Educating the Whole Child Symposium

ACTIVE LIVING & ACTIVE LEARNING: Designing Whole Schools and Whole Communities for the Whole Child

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Contents

Background

Obesity Epidemic

➢ The World

- **Adults:** 37% overweight or obese.
- **Children & Adolescents:** 14% overweight or obese.

(Based on findings published in the Lancet in 2014. www.healthdata.org/gdb)

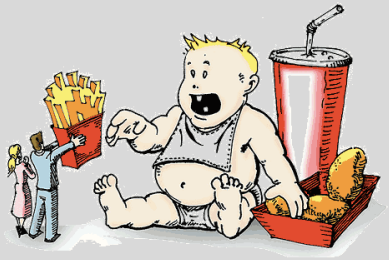
➢ U.S.

- **Adults:** 42.4% obese (2017-2018)
- **Children & Adolescents:** 1 in 5 is obese.
- The % of children and adolescents affected by obesity has **more than tripled** since the 1970s.

(US Centers for Disease Control & Prevention, 2021)

Obesity:
Genetics + Energy Balance

Energy Intake > Energy Exertion



Unhealthy Diet — Physical Inactivity

- **Among the top risk factors for deaths in the U.S.** (Danaei G et al, 2009)

CONSEQUENCES OF CHILDHOOD OBESITY

Children who have a high body mass index between 2 and 19 years are at 40-60% higher risk of early death by any cause

Children are at higher risk of psychological distress (poor self-esteem, anxiety, depression and social problems such as bullying and stigma)

In childhood, obesity is associated with hypertension and early stages of cardiovascular disease, insulin resistance and early stages of type 2 diabetes, asthma, sleep apnea, increased risk of fractures

Early death | **Psychological stress** | **Multiple diseases**

- **Physical Activity Guidelines for Americans:** Children and adolescents should engage in **60 minutes or more of moderate-to-vigorous physical activity (PA)** daily.
- **Children's PA** has been declining over the past few decades.
- **PA behaviors established in early childhood** predict adolescent and adult PA behaviors.
- **K-12 public schools** are important settings for related interventions because 50.8+ million children spend ~180 days per year in these schools.

Active Living

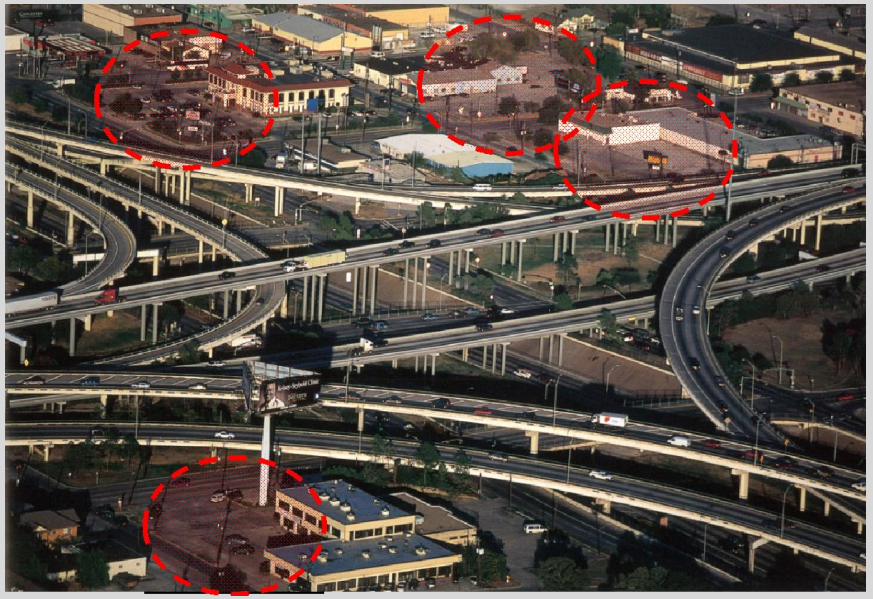
"A way of life that integrates physical activity into daily routines."

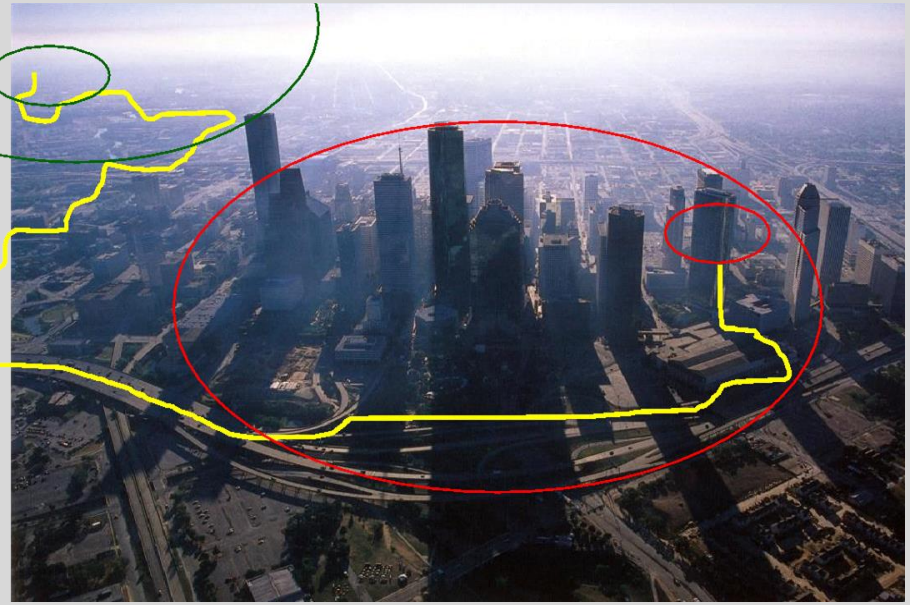
…BY DESIGN…

www.lta.gov.sg

Activity domains:
- Transportation
- Household
- Work/study
- Leisure/exercise

❖ Dominance of automobile-centered development

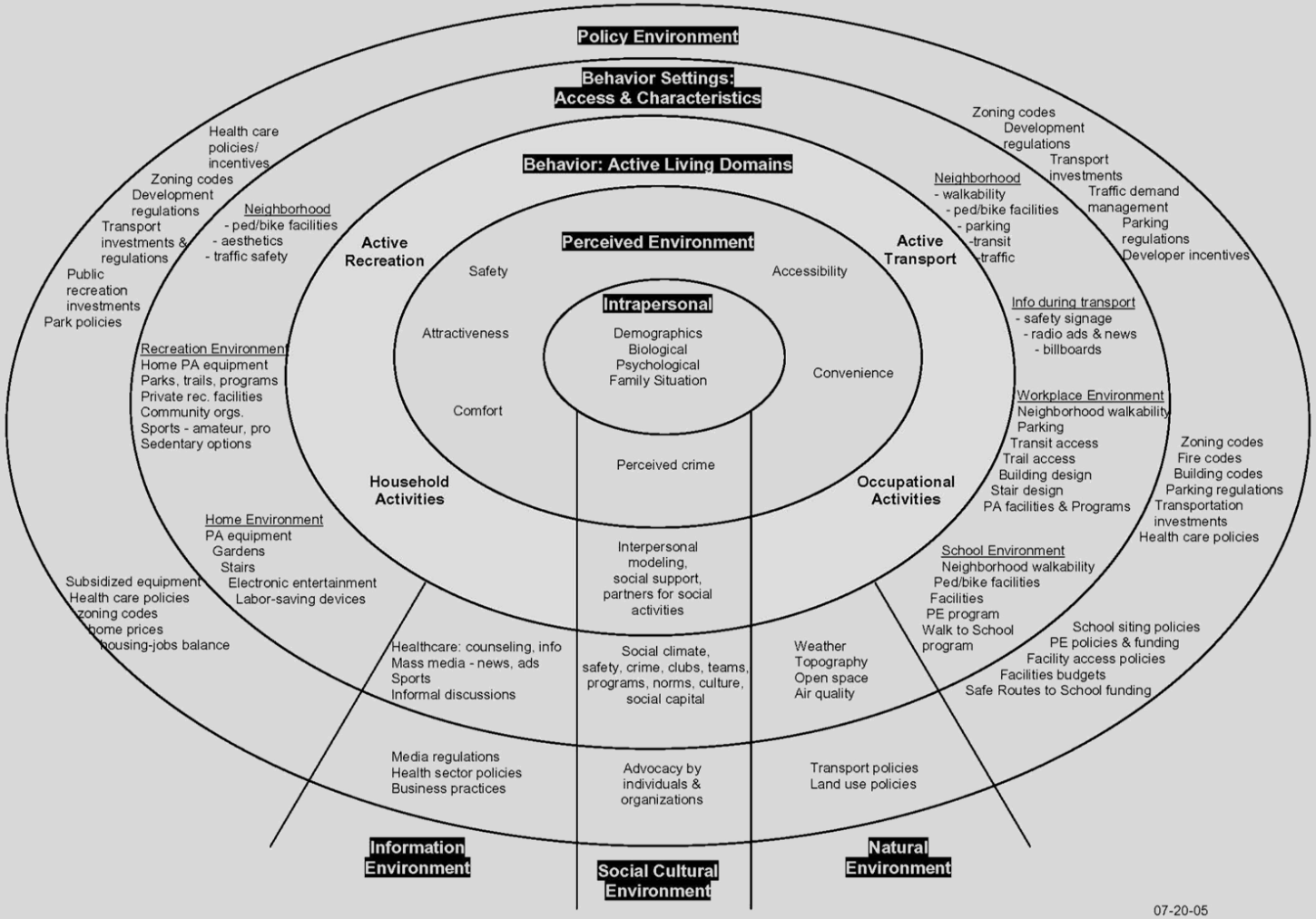




Social Ecological Model

- Nested or embedded systems
- Dynamic, interactive & inter-dependent
  - Causes are multi-level
  - Solutions must be multi-level

Ecological Model of 4 Domains of Active Living



(Sallis et al., Ann Review of Public Health, 2006)

Whole School, Whole Community, Whole Child Model

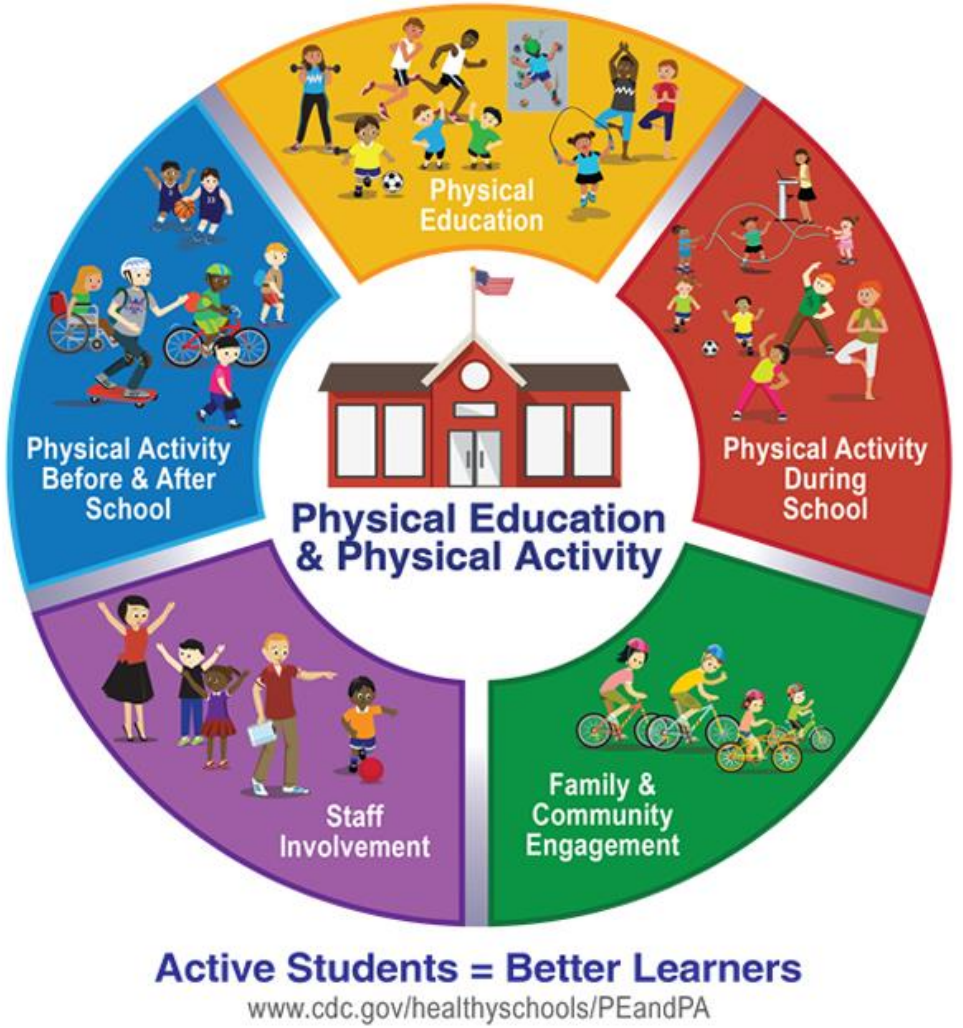
- **CDC's framework for addressing health in schools**
- Student-centered and emphasizes the role of the community in supporting the school, the connections between health and academic achievement and the importance of evidence-based school policies and practices.

Edu-cation + **Public Health** → **Whole Child Development** (cognitive + physical + social + emotional)

- **10 Components**

Comprehensive School Physical Activity Program (CSPAP)

- **5 Components**



Whole School for Active Living

Physical Activity During School

Systematic Literature Review

Purpose: Examines how **physical environmental interventions at K-12 schools** can help promote students' physical activity (PA).

Method: Followed Preferred Reporting Items for Systematic Reviews and Meta-analyses **(PRISMA) Guidelines**.

- **Databases:** ERIC (Ebsco, Medline Complete (Ebsco), CINAHL Ebsco, APA Psycinfo, Academic Search Ultimate, Environment Complete, Art & Architecture, & Avery Index to Architectural Periodicals.

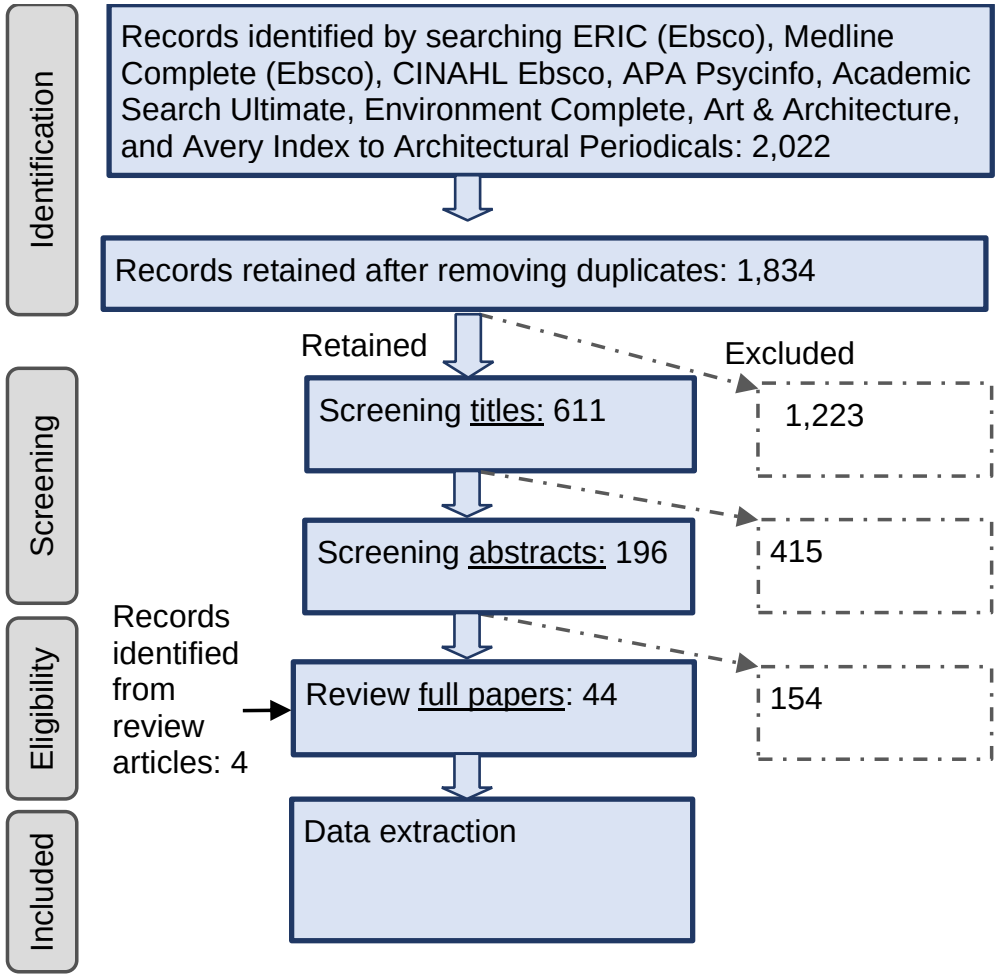


Figure 1. Process of literature review

RESULTS

- **44 articles (41 interventions)** were identified, with **quasi-experimental design (n=31)** being the most common study design.
- Increased studies over the years (Figure 2).
- **Range of sample size:** 14 –18,777 students; 1 – 275 schools.
- **US** was the country with the most studies (n = 14), followed by **UK** (n = 10), **Australia** (n = 6), other countries (n =14) (Figure 3).

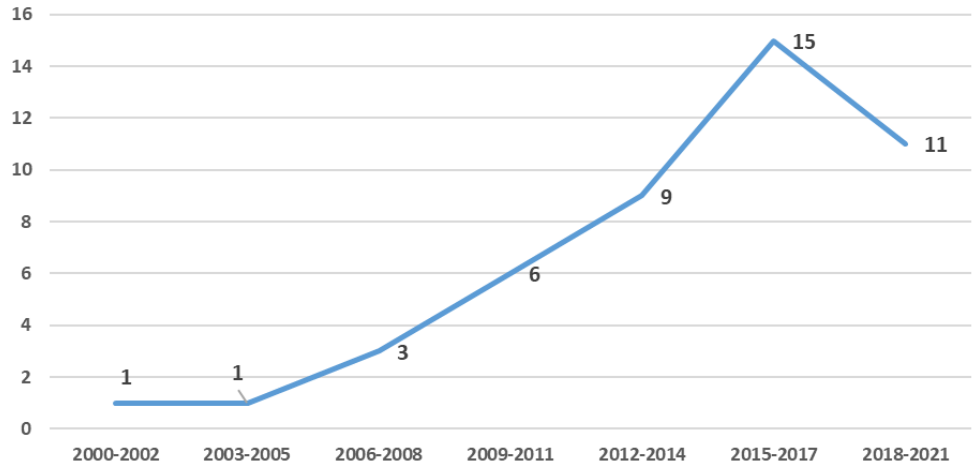


Figure 2. Number of articles by year of publication

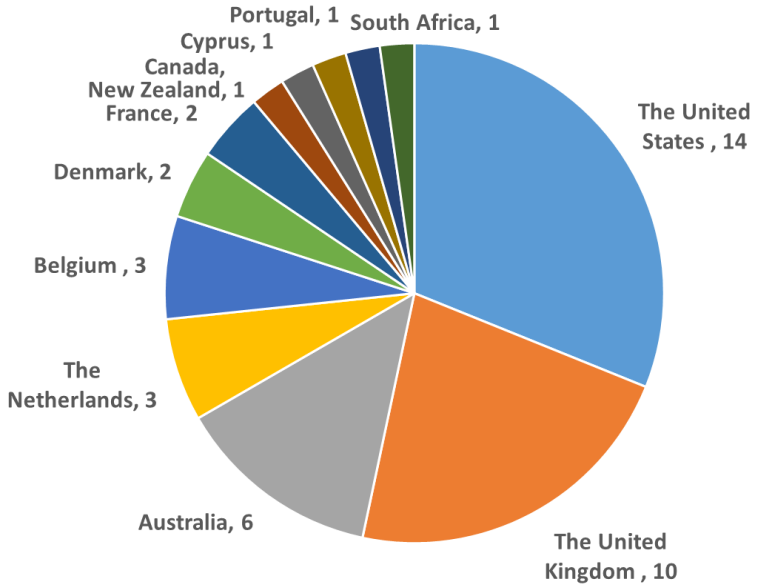
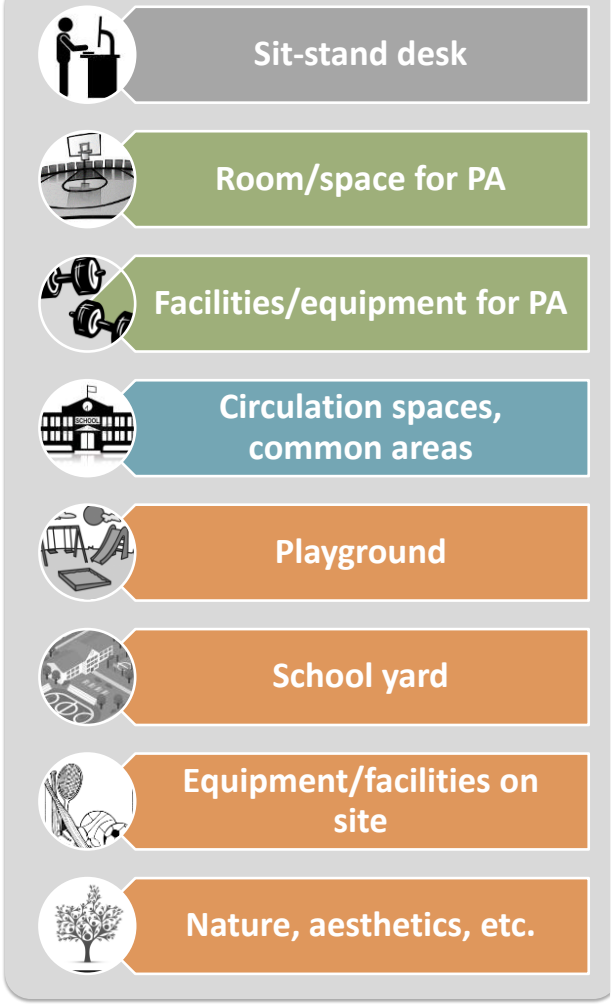


Figure 3. Number of articles by country

RESULTS

- **STUDY STATION (6 articles):** Standing desk showed positive impacts in reducing sitting and improving standing/stepping. but tend to be insignificant for light, moderate or vigorous PA.
- **CLASSROOM (2 articles):** Less studied but showed promising results.
- **BUILDING:** Included in a few multi-scale/level interventions and showed promising (although still mixed) results.
- **OUTDOOR SPACE (21 articles):** The most studied scale, with a focus on playground/schoolyard marking, equipment, or greening, or a combination of elements. Very promising results although a few studies showed no improvement.
- **Mutli-scale (3 articles):** Positive (although mixed) results.
- **Multi-level (13 articles):** Various interventions with overall positive results.



Study Desk

Study	Intervention	Outcome[a]	Intervention results: mean or mean (95% confidence interval) for change from baseline
Contardo Ayala (2016)	**Sit-stand Desks**	Sitting during school	• -27.75 (-48.54, -6.95) for # of sit bouts > 10 min • NS[b]: sitting; # of sit bouts >5 min; # of sit bouts>20 min
		Standing, stepping, LPA, & sit-to-stand transition during school	• +7.26 (1.2, 13.32) for sit-to-stand transition • NS: standing time; stepping time; LPA
Clemes (2020)	**Sit-stand desks**	LPA, MVPA	• − 30.6 min/day (− 56.4, − 4.8) for sitting
Ee (2018)	**Sit-stand desk and "fidget bars"**	SB, LPA, MPA, VPA	• +21 min/school day for standing • -24 min/school day for sitting • NS for LPA, MPA. VPA
Verloigne (2018)	**Sit-to-stand desk**	Sitting, standing	• -25.9 min. for sitting • +25.6 min. for standing
Swartz (2019)	**Standing desks with height-matched stools**	SB, LPA, MVPA	• NS[c] for SB, LPA, MVPA • Significant interaction between type of desk and time: More sedentary before engaged in less SB when using a stand-biased desk compared to the traditional desk.
Benden (2014)	**Stand-biased desk and stool**	Step counts (steps/min)	• +1.61 steps/min

[a] SB: Sedentary behavior; LPA: light physical activity (PA); MVPA: PA; VPA: Vigorous PA; [b] NS: not significant

Samples of Study Desk Interventions

- **Sit-to-stand desk used in a Belgium study** by Verloigne et al. 2018 (based on the link provided)
  - → -25.9 min. for sitting
  - → +25.6 min. for standing

- **A stand-biased desk and a seated desk used in a U.S. study by Benden et al. (2014)**
  - → **Step counts:** +1.61 steps/min

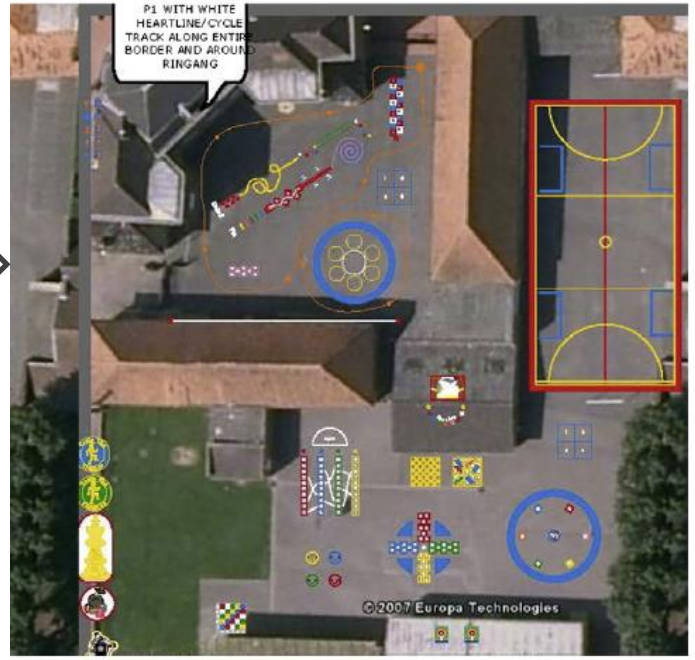
(photos courtesy of PositiveMotion LLC)

Classroom

Study	Intervention type	Outcome	Intervention results: mean or mean (95% confidence interval) for the change from baseline
Aminian et al. (2015)	**Dynamic classroom design with standing workstations;** Swiss balls beanbags, benches and a "mat space" for sitting	Sitting, standing, stepping, step counts, sit-to-stand transitions during school	**Baseline-5 weeks:** +36 min. for standing, +19 min. for stepping, -11 for sit-to-stand transitions, NS for sitting and step counts **5 weeks -9 weeks:** NS **Baseline-9 weeks:** NS
McCrady-Spitzeret al. (2015)	**Active Classroom Equipment** (e.g., overhead ladder, a balance beam, spinners, personal trampolines, hopscotch, and gym mats)	PA measured as Accelerometer units (AU)/ min	+72 (AU)/min

Outdoor Space:

Authors	Intervention	Outcome variables	Intervention results: mean or mean (95% confidence interval) for the change from baseline
Blaes et al. (2013)	**Playground marking**	% of SB, LPA, MPA, VPA, MVPA	• −2.8% for SB, +1.1% for MPA, +0.3% for MPA, +1.4% for MVPA
Hyndman et al. (2014)	**Equipment**	PA, area-level PA intensities	• +13.08 (7.31-18.84) steps/per min after 7 weeks • +5.93 (0.14-11.72) steps/min after 8 months
Loucaides et al. (2009)	**Marking + equipment**	Steps during the 20-mn school break & after school	• More steps during school break: mean in the first (1427±499) and second (1331±651) intervention school higher than control school (1053 ± 447) • NS for after-school activities
Raney et al. (2021)	**Playground greening**	LPA, MPA, VPA during 20-min recess	• +MVPA: 11.2 min (10.6, 11.8) in intervention group vs 8.9 (8.3, 9.3) in control group
Hamer et al. (2017)	**Complete reconstruction**	SB, LP, MVPA	• −28.0 (−1.9, −54.1) min/school day for SB • +24.6 (0.3, 48.9) min/school day for LPA for children aged under 9 yrs. old



Samples of Outdoor Space Interventions

→ **RESULTS:** Among least-active children: 12.2 more daily min. spent in schoolyard; more PA time in schoolyard (4.4 min more/day, including 0.9 more min/day in MVPA & 3.5 min/day in LPA).

(Pawlowski et al., 2020)

1

Before

After

5 Movement Areas:

- 3.5-m tall hill covered with rubber and a trampoline
- Music/dancing area with an in-ground amphitheater with mirrors, a moveable loudspeaker, and poles;
- Outdoor classroom area;
- Playground kitchen/outdoor canteen area;
- Play-box area with different multi-courts and parkour facilities.

2

Before

After

Loop merging a forest area & schoolyard:

- Runs through the schoolyard and the forest with various design features (e.g., bench, tribune, broken climbing-ladder, swings, spider's web, balance-bars, & treetop house.
- Amenities along the loop (e.g., forest-café, forest-amphitheater, skating pool multi-court area, & dancing spot with a big screen).

(Pawlowski et al., 2020)

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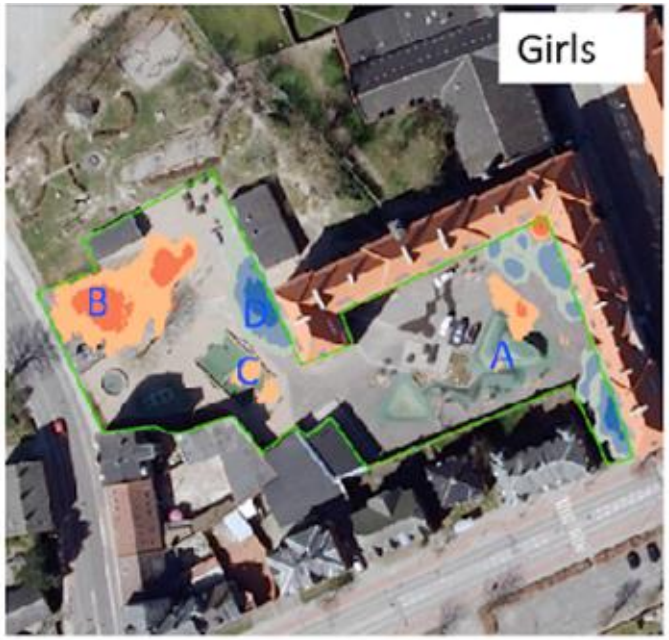


Figure 3a-c. Hot-spots and cold-spots in intervention areas by school and gender after renewal

A: Hills
B: Multi-court
C: Soccer court
D: Outdoor kitchen area

Hot and cold spots (Confidence level

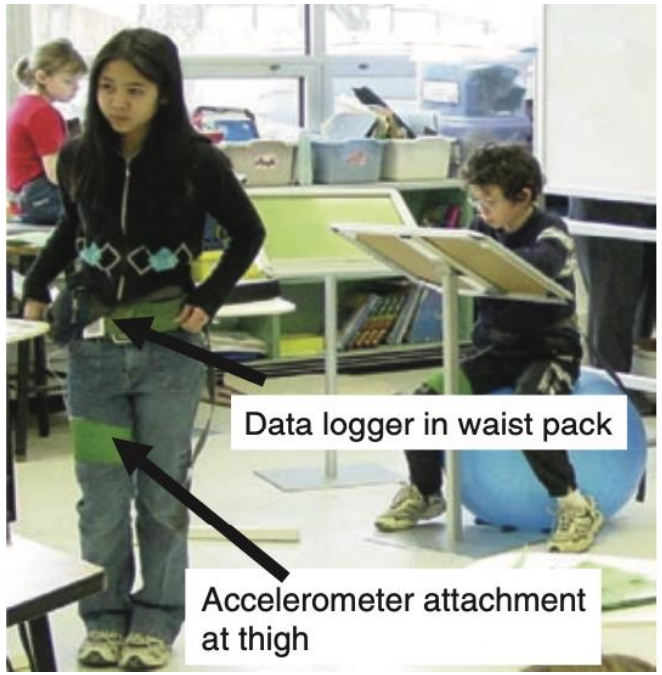
cold spot (99%
cold spot (95%
cold spot (90%
hot spot (90%)
hot spot (95%)
hot spot (99%)

(Anderson et al., 2019)

Multi-scale Intervention

Study	Intervention type	Outcome	Intervention results: mean or mean (95% confidence interval) for change from baseline
Lanningham-Foster et al. (2008)	**Three different school environments:** 1) traditional school with fixed and assigned chairs and desks; 2) New school with an activity-permissive neighborhood; 3) traditional school with standing desks	PA: activity-permissiveschool/ neighborhood vs. traditional schools	+44 min.
		PA: traditional school vs. traditional school with standing desk	NS
De Meester et al. (2014)	**Active schoolyards or playgrounds** (**facilities,** such as **sports hall**, polyvalent spaces, covered play areas, fields of grass, outdoor sports fields, **equipment** such as small sports and play material, loan desk for material, music installation, lockers, lines, goals, nets)	Steps, MVPA (weekday steps, mean steps/day)	Positive association between the implementation score of active schoolyards/playgrounds and step counts
Brittin et al. (2017)	**Move to a new school designed to provide active learning opportunities** with outdoor classrooms, gardens, nature trails, other landscape amenities, as well as gymnasia, playgrounds, and two large sports fields.	MVPA. LPA, SB (min/day) Average daily number of breaks from SB Average length of a sedentary Bout [c]	• Increase LPA by 67.7 ± 10.7 min./day • Attenuated increase in SB by 81.2 ± 11.4 minutes/day • Decreased MVPA by 10.3 ± 2.3 minutes/day

Samples of Multi-scale Interventions (Lanningham-Foster, 2008)



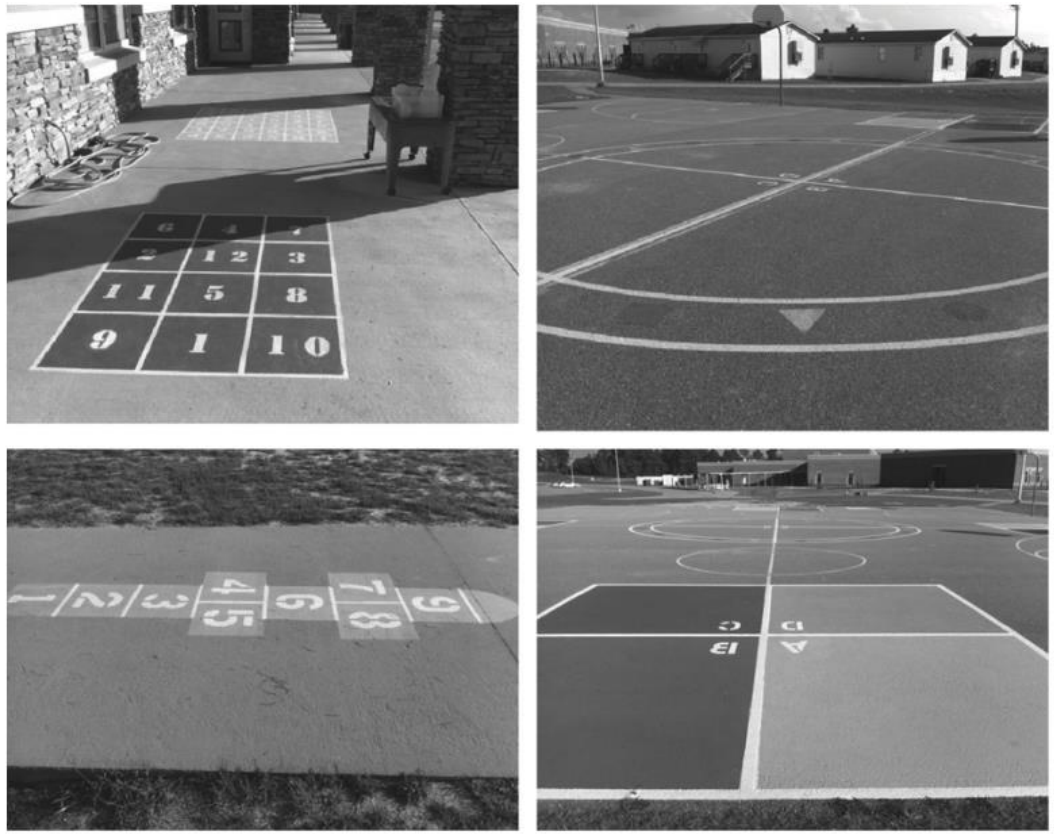
- **BUILDING: The Neighborhood** was designed to encourage an active learning environment and **resembled a village square**. Also included miniature golf, basketball hoops, indoor soccer, climbing mazes, and activity-promoting games.
  - Children were allowed to move throughout The Neighborhood during lesson plans.
- **CLASSROOM: Standing Classroom** was **a plasticized hockey rink complete with standing desks and vertical, mobile whiteboards** that allowed for activity-permissive lessons. The children used **wireless laptop computers and portable video display units** to facilitate mobile learning.
  - Students could stand, kneel, or sit on stability balls at the adjustable vertical desks.

→ **PA: activity-permissive neighborhood vs. traditional schools: +44 min.**

Multi-level Intervention

Study	Intervention type	Outcome	Intervention results
Kelly et al. (2012)	**Colored playground markings + equipment + game resource and training + social support**	MVPA, LPA, SB, observations of activity	No positive improvement
Lorenz et al. (2017)	**Environmental intervention** (increased access, opportunity, equipment, and supervision to recreational facilities) **+ behavioral intervention**	Mean number of students in MVPA during lunch (observed)	**Environmental intervention vs. baseline:** • +8.31 girls at main gym; +28.36 boys at main gym; -13.45 boys at outdoor courts; NS: girls at outdoor, track , soccer filed, east filed; boys at track, soccer field, east field **Environmental + behavioral intervention vs. baseline:** • +5.56 girls at main gym; +10.64 boys at main gym; -5.43 boys at outdoor courts; NS: girls or girls at track/soccer filed/east filed
Mayfield et al. (2017)	**Environmental changes** (e.g., marked surfaces with colorful interactive games, school received equipment to use with the games) **+ training for recess supervisor + lessons for students**	MVPA	+15.5% for girls & +20.5% for boys in intervention school 2; NS: girls and boys in intervention school 1
		SB	-10.9% girls in Intervention school 2; NS: boys in intervention school1, and girls and boys in Intervention school 1
Huberty et al. (2011a)	**Recess intervention with staff training (ST) or providing recreational equipment (EQ), separately, and both.**	Time spent in MVPA during recess	EQ+SF vs Control: • + 34.2% healthy boys • + 12.8% overweight girls • NS: Overweight boys, healthy girls

Samples of Multi-level Interventions (Mayfield et al., 2017)



- **Blacktop surfaces on playgrounds were marked with colorful interactive games**.
- **Equipment to use with the games.**
- **Supervisor training** on the utility of the games and how to incorporate them into classroom or PE instruction.
- **Student lessons about how to play games using the markings and equipment**.
- Teachers were given an instructional manual.
- Some PE teachers reported using YouTube as a secondary resource.

→ MVPA: +15.5% for girls and +20.5% for boys in Intervention school 2;
NS for girls and boys in intervention school 1

→ SB: -10.9% girls in Intervention school 2;
NS: boys in intervention school 1, and girls and boys in Intervention school 1

CONCLUSIONS:

- Overall, study quality is limited by selection bias, confounders, difficulty of blinding, and lack of control groups and long-term assessments.
- Lack of consistent measures makes it difficult to synthesize findings.
- Despite the limitations, previous studies revealed significant potential in promoting PA through innovative school designs, especially when multi-level and high-intensity strategies are used.

IMPLICATIONS FOR PRACTICE AND POLICY:

- For future research and practice, it is important to consider multiple scales of environmental impacts and be aware of the impacts of contextual factors (e.g., school policies, curriculum), as well as the synergetic impacts between PA and academic performance.
- Need to consider and compare short-, medium-, and long-term impacts (e.g., UK playground study)
- A more holistic approach is needed for active school design and planning.


(Stantec)


(Snug and Outdoor.!)


Daubeney Primary School in Hackney in 2002


(Stantec)


(Stantec)

Whole Community for Active Living

Physical Activity before/after School

Surgeon General's Call to Action to Promote Walking and Walkable Communities

Promote Healthy Communities
Joint Call to Action

The American Institute of Architects

American Planning Association
Making Great Communities Happen

APHA
American Public Health Association

ASCE
American Society of Civil Engineers

American Society of Landscape Architects

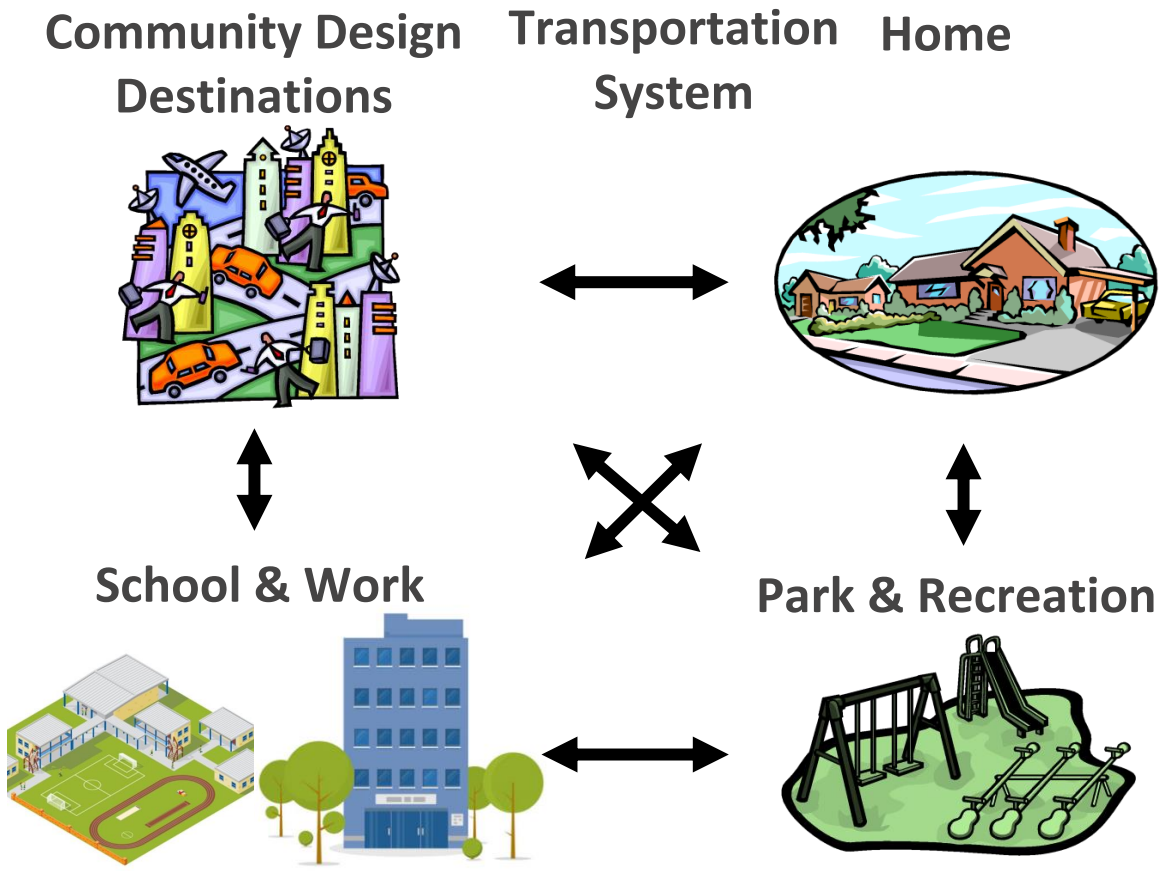
NRPA
National Recreation and Park Association

Urban Land Institute

"Addressing growing **health challenges** and **inequities** requires new partnerships and collaboration between built environment and public health practitioners, and **a health-focused approach to landscapes, buildings and infrastructure**."

Active Living Community

Key Elements



(Sallis, 2020)

Community Preventive Services Task Force

Physical Activity: Built Environment Approaches Combining Transportation System Interventions with Land Use and Environmental Design

Built Environment Approaches in Combination by Intervention Type

Pedestrian and Bicycle Transportation System Intervention Component	Land Use and Environmental Design Intervention Component
○ Street pattern design and connectivity	○ Mixed land use
○ Pedestrian infrastructure	○ Increasing residential density
○ Bicycle infrastructure	○ Proximity to community or neighborhood destinations
○ Public transit infrastructure and access	○ Parks and recreational facility access

Community Patterns

Same land area; different development patterns

Walkable community:
- High density
- Mixed land uses
- Connected street systems
- Short distance to destinations
- Human-scale design

Auto-dependent community:
- Low density
- Segregated land uses
- Disconnected street systems
- Long distance to destinations
- Auto-oriented design

Street-scale Design & Placemaking

Human-centered design

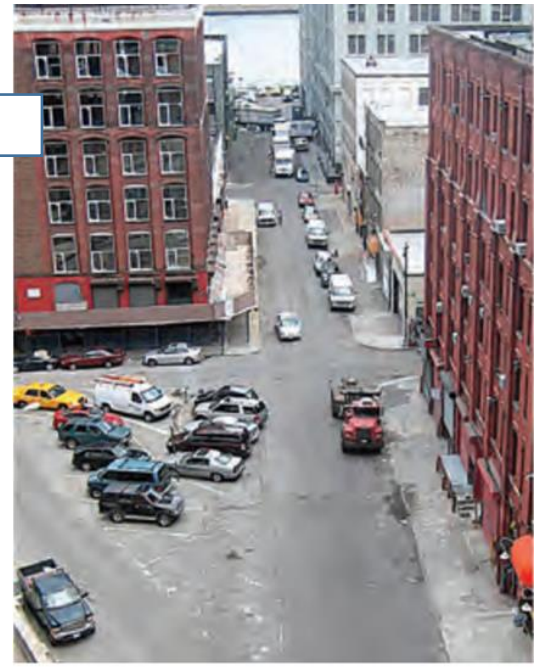
www.curbed.com/2019/6/24/18715939/real-estate-development-walkable-urbanism

Auto-centered design

A Broadway pedestrian

(http://nyc.gov/)

The trial plaza at Madison



Street-scale Design & Placemaking

Human-centered design
accommodating pedestrians, bicyclists, transit and cars

Auto-centered streets
accommodating cars yet discouraging walking and bicycling

Child-friendly Community

Active Living Communities

Community Design
Destinations

Transportation
System

Home

School & Work

Park & Recreation

(Sallis, 2020)

What makes it child-friendly?

Active School Commute

Independent Mobility

Other PA opportunities

Safe Routes to School (SRTS)

- **A movement aiming to make it safer and easier for students to walk and bike to school.**

Many Benefits of SRTS

- Walking and biking ↑
- Total physical activity ↑
- Obesity ↓
- Collisions and injuries ↓

- Cognitive development ↑
- Concentration ↑
- Engagement in learning ↑
- Academic performance ↑

- Mobility and social skills ↑
- Neighborhood cohesion ↑
- Transportation cost ↓
- Environmental pollution ↓
- Equity ↑

Physical + **Mental** + **Social**

Six E's of SRTS

- Evaluation
- Education
- Encouragement
- Engineering
- Enforcement
- Equity

Does Community Environment Matter?

- Distance and land uses en route to school
- Transportation infrastructure (e.g., sidewalks, bike lanes, traffic calming)
- Traffic and crime safety (e.g., visual surveillance)
- Tree shade and other environmental amenities
- Contextual differences

Safe Routes to School (SRTS) **programs work**

ACTIVE LIVING RESEARCH

today, few kids actively travel to school

TRAFFIC SPEED AND VOLUME, AND LACK OF SIDEWALKS, ARE THE MAIN BARRIERS

compared to 48% in 1969

13% walk or bike now

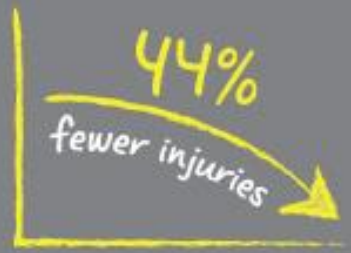
among those living within ¼ mile of school

just 56% walk or bike

kids are more active when walking and biking are safe

AFTER IMPLEMENTING SAFE ROUTES TO SCHOOL PROGRAMS:

45% increase in walking



OF THE RECOMMENDED 60 MINUTES OF DAILY ACTIVITY:

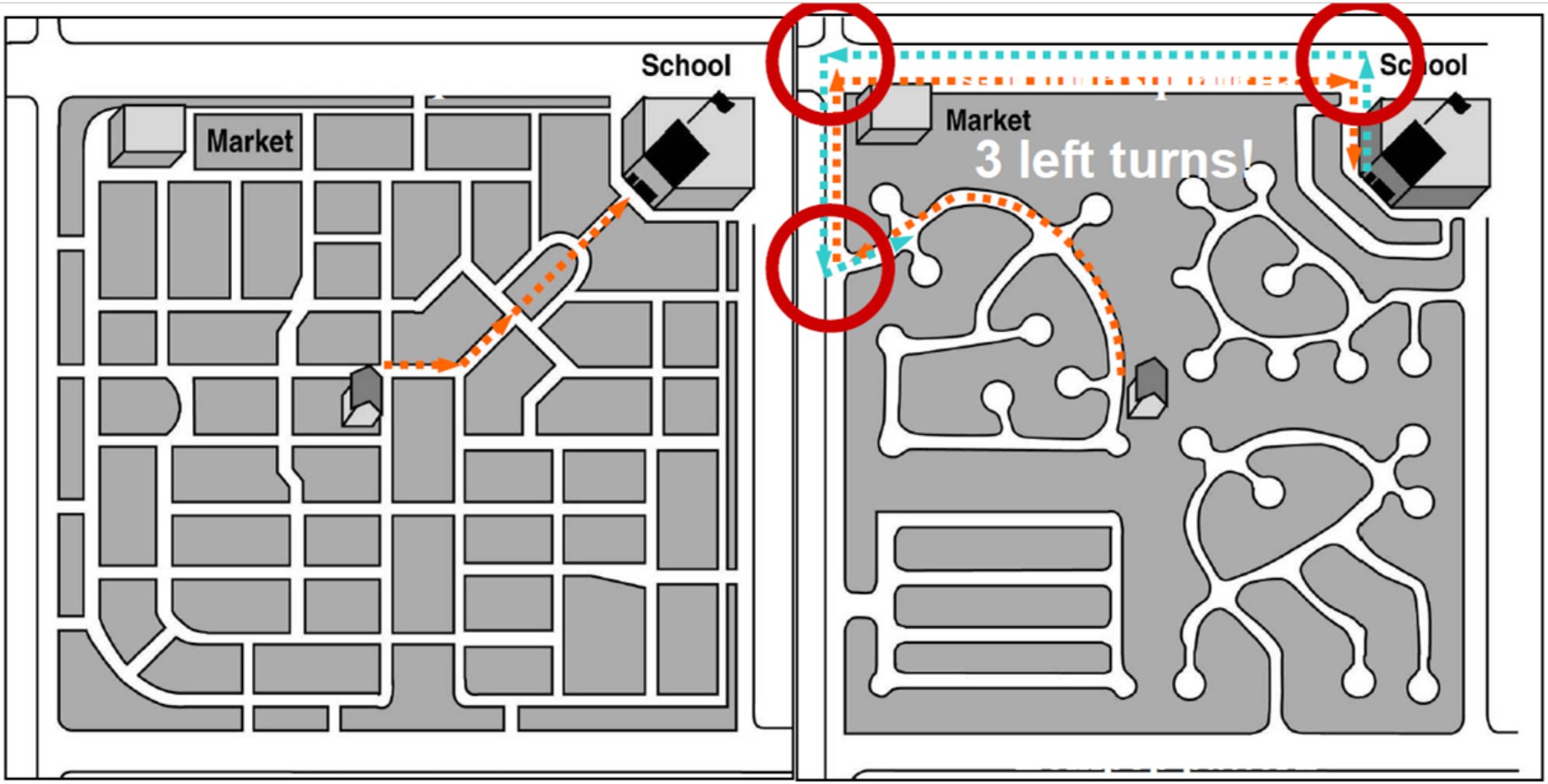
16 min (average) can be achieved by walking or biking to school

SOURCES: McDonald NC, et al. (2011). U.S. school travel, 2009: an assessment of trends. Am J Prev Med. 41:146–151. Chaufan C, et al. (2012). The safe routes to school program in California: an update. Am J Public Health. 102(6):e8–e11. Ahlport KN, et al. (2006). Barriers to and facilitators of walking and bicycling to school: formative results from the non-motorized travel study. Health Educ Behav. 35(2):221–244. Timperio A, et al. (2006). Personal, family, social, and environmental correlates of active commuting to school. Am J Prev Med. 30(1):45–51. Bassett DR, et al. (2013). Estimated energy expenditures for school-based policies and active living. Am J Prev Med. 44(2):108–113. Stewart O, et al. (2014). Multistate evaluation of safe routes to school programs. Am J Health Promot. 28(3 Suppl):S89–S96. DiMaggio C and Li G. (2013). Effectiveness of a safe routes to school program in preventing school-aged pedestrian injury. Pediatrics. 131(2): 290–296.

Learn more about why Safe Routes to School programs work at activelivingresearch.org/SRTSreview.

Connected, walkable streets

Disconnected, auto-dependent streets



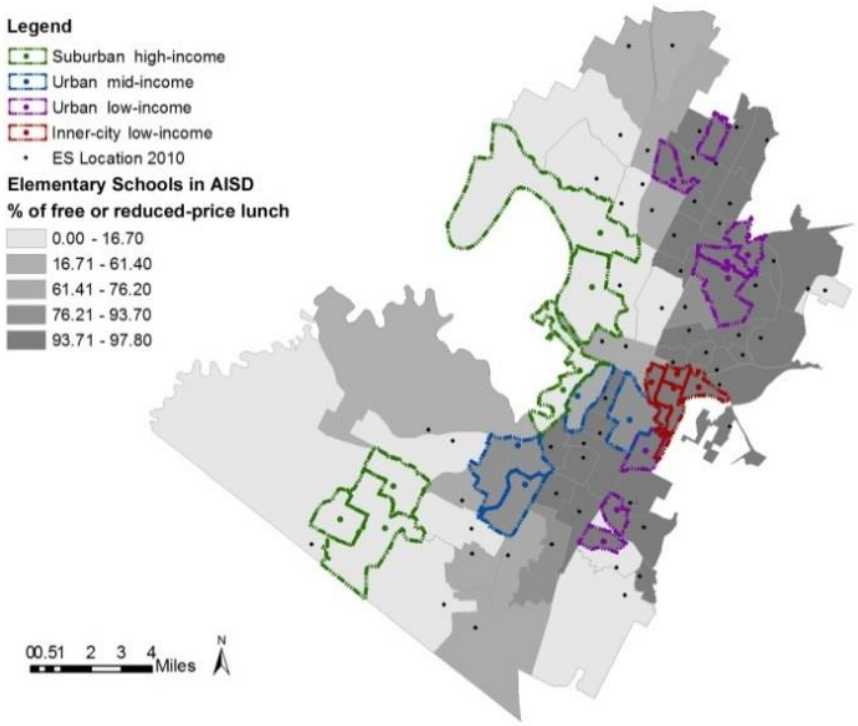
Source: PBIC/FHWA, 2009

Evidence

(Zhu et al, 2010)

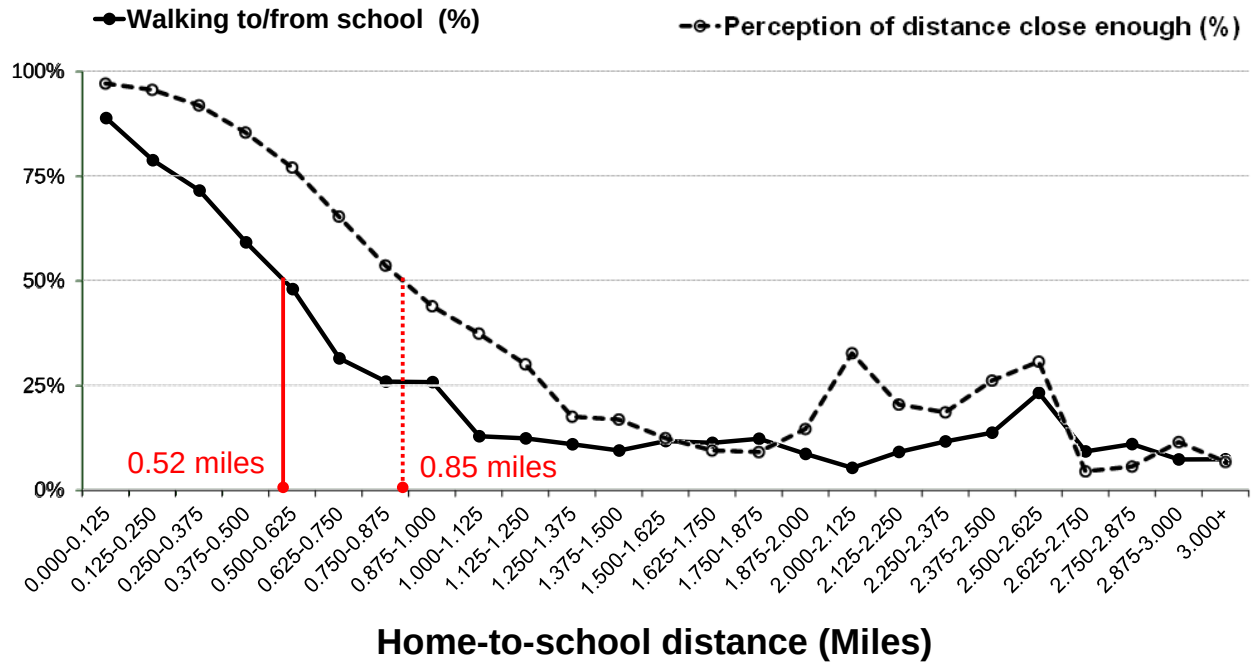
What is a Walkable Distance?
Data from Austin Elementary Schools

Elementary schools included in 2007 and 2010 Safe Routes to School Survey



- 22 schools
- 6,383 elementary school students

Percentage of Walking to/from school and perceiving distance as close enough for walking within different distance ranges



- Percentage of Walking to/from school decreases as the home-to-school distance increases
- It dropped to 50% at the distance of 0.52 miles.

Independent Mobility vs. PA in Community

Unsupervised outdoor play

+

Independent travel

CIM has dramatically declined over recent decades, which accounted for the overall decrease in children's PA level (Shaw, 2015; Fyhri, 2011; Kytta, 2015)

Significance of CIM

Children

- Healthy development
  - **Physical**: e.g., physical activity, motor skills, weight control
  - **Mental**: e.g., positive vs. negative emotion
  - **Social**: e.g., social interaction with people and environment

Neighbor-hood

- Stronger sense of community

Parents

- Time management: chauffeuring and free time
- Reduced workload (especially main caregivers)

Evidence

Significant physical environmental factors impacting CIM

Stranger danger[a] **(- - -)**

Crime danger: Presence of registered sex offenders **(-)**

Corner lot of a dead-end street (+)

Transit score (--)

Walking/biking trails[a] **(-)**

Friend's & relative's home[a] **(+ + +)**

Quality of surrounding neighborhood environments[a] **(+)**

(Qiu, 2021)

Implications

- Design for SAFETY—create defensible space
- Design with surveillance

Housing providing the space with surveillance for safe play
Mueller, Austin

- Child-friendly amenities and infrastructure (e.g. buffered sidewalk/ bike lane)

"Wonderland"—a moveable play space for children living in Hutong, by MAD Architects

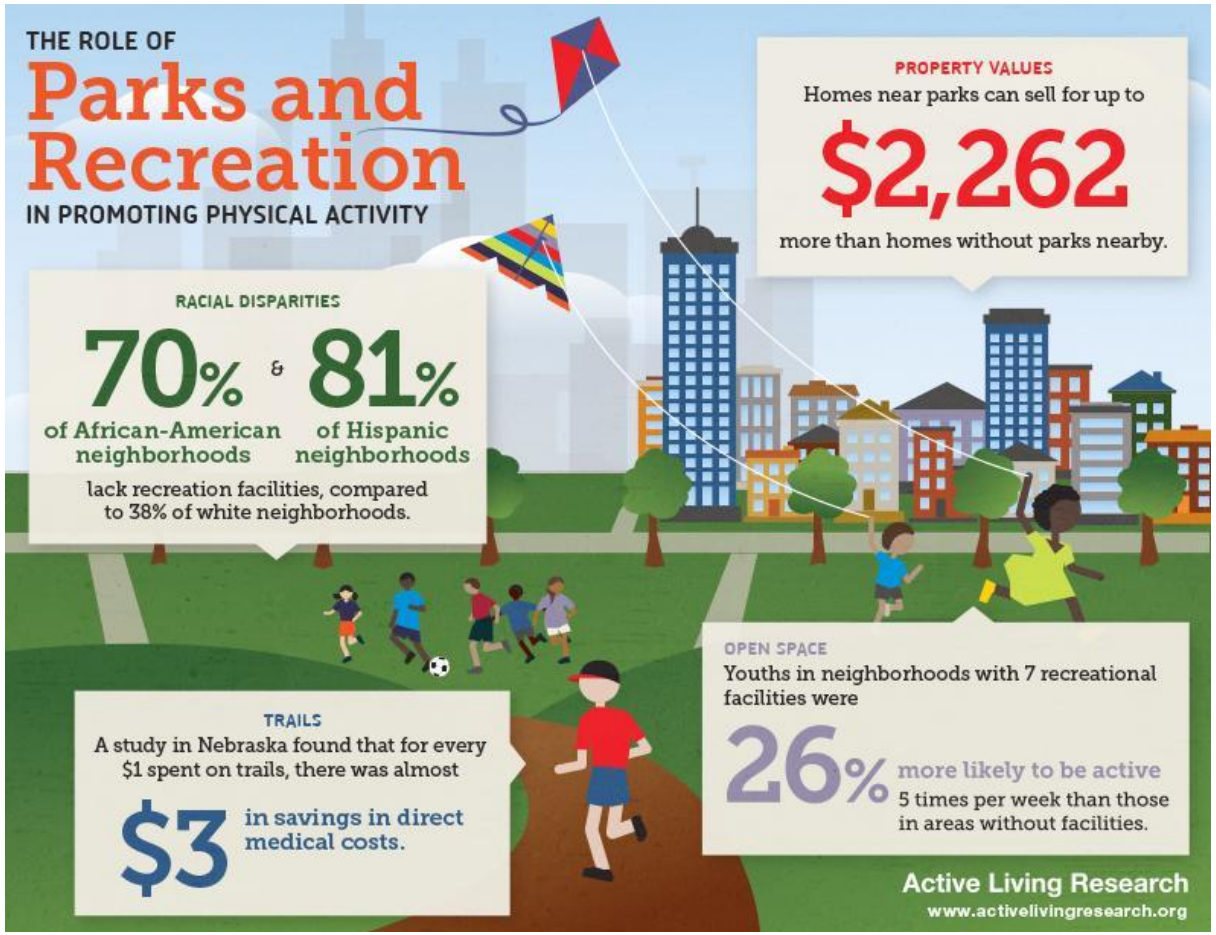
- Design positive play area with "affordance"
- Provide child-friendly places/ destinations within neighborhood

Buffered sidewalk/bike lane
Mueller, Austin

- Have green spaces for plants and animals (UNICEF, 2004)
- Spaces with different scales for diverse activities and socializing needs

Natural Habitat Restoration
Mueller, Austin

Other PA Opportunities in Community



Activity-friendly parks and open spaces

Parks and open spaces that provide facilities and amenities and encourage use

Non-activity-friendly parks and open spaces

Parks and open spaces that do not provide facilities and discourage use

Active Living vs. Active Learning

Educating the Whole Child

Making the Connection

Active Learning

Whole School

WHOLE CHILD

Active Living

Whole Community

"Whole" School & "Whole" Community

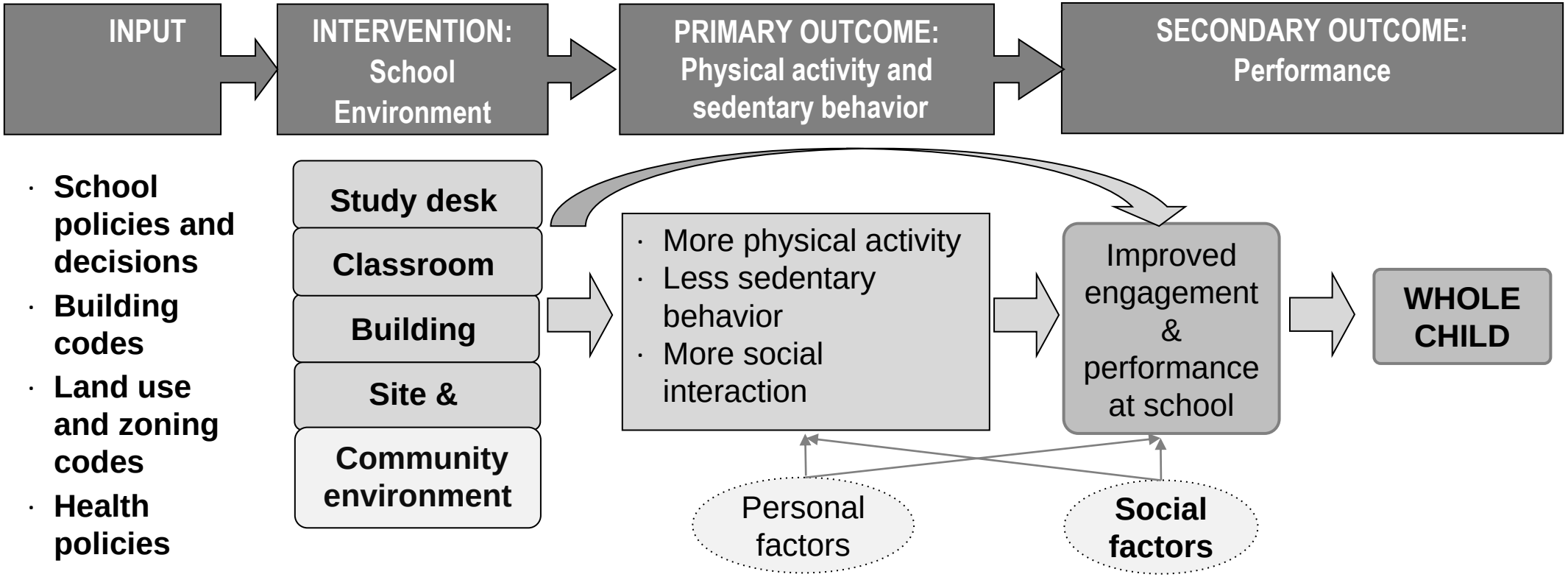


Figure 4. Proposed conceptual framework for future research and practice

active kids learn better

ACTIVE LIVING RESEARCH

physical activity at school is a win-win for students and teachers

GRADES:

20% more likely to earn an A in math or English

STANDARDIZED TEST SCORES:

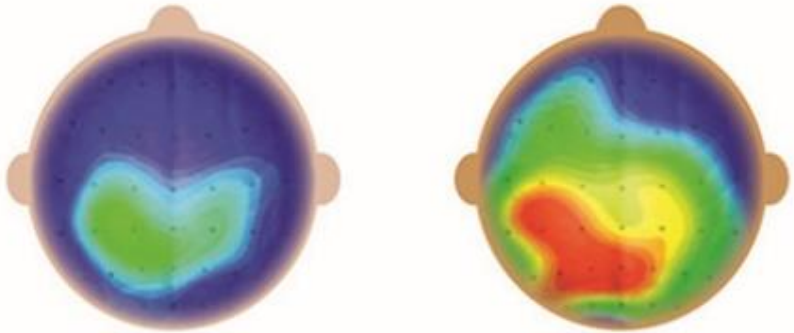
JUST ONE PHYSICALLY ACTIVE LESSON CREATES:

13% increase in students' physical activity for the week

21% decrease in teachers' time managing behavior

physically active kids have more active brains

BRAIN SCANS OF STUDENTS TAKING A TEST:



after 20 minutes of sitting quietly

after 20 minutes of walking

Red areas are very active; blue areas are least active.

MORE RESULTS:

after 20 minutes of physical activity:

students tested better in reading, spelling & math and were more likely to read above their grade level

after being in a physically active afterschool program for 9 months:

memory tasks improved 16%

SOURCES: Donnelly J.E. and Lambourne K. (2011). Classroom-based physical activity, cognition, and academic achievement. Prev Med. 52(Suppl 1):S36-S42. Hillman C.H. et al. (2009). The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children. Neuroscience. 159(3):1044-1054. Kamijo K. et al. (2011). The effects of an afterschool physical activity program on working memory in preadolescent children. Dev Sci. 14(5):1046-1058. Kibbe D.L. et al. (2011). Ten years of TAKE 10!: integrating physical activity with academic concepts in elementary school classrooms. Prev Med. 52(Suppl 1):S43-S50. Nelson M.C. and Gordon-Larson P. (2006). Physical activity and sedentary behavior patterns are associated with selected adolescent health risk behaviors. Pediatrics, 117(4): 1281-1290.

Learn more about why active kids learn better and how schools can help at activelivingresearch.org/activeeducationbrief.

THANK YOU!

Questions?

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