National calibration of the Integrated Transport and Health Impact Modeling tool using the National Household Travel Survey, 2009

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INTRODUCTION

- Active transportation is one way that people can attain recommended amounts of physical activity[1]
- Increasing walking and bicycling for transportation is a national public health priority highlighted in the Surgeon General's Call to Action to Promote Walking and Walkable Communities and Healthy People 2020 goals
- The Surgeon General's Call to Action summarizes the evidence supporting walking and the strategies to increase walking, including that done for transportation
- Healthy People 2020 (HP2020) developmental goals PA-13 and PA-14 call for an increased proportion of short trips to be made by walking and bicycling
- Estimating the health impacts, both beneficial and harmful, of shifting travel patterns toward more active transportation might help foster support for these initiatives
- The ITHIM tool estimates potential benefits and harms of various transportation scenarios
- Calibrating the physical activity components of the model is a first step for using ITHIM
- **<u>Our purpose</u>: to estimate the national-level health impacts of increasing the proportion of short trips made by walking and bicycling, as noted in HP2020, using 2009 National Household Travel Survey (NHTS) data as a baseline**

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METHODS

Integrated Transport and Health Impact Modeling (ITHIM) Tool

- Developed in UK[2], first use in US was in the Bay Area, CA[3]
- Uses comparative risk assessment to estimate hypothetical changes in the burden of disease given a change in exposure (here, physical activity):

$$\Delta Burden = \frac{\int_{x\,min}^{x\,max} RR(x)P(x) - \int_{x\,min}^{x\,max} RR(x)Q(x)}{\int_{x\,min}^{x\,max} RR(x)P(x)} \times Burden_{Base}$$

Where x=activity level, RR= relative risk, P=baseline and Q=Scenario

- Calculations are repeated over 8 age and 2 sex groups for 8 diseases linked to physical activity, ignore latent periods

Model Calibration

ITHIM requires 15 calibration data points related to the target population's baseline travel patterns, physical activity, disease burdens, exhaust emissions, collision burden, and demographics

- The 2009 NHTS provided 7 calibration items related to travel habits, including participation in active transportation
- Non-travel physical activity was obtained from the 2011-2012 National Health and Nutrition Examination Survey
- For 7 diseases related to physical activity, direct healthcare costs and indirect lost productivity costs were obtained from a literature review, then adjusted for ITHIM-predicted changes in disease burden

Scenario Development

Three scenarios were developed that investigated the impact of replacing a portion of vehicle miles with walking and bicycling

- First, 2% of total miles traveled in private vehicles were reallocated to walking and bicycling, while maintaining the driver:passenger and walk:bike ratios
- Next, we identified NHTS trips ≤0.7 miles (mean walk trip distance; henceforth, "walkable") and ≤2.3 miles (mean bike trip distance; henceforth, "bikeable") that were taken by car
- We then randomly reallocated 25% or 50% of walkable trips to walking and bikeable trips to biking, then re-ran summary statistics to derive our scenario mode shares

RESULTS

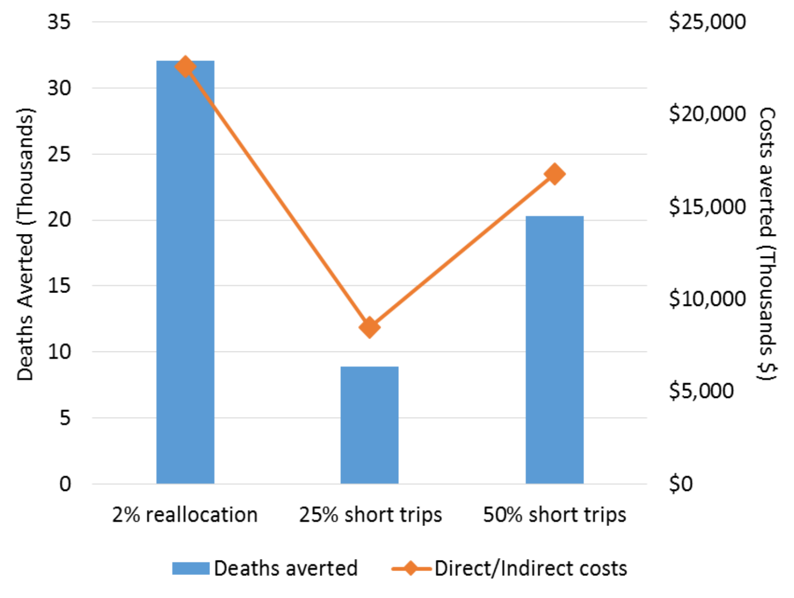
Table: Mode shares for baseline and 3 reallocation scenarios

Miles / week	Baseline	2% Reallocation	25% short trips	50% short trips
Walk	2.2	5.0	2.4	2.6
Bicycle	0.7	1.6	3.0	5.3
Car driver	137.1	134.4	135.3	133.5
Car passenger	49.2	48.2	48.5	47.9
Total*	**198**	**198**	**198**	**198**
Minutes / week				
Walk	47.4	110.9	53.3	57.8
Cycle	6.2	14.2	26.5	46.8
Total	**53.6**	**125.1**	**79.8**	**104.5**

*The totals contain constants for bus, train, and motorcycle miles, all unchanged

- The 25% and 50% reallocation scenarios resulted in a shift towards bicycle miles traveled as bikeable trip distances are more common in NHTS than walkable distances
- The 2% reallocation approaches the 150 minute / week guideline for aerobic physical activity[4]

Figure 1: Deaths and costs averted, 3 reallocation scenarios



- Under these scenarios, 8,880 to 32,021 annual deaths might be averted as a result of increased physical activity
- This translates, annually, into $8.5 to $22.6 billion in averted direct and indirect costs

Figure 2: Cause-specific changes under the 50% Short Trip Scenario

50% Short Trips	Δ Disease Burden	Δ Premature Deaths / Year
Cardiovasc. Diseases	-2.3%	16,996
Diabetes	-2.6%	2,398
Depression	-0.4%	3
Dementia	-0.4%	472
Breast Cancer	-0.4%	208
Colon Cancer	-0.7%	315
Total	-0.8%	20,392

- Under the 50% short-trips scenario, cardiovascular diseases and diabetes experienced the largest decline

CONCLUSIONS

Shifting various proportions of automobile travel to walking and bicycling might confer substantial health benefits to the US population.

Based on ITHIM predictions:

- If 2% of automobile miles traveled were replaced by walking and bicycling, a population average of 125.1 minutes of active transportation per person per week could be obtained. This could avert 32,021 deaths and $22.6 billion in direct and indirect costs per year
- If 25% of walkable- and bikeable-distance automobile trips were replaced with walking and bicycling, a population average of 79.8 minutes per week of active transportation per person could be obtained. This could avert 8,880 deaths and $8.5 billion in direct and indirect costs per year
- If 50% of walkable- and bikeable-distance automobile trips were replaced with walking and bicycling, a population average of 104.5 minutes per week of active transportation per person could be obtained. This could avert 20,280 deaths and $16.8 billion in direct and indirect costs per year

These estimates likely <u>overestimate</u> health benefits because potential increases in pedestrian and bicycle collisions will attenuate these values and predicted reductions in ambient air pollution will likely be small for the small reductions in vehicle miles modeled here.

Additional work is needed to determine the health effects of altered collision patterns and air pollution concentrations under these scenarios.

These results can help decision makers compare the costs of pedestrian and bicycle facilities with the hypothetical health benefits.

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