COST-UTILITY ANALYSIS OF CHOCOLATE CONSUMPTION FOR PREVENTION OF CARDIOMETABOLIC DISEASE

O’Day K, Campbell DJ
Xcenda, Palm Harbor, FL, USA

BACKGROUND
- Chocolate (cocoa), made from cocoa beans of the Theobroma cacao tree, is widely consumed throughout the world, with 3.7 million tons consumed annually
- Chocolate contains many compounds including polyphenols and flavanoids, which exert a variety of pharmacologic effects
- Randomized controlled studies have shown favorable effects of chocolate on various cardiometabolic risk factors, including inflammatory markers, blood pressure, lipids, and insulin sensitivity
- Epidemiologic studies suggest chocolate consumption may reduce risks of cardiometabolic diseases including coronary heart disease, stroke, and diabetes
- There is limited information currently available to describe the potential economic impact of these benefits of chocolate

OBJECTIVES
- This study assessed the cost-utility of chocolate consumption from a United States (US) health system perspective

METHODS

MODEL DESIGN
- A cohort life-table analysis was developed to model life-years (LYs) and quality-adjusted life-years (QALYs) of chocolate consumption vs non-consumption over a lifetime horizon in US adults
- Age- and sex-specific disease incidence and mortality rates in the published literature were used to model outcomes of cardiometabolic diseases, including coronary heart disease, stroke, and diabetes
- Relative risks of cardiometabolic disease associated with chocolate consumption were obtained from meta-analysis of prospective cohort and cross-sectional studies and applied to estimate the reduction in disease incidence, mortality, and costs associated with chocolate consumption
- Utility weights, baseline healthcare costs, and attributable disease costs were obtained from the literature
- Costs of chocolate were estimated based on consumption of 350 mg chocolate bars per week
- Outcomes included undiscounted LYs and discounted costs and QALYs. Incremental analyses, stratified by sex, and probabilistic sensitivity analyses (PSAs) were conducted

RESULTS

CHOCOLATE CONSUMPTION AND COSTS OF CHOCOLATE
- Consumption was based on the number of 150 mg chocolate bars consumed per week and was assumed to be 3 bars per week, consistent with consumption in the meta-analysis
- Costs of chocolate consumption were based on the consumer price index of 1.5 oz chocolate bar costs from common chocolate brands
- Low cost was estimated at $0.75 per 1.5 oz bar based on $26.95 cost of 36-pack of Hershey chocolate bars
- Moderate cost was estimated at $1.90 per 1.5 oz bar based on $50.95 cost of 36-pack of Hershey chocolate bars
- High cost was estimated at $2.92 per 1.5 oz bar based on $70.00 cost of 36-pack of Godiva chocolate bars

MODEL ANALYSES
- Incremental analyses were conducted by consumption, cost, and sex from a US health system perspective
- A probabilistic sensitivity analysis (PSA) was conducted by running 1000 simulations for the PSA, lognormal distributions were used for relative risks, beta distributions for QoL loss, and normal distribution for costs. Standard errors for the PSA were based on data for the relative risks and chocolate costs, were assumed to be 90% of the base case value for QoL loss (due to the uncertainty), and were assumed to be 95% for the costs of disease

LIMITATIONS
- This analysis, based on recent meta-analyses of epidemiologic studies assessing the effect of chocolate consumption on cardiometabolic disease, found that chocolate likely reduces overall direct healthcare costs in the US
- Chocolate consumption may be a cost-effective means to reduce the risk of cardiometabolic disease
- Given the limitations of observational study data, further research is warranted to confirm these findings


Table 1. Model Inputs

<table>
<thead>
<tr>
<th>Disease</th>
<th>Relative Risk of Disease for Chocolate Users</th>
<th>QALY Loss per Year (Δ)</th>
<th>Annual Costs ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary heart disease</td>
<td>0.693 (0.117)</td>
<td>0.200 (0.100)</td>
<td>$1,636 (923)</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.710 (0.117)</td>
<td>0.200 (0.100)</td>
<td>$9,571 (479)</td>
</tr>
<tr>
<td>Diabetes (female)</td>
<td>0.730 (0.186)</td>
<td>0.200 (0.100)</td>
<td>$4,702 for patients &lt;65 y/o</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$6,004 for patients 65-69 y/o</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$12,854 for patients ≥70 y/o</td>
</tr>
<tr>
<td>Diabetes (male)</td>
<td>0.650 (0.138)</td>
<td>0.200 (0.100)</td>
<td>$4,702 for patients &lt;65 y/o</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$6,004 for patients 65-69 y/o</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$12,854 for patients ≥70 y/o</td>
</tr>
</tbody>
</table>

*Referred to 2013 dollars using the Medical Care Component of the Consumer Price Index. Key: ΔQALY = quality of life, ΔE = standard error, y/o = years old

Figure 1. Model Schematic

Figure 2a. Male Cost-effectiveness Plan (CEPs)
Figure 2b. Female Cost-effectiveness Plan (CEPs)

Table 2. Disaggregated Results for Base Case Analysis

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>No Consumption</th>
<th>Consumption</th>
<th>QALYs (discounted)</th>
<th>No Consumption</th>
<th>Consumption</th>
<th>QALYs (discounted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life expectancy</td>
<td>92.07</td>
<td>92.30</td>
<td>0.23</td>
<td>91.94</td>
<td>92.17</td>
<td>0.23</td>
</tr>
<tr>
<td>Mortality</td>
<td>1.63</td>
<td>1.60</td>
<td>0.03</td>
<td>1.57</td>
<td>1.52</td>
<td>0.03</td>
</tr>
<tr>
<td>Medical costs</td>
<td>$204,982</td>
<td>$201,381</td>
<td>$204,982</td>
<td>$221,630</td>
<td>$201,381</td>
<td>$204,982</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
</tr>
<tr>
<td>Stroke</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
</tr>
<tr>
<td>Diabetes</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
<td>$22,966</td>
</tr>
</tbody>
</table>