects have on walking or bicycling to school? More information about these outcomes would allow economic evaluations to assess benefit to cost ratios.
- What is the appropriate time horizon to compare the benefit and cost of ATS interventions? Though infrastructure projects have a longer service life, it may be appropriate to consider a time horizon not longer than 10 years when assessing costs and benefits of ATS projects to reflect realistic decision making scenarios.

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