An Economic Evaluation of Physical Activity and Implications for Its Promotion

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Introduction

Physical activity (PA) is known to positively influence morbidity and mortality from many common chronic conditions. While the health benefits of physical activity are well documented the economic benefits are less clear.

Objective

Limited research published to date has calculated the benefits of PA in terms of costs, quality of life and life expectancy resulting from those conditions responsible for the majority of morbidity and mortality in the Western world. This paper aims to calculate the savings engendered when a sedentary person becomes active and, to extrapolate those findings to a population level by means of a comparison between the cost-effectiveness of enabling physical activity and a laissez-faire stance.

Method

The study builds two decision-analysis models for a cohort of healthy 40-year-olds using a decision tree: A cost minimization (CMA) and a cost-utility analysis (CUA). Both include data collected from local and international literature on disease costs, utilities and lifetime risks and physical activity's impact on these factors.

Results

The CMA shows that one can expect a physically active adult to incur $117,000 less in disease-related costs compared to a sedentary individual. Even if only 1% of the Israeli population becomes active one could invest $90 million a year and still realize a saving.

The CUA then calculates at what levels of population adherence to PA recommendations and at what level of societal investment enabling PA would be cost-effective.

In the base case, assuming a $10,000 per person lifetime investment and a 25% increase in proportion of active individuals, the mean incremental cost-effectiveness ratio (ICER) of promoting PA is under $600 per QALY gained.

In univariate sensitivity analysis, the most important variables are the effectiveness and cost of the intervention as well as the percentage of the population currently active. The model is less sensitive to the degree to which PA decreases disease risk and cost and increases utility.

Level & strength of evidence for a relationship between physical activity and contemporary chronic conditions

Condition	Lifetime risk	Lifetime cost	Preventive effects Level of evidence	Therapeutic effects Level of evidence
Cardiovascular disease				
Dyslipidemias	50%	$210,000	Medium	High
Hypertension	50%	No data	High	High
Coronary heart disease	38.45% F 38% M	$160,000	High	Medium
Stroke	15%	$65,000	High	Low
Cancer				
Overall	40%	No data	Medium	No data/insufficient data
Colon	6%	$64,000	High	High
Rectal	5%	$76,540	Medium	
Breast	13.3%	$156,000	High	High
Prostate	16%	$44,000	High	
Musculoskeletal disorders				
Osteoporotic fracture (bone mineral density)	No data	No data	High	Medium
Osteoarthritis	45% (knee)	$80,000	Medium (Attenuation of disability)	Medium
Low back pain	28%	No data	Medium	High
Fractures and falls	38.15% F 19%	$19,000 (hip)	Medium	
Mental function				
Clinical depression	12%	No data	Low	High
Cognitive dysfunction	38.14% 8.25%	$215,000	Medium	Low
Parkinson's Disease	1.79%	$100,000	Low	High
Other				
Obesity and overweight	Overweight: 58% Obesity: 25%	$250,000.00	Medium	High
Type 2 diabetes	18%	$110,000	High	High
Asthma	14%	$30,000	Insufficient data	Medium

(Adapted from Chief Medical Officer, British Department of Health, 2004, American College of Sports Medicine Position Stand, 2009 and Brukner and Brown 2005)

Conditions included in the decision tree are:

- Coronary Heart Disease
- Cerebrovascular Attacks
- Type 2 Diabetes Mellitus
- Colon Cancer
- Breast cancer (for women)
- Dementia
- Musculoskeletal disorders (arthritis and hip fracture)

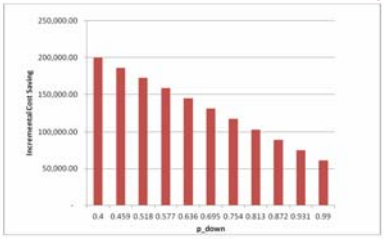
Tree model describing cost-minimisation analysis:
P_down: reduction in disease risk due to PA
C_down: reduction in disease cost due to PA
QALY: Quality adjusted life-year (quality of life (scale 0-1) * years lived)

CMA Base case, Two-dimensional (Sampling and Trials): 50,000 iterations

Statistic	C(PA)	C(no_PA)	Saving
Mean	$208,219	$325,260	-$117,041
Minimum	$47,777	$104,130	-$56,353
Median	$204,006	$323,164	-$119,158
Maximum	$459,685	$606,695	-$147,010

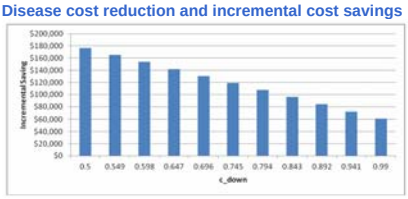
One-way Sensitivity Analysis

Disease risk reduction and incremental cost savings



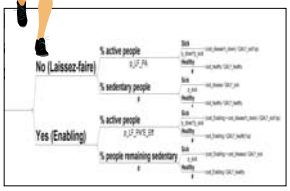
If disease risk is reduced by 60% a sedentary individual who becomes active can expect to incur $200,000 less in medical costs, Even a 1% decrease in lifetime risk will involve a substantial saving i.e. $60,000 over a lifetime.

Disease cost reduction and incremental cost savings



Varying disease cost reduction from 1-50% for active people results in a lifetime saving of $61,000 – 175,000.

Should We Invest in Promoting PA?



Schematic diagram of final model

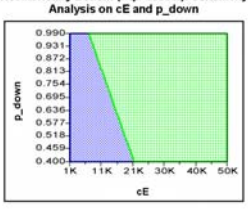
CUA base case, two-dimensional (sampling and trials): 50,000 iterations

Statistic	Cost(E)	QALY(E)	Cost(LF)	QALY(LF)	ICER
Mean	$302,217	23.22	$302,017	22.87	$571.43
Minimum	$86,484	16.84	$85,507	16.73	$8,881.82
Median	$300,671	23.21	$300,737	22.86	DOMINANT
Maximum	$570,102	30	$566,434	28.88	$3,275.00

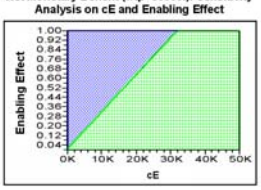
ICER = Incremental Cost-Effectiveness ratio

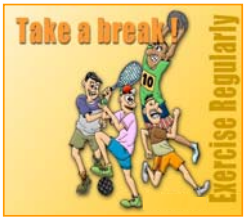
$$\frac{COST_{new\ strategy} - COST_{current\ practice}}{EFFECT_{new\ strategy} - EFFECT_{current\ practice}}$$

Net Monetary Benefit (wtp=50000.): Sensitivity Analysis on cE and p_down



Net Monetary Benefit (wtp=50000.): Sensitivity Analysis on cE and Enabling Effect





Conclusions

If all Israeli 40-year-olds met recommended levels this would translate to a $9.5 billion saving over the lifetime of the cohort. Thus, the study adds to the growing literature giving weight to arguments that will convince policy-makers that investing in a national programme to promote physical activity is a worthwhile use of public funds.

Graphics & Layout: Lois Gordon