### CIVL 642 Public Health, Physical Activity, and Design of the Built Environment

Lecture 1

## STRIDE

Southeastern Transportation Research, Innovation, Development and Education Center



### Introductions

- Introduction of Instructors
- Introduction of Students
  - Name
  - Educational background
  - Employment background
  - What you hope to learn from this course
  - Something you like to do for fun

### A bit about Dr. B.



























### A bit about Dr. Davis



### PHYSICAL ACTIVITY AND CHRONIC DISEASE

#### **Learning Objectives**

- Define what chronic disease is and understand prevalence and impact of chronic disease
- Understand evidence on relationship between physical activity and specific chronic diseases
- Explain relationship between obesity, physical activity, physical inactivity, being sedentary, and exercise
- Explain dose-response relationships in PA and chronic disease



#### FIGURE 1.1 Top causes of death in the United States in the year 2015.

*Source:* Adapted from Centers for Disease Control and Prevention. Leading Causes of Death in 1975 and 2015: United States, 1975–2015 (Figure 8). Health, United States, 2016. Available at: https://www.cdc.gov/nchs/data/hus/hus16.pdf#019.

# Physical Activity, Physical Fitness, & Obesity

- Do we have an obesity epidemic?
  - If so, what does it look like?
- Do we have a physical inactivity epidemic?
  - If so, what does it look like?
- What's the difference between physical activity and physical fitness?

### PHYSICAL ACTIVITY

- According to the Centers for Disease Control and Prevention (CDC), physical activity (PA) is "Any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level."
  - For this chapter: PA refers to subset of PA that enhances health
- Current recommendations:
  - Greater than 150 minutes per week of moderate-intensity PA, or greater than 75 minutes per week of vigorous PA
  - Greater than 2 days per week of muscle-strengthening activities involving major muscle groups
- Physical inactivity: deaths and costs
  - Fourth leading risk factor for global mortality  $\rightarrow$  associated with 35 diseases/conditions
  - Cost of \$53.8 billion to healthcare systems worldwide in 2013

### PA AND CARDIOVASCULAR DISEASE

#### Cardiovascular disease (CVD)

- Group of disorders of heart and blood vessels
- Risk factors: behavioral, metabolic, socioeconomic, age, psychological, genetic influences, and so forth.

#### • Studies with PA:

- Observational study: Over 10-year period, California longshoremen who performed light and moderate work had 1.8 and 1.7 times increased risk of coronary heart disease, respectively, compared to reference group that performed strenuous work.
- Meta-analysis of 32 randomized controlled trials (RCTs) showed that walking in sedentary individuals significantly reduced blood pressure, weight and body fat, and significantly increased aerobic fitness.

### What is Dose-Response?





**FIGURE 1.2 Dose–response** association between LTPA and incident CHD. CHD, coronary heart disease; LTPA, leisure-time physical activity.

*Source:* Adapted from Sattelmair J, Pertman J, Ding EL, et al. Dose response between physical activity and risk of coronary heart disease: a meta-analysis. *Circulation*. 2011;124:789-795. doi:10.1161/circulationaha.110.010710.

### PA AND HYPERTENSION

#### • Hypertension affects ~33.5% of American adults 20 years of age or older.

- By 2030, prevalence is projected to increase to 37.3%, and healthcare cost to \$200.3 billion.
- Risk factors: age, race, genetic factors, socioeconomic status, overweight/obesity, physical inactivity, tobacco use, psychosocial stressors, diet, and so forth.
  - PA levels, tobacco use, and diet are modifiable risk factors.

#### • Studies with PA:

- Observational study: Among 14,998 Harvard male participants, those who did not regularly perform vigorous sports after college, independent of sports participation in college, had a 35% greater risk of hypertension.
- A meta-analysis of RCTs done with hypertensive individuals showed that moderate- to vigorousintensity PA (MVPA) reduced systolic and diastolic blood pressure by 11 and 5 mmHg, respectively.



**FIGURE 1.3** Dose–response association between LTPA and incident hypertension. LTPA, leisure-time physical activity.

*Source:* Adapted from Liu X, Zhang D, Liu Y, et al. Dose–response association between physical activity and incident hypertension: a systematic review and meta-analysis of cohort studies. *Hypertension*. 2017;69:813-820. doi:10.1161/hypertensionaha.116.08994.

### PA AND DIABETES

- Diabetes is a chronic condition where the body ineffectively uses insulin, resulting in elevated blood glucose levels.
- Over 10% of global population is expected to have diabetes by 2040.
  - Increase is associated with increase in physical inactivity.
- Studies with PA:
  - Observational study: Achieving the recommended 150 minutes per week of MVPA was associated with a 26% reduced risk of developing diabetes relative to completely inactive individuals.
    - No plateau effect; increasing activity level to 60 MET-hours per week resulted in up to 53% risk reduction of developing diabetes.
  - PA can improve glucose tolerance and increase insulin sensitivity in individuals with diabetes.





#### FIGURE 1.4 Reduction in risk of type 2 diabetes in the DPP. DPP, Diabetes Prevention Program.

*Source:* Adapted from Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med.* 2002;346:393-403. doi:10.1056/NEJMoa012512; Diabetes Prevention Program Research G, Knowler WC, Fowler SE, et al. 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. *Lancet.* 2009;374:1677-1686. doi:10.1016/s0140-6736(09)61457-4.

### PA AND CANCER

• Cancer, a condition of uncontrolled growth of abnormal cells, is a global concern and the second leading cause of death in the United States.

- Four leading causes of cancer mortality: lung, prostate, breast, and colorectal
- Recommendations: 150 minutes of MVPA, or 75 minutes of vigorous PA per week, for cancer survivors and the general population
- Lung
  - Meta-analysis found that high levels (90th percentile) of LTPA were associated with a 27% decreased risk of lung cancer compared to low levels (10th percentile) of LTPA
- Prostate
  - Individual studies demonstrate benefits of PA on risk of prostate cancer, but meta-analyses suggest a slight, if not insignificant, benefit.
- Breast
  - Meta-analysis demonstrated that high levels (90th percentile) of LTPA were associated with a 10% reduced risk for breast cancer compared to low levels (10th percentile) of LTPA.
- Colorectal
  - Meta-analysis demonstrated that high levels (90th percentile) of LTPA were associated with risk reductions of 16% and 13% for colon and rectal cancers, respectively.



FIGURE 1.5 Hazard ratios for 26 types of cancer. Ratios compared 90th (high) with 10th (low) percentile of LTPA. LTPA, leisure-time physical activity.

*Source:* Adapted from Moore SC, Lee IM, Weiderpass E, et al. Association of leisure-time physical activity with risk of 26 types of cancer in 1.44 million adults. *JAMA Intern Med.* 2016;176:816-825. doi:10.1001/jamainternmed.2016.1548.

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### CURRENT ISSUES IN PA AND CHRONIC DISEASE RESEARCH

- Sedentary: "characterized by or requiring a sitting posture."
  - Sedentary behavior: walking activities performed while sitting or reclining that require energy expenditure less than 1.5 metabolic equivalents (METs).
- Sedentary behavior positively associated with risk of CVD, type 2 diabetes, and all-cause CVD mortality.
  - A study of over 150,000 older adults found that replacing 1 hour per day of sitting with an equal amount of exercise or nonexercise activities (e.g., walking) was associated with 42% and 30% lower all-cause mortality, respectively.
  - The American Diabetes Association recommends that all adults, particularly those with diabetes, should interrupt prolonged sitting with bouts of light activity every 30 minutes for blood glucose benefits.
- Existing sedentary behavior guidelines are vague.

### THINGS TO CONSIDER

- PA reduces risk of many of the chronic diseases including CVD, hypertension, diabetes, and cancer.
- There are many type of studies (e.g., observational, RCT) that demonstrate the reduction in chronic disease risk with PA.
- Since sedentary behavior is a risk factor for many chronic diseases, it needs to be addressed in interventions in addition to promoting PA.
- What is the role of active transportation in increasing PA, decreasing sedentary time, and reducing chronic disease?

# Questions?