# Meal and Fruit and Vegetable Snack Interventions to Increase Availability of Healthier Foods and Beverages in Schools

## Summary Evidence Table – Economic Systematic Review

| Study Information | Study and Population Characteristics | Trial Name Intervention & Comparison | Effectiveness | Intervention Cost | Healthcare Cost Averted Productivity Loss Averted | Economic Summary Measure |
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| **Author (Year):** Bere et al. papers (2005, 2006, 2007, 2014)<br><br>**Design:** RCT<br><br>**Economic Method:** Intervention Cost<br><br>**Funding:** Norwegian Research Council, Norwegian Fruit and Vegetable Marketing Board<br><br>**Monetary Conversions:** Assumed index year 2005 in Norwegian Krone | **Location:** Norway<br><br>**School Type:** Elementary<br><br>**Population** Elementary school children<br><br>**Sample Size:** 38 schools from schools already participating in the subscription based Fruit and Vegetables Make the Mark (FVMM) program. 9 (585 students) allocated to intervention and free participation and 29 (1365) to control.<br><br>**Demographics:** Mean age 12<br><br>**Time Horizon:** One school year Oct 2001 to June 2002. Surveys in Sep 2001, May (2002, 2003, | **Intervention:** Schools from the Fruit and Vegetables Make the Mark (FVMM) program chosen to participate for free.<br><br>**Arms:** 1. Free Fruit: Subscription to Norwegian School Fruit Program at no cost. A piece of fruit or a carrot was provided each school day, usually at lunch at no cost to the parents. FVMM educational component. 2. Paid Subscription: Standard School Fruit Program provided a piece of fruit of carrot each day that parents pay for. FVMM educational component.<br><br>May have included the educational component from the FVMM program.<br><br>**Comparison:** | Increase in mean fruit and vegetable consumption at year 3 was 30 to 35 grams per day.<br><br>**Context:** The previous FVMM program without the free fruit initiative had not achieved an increase in fruit and vegetable intake. | Subscription cost NOK 2.50 daily plus NOK 1.00 state subsidy<br><br>**Components Included in Cost:** Fruit product cost and cost of preparation<br><br>**Components Not Included in Cost:** Unclear if cost of education regarding healthy diet was included<br><br>**Data Source:** Cost of subscription plus state subsidy | **Healthcare Cost:** NR<br><br>**Productivity:** NR<br><br>**Other Economic Costs:** NR | **Cost-Benefit:** Claim that intervention is cost-effective based on increased fruit and vegetable intake achieved. Claim is based on a Norwegian government report that identifies minimum increase in daily fruit and vegetable intake of 2.5 grams necessary for social benefits to exceed cost of intervention.<br><br>Authors use the term cost-effectiveness incorrectly when they mean cost-benefit. |

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| | 2005) and Sep 2009. | No fruit offered in school | | | | |
| **Author (Year):** Chang et al. (2014)<br><br>**Design:** Cross-sectional<br><br>**Economic Method:** Intervention Cost<br><br>**Funding:** National Science Council, Taiwan<br><br>**Monetary Conversions:** Assumed index year 2008 in Taiwan dollars | **Location:** Taiwan<br><br>**School Type:** Elementary<br><br>**Population:** Nationally representative sample of elementary school children of Taiwan<br><br>**Sample Size:** 2017 elementary school children<br><br>**Demographics:** Nationally representative sample of children (age 6 to 12), parents, households, and schools.<br><br>**Time Horizon:** Survey is for year 2002. Date of analysis not provided. | **Intervention:** Comparison of body weight of children who:<br>a. participate in school lunch prepared at school<br>b. participate in school lunch prepared by local restaurant or external foodservice providers<br>c. bring lunch from home or purchase boxed lunch from local restaurants<br><br>**Comparison:** School lunches not prepared within schools.<br><br>**Context:** Consideration of national policy to provide school lunch. Currently some poorer counties do not provide lunch. Regulations require rice, soup, meat, and at least 2 different vegetables. However, there are no nutrient requirements. | Children who participate in school lunch program where food preparation occurs within the school are less likely to be overweight compared to children in all other scenarios.<br><br>Percent overweight<br>No lunch 26.1% of 204<br>School kitchen 24.2% of 626<br>Purchased outside 28.6% of 1,187<br><br>There is evidence of positive self-selection bias. School lunches are correlated with children's weight due to some unobserved factors.<br><br>**Data Source:** Nutrition and Health Survey in Taiwan for Elementary | National average cost of providing Department of Hygiene regulated lunch:<br>NT$30 to35 per meal.<br><br>**Component Included in Cost:** NR<br><br>Prices set by each school board.<br><br>**Context:** Parents pay monthly fee for meals. Low or middle-income families or students with disabilities receive free lunch funded by local government.<br><br>**Data Source:** NR | **Healthcare Cost:** NR<br><br>**Productivity:** NR<br><br>**Other Economic Costs:** NR | **No summary estimates reported**<br><br>**Comments:** Effects were controlled for age, gender, family structure, family income, whether the kids ate breakfast, hours of television viewing, physical activity at school, rural/urban, large/small school size, parent (mother) education and employment. Model and analysis addresses endogeneity (self-selection effect). |

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| | | | School Children (NAHSITC) from Bureau of Foods and Hygiene of the Department of Health, Taiwan, 2002. | | | |
| **Author (Year):** Gortmaker et al. (2015)<br><br>**Design:** Model (Microsimulation)<br><br>**Economic Method:** Cost-effectiveness<br><br>**Funding:** JPB Foundation, The Robert Wood Johnson Foundation (Grant No. 66284), the Donald and Sue Pritzker Nutrition and Fitness Initiative; and the Centers for Disease Control and Prevention (Grant No. U48/DP001946), the Nutrition and Obesity Policy Research and Evaluation Network.<br><br>**Monetary Conversions:** Index year 2014 in U.S. dollars | **Location:** Modeled for U.S. population<br><br>**School Type:** All grades<br><br>**Population:** Children in schools where reimbursable meals are served<br><br>**Sample Size:** Modeled for 28 million school children<br><br>**Demographics:** U.S nationally representative sample of school children<br><br>**Time Horizon:** Modeled 10 years over years 2015 to 2025 | **Intervention:** U.S. national school meal intervention.<br><br>Implement nutrition standards for national school lunch and school breakfast programs (NSLP and NSBP). Modeled on US Department of Agriculture (USDA) regulations. Starting 2012-2013 school year, required schools to increase the availability of fruits, vegetables, whole grains, and fat-free and low-fat milk; reduce levels of sodium, saturated and trans fats; and for the first time set minimum and maximum calorie levels.<br><br>Major inputs to model drawn from systematic review of the literature: | Effect of intervention on BMI modeled to take 18-36 months. (Based on Taber et al. 2013)<br><br>Mean Reduction in BMI: Students with free or reduced price meals 1.76 Students on full price meals 0.83<br><br>Effect of intervention assumed sustained over remaining 8 years in 10-year analytic horizon.<br><br>10-year cases of childhood obesity prevented 1,815,966 out of 28 million children. | Cost of implementation $1,112 million per year ($39.71 per student per year)<br><br>**Component Included in Cost:** State additional administration, training, technical assistance, review, compliance monitoring $9.4 million per year. School districts additional $414.8 million in food costs and $400 million in food service labor costs per year. Federal government additional $396 million per year in reimbursements for meal costs at the 6 cents higher rate for compliant programs and $25 million per year grants to school districts for kitchen equipment. | 10-year effect on healthcare cost of reduced obesity. Based on studies estimating excess healthcare cost associated with obesity among children and adults.<br><br>**10-year Healthcare Cost Averted:** $4,670 million ($16.68 per student per year)<br><br>**Source of Data:** Systematic review and modeling.<br><br>**Productivity:** NR<br><br>**Other Economic Costs:** NR | 10-year Net Benefit Per Person Intervention Cost=$397 Averted Healthcare Cost=$167 Net Benefit = $167-$397=($230) |

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| | | effectiveness, reach, cost, and implementation scenarios.<br><br>**Comparison:** No nutrition guidelines | Modeled change in obesity prevalence and health outcomes over 10-year horizon using ACE-Obesity model from Australia calibrated to U.S. context. | **Component not Included in Cost:** None<br><br>**Source of Data:** Cost assessment done for federal government in conjunction with passage of regulation. | | |
| **Author (Year):** Montgomery et al. (1996)<br><br>**Design:** RCT<br><br>**Economic Method:** Intervention Cost<br><br>**Funding:** NR<br><br>**Monetary Conversions:** Assumed index year 1993 in U.S. dollars | **Location:** Statewide, Texas<br><br>**School Type:** NR<br><br>**Population:** School children No details<br><br>**Sample Size:** Intervention 14 schools Control 10 schools<br><br>**Demographics:** NR<br><br>**Time Horizon:** Ingredient level cost data collected for October 1992. Average yearly cost of meals calculated for | **Intervention:** Eat Smart (Child and Adolescent Trial for Cardiovascular Health - CATCH).<br><br>Foodservice component of the CATCH intervention.<br><br>Intervention lowered fat and sodium in school breakfast and lunch in intervention schools.<br><br>**Comparison:** Schools with no change in food preparation. | Percent of energy from fat decreased from 41% (for both control and intervention) to 34% for control and 30% for intervention. | Range in mean cost per breakfast meal: $0.47 to $0.50 in control $0.49 to $0.51 in intervention<br><br>Range in mean cost per lunch meal: $0.67 to $0.73 in control $0.71 to $0.74 in intervention<br><br>There was no statistically significant difference in cost of meals between control and intervention schools.<br><br>**Component Included in Cost:** Cost of ingredients and preparation of meals. | **Healthcare Cost:** NR<br><br>**Productivity:** NR<br><br>**Other Economic Costs:** NR | **No summary estimates reported** |

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| | foodservice data from September 1991 to May 1994. | | | **Components not Included in Cost:** None<br><br>**Data Source:** Foodservice accounts data | | |
| **Author (Year):** te Velde et al. (2011)<br><br>**Design:** Modeled based on 2 RCTs<br><br>**Economic Method:** Cost per DALY<br><br>**Funding:** European Commission QLK1-CT-2001-00547 and Netherlands Organization for Health Research and Development Grant 50-50110-98-017. Dutch Ministry for Health Welfare and Sport, Holland Produce Promotion. World Cancer Research Fund. NHMRC Capacity Building grant.<br><br>**Monetary Conversions:** Index year 2003 in Euros | **Location:** The Netherlands<br><br>**School Type:** Pro Children Last 2 years of elementary school. Schoolgruiten 2 years starting in Grade 5.<br><br>**Population:** Middle school children<br><br>**Sample Size:** Pro Children 735 Schoolgruiten 771 Modeled for national population of age 10 years 190,723<br><br>**Demographics:** Age 10-12<br><br>**Time Horizon:** Intervention length 2 years. RCT data collected 2003-2005. | **Intervention:** Modeled based on 2 intervention evaluation results: Pro Children and Schoolgruiten.<br><br>Components included a school curriculum, parent involvement, and free fruit and vegetable scheme.<br><br>Goal of both interventions was to increase fruit and vegetable intake.<br><br>Pro Children – 2 year intervention. Free piece of fruit and tomato or carrot twice a week. School worksheets and computer tailored feedback tool. Parents involved in homework, projects, and web based tool.<br><br>Schoolgruiten – 2 year free fruit and | Intervention versus control Mean increase in daily grams of fruit and vegetables intake Pro Children 78.8 higher at year 1 and 28.7 higher at year 2 Schoolgruiten 29.6 higher at year 1 and 17.4 higher at year 2<br><br>Change at 2 years used in model input.<br><br>Model extends the increased fruit and vegetable intake recorded in the 2 interventions to long term health outcomes and healthcare cost.<br><br>Gamma distribution fitted to mean fruit and | Pro Children 42.47 per child for 2 years<br><br>Curriculum and Materials 12.47 in year 1 and 0.33 in year 2 Fruit and Vegetable Scheme 14.00 per student per year Teacher training 10.59 per teacher Cost to implement nationally 8.1 million<br><br>Schoolgruiten 37.47 per student over 2 years Curriculum and Materials 4.00 per child per year Fruit and Vegetable Scheme 14.00 per student per year Cost to implement nationally 7.1 million<br><br>**Component Included in Cost:** | Lifetime Healthcare cost averted: Pro Children 19.92 per student Schoolgruiten 12.06 per student<br><br>**Components:** Cost attributed to ischemic heart disease, ischemic stroke, and cancer. Includes inpatient, primary care visits.<br><br>**Data Source:** Modeled<br><br>**Analytic Period:** Lifetime<br><br>**Productivity:** NR | Lifetime DALY averted per 100K children (Base 30% sustained effect and 3% discount rate) Pro Children 394 for boys and 296 for girls Schoolgruiten 236 for boys and 178 for girls<br><br>**Net Cost:** Pro Children 8.1l – 3.8 = 4.3 mil Schoolgruiten 7.1 – 2.3 = 4.8 mil<br><br>**Cost per DALY:** Pro Children 5728 Schoolgruiten 10674<br><br>**Cost per DALY Without Healthcare Savings:** Pro Children 10679 |

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| | | vegetable. No family component or computer feedback tool. Curriculum not compulsory.<br><br>**Comparison:**<br>Schools with no intervention | vegetable consumption data for age 19-30 drawn from National Food Consumption Survey, 2003. Distribution shifted upward by percentage increase in mean consumption for intervention population. Two assumptions:<br>Base case of 30% of effect assumed to sustain over lifetime<br>Increased F&V consumption associated with lower incidence of ischemic heart disease, ischemic stroke, and cancer. These modeled using age- and gender-specific exposure and risk of disease incidence.<br><br>Disability-adjusted life expectancy calculated from prevalence and mortality derived | Curriculum development<br>Teacher training<br>Materials<br>Fruit and vegetables<br><br>**Components not Included in Cost:**<br>None<br><br>**Data Source:**<br>From Pro Children and Schoolgruiten program records. | **Other Economic Costs:**<br>NR | Schoolgruiten 15623<br><br>Dutch DALY benchmark of 19600 used in study indicates both interventions are cost-effective.<br><br>Not cost-effective under sensitivity analysis when only 10% effect of intervention sustained and when discount rate is 5%.<br><br>**Limitation**:<br>Self-reported fruit and vegetable consumption. |

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| | | | from incidence rates. | | | |
| **Author (Year):** Qian (2014)<br><br>**Design:** Panel with Matching Comparison<br><br>**Economic Method:** Intervention Cost<br><br>**Funding:** None<br><br>**Monetary Conversions:** Assumed index year 2008 in U.S. dollars | **Location:** Statewide, Arkansas<br><br>**School Type:** Grades KG through 10. But only even numbered grades had consistent measurements each year.<br><br>**Population and Eligibility:** Children in schools admitted to the Fresh Fruit and Vegetable Program (FFVP)<br><br>**Sample Size:** FFVP Schools 2008-2009 24 2009-2010 47<br><br>**Demographics:** Reflects FFVP program subgroup in State.<br><br>**Time Horizon:** Program began 2008-2009 school year. Data from 2007-2010. | **Intervention:** Fresh Fruit and Vegetable Program (FFVP) of the US Department of Agriculture (USDA) in Arkansas.<br><br>Schools have to apply for program. Fresh Fruit and Vegetable Program (FFVP) participation required National School Lunch program (NSLP) participation and 50% of students eligible for Free/Reduced Lunch. But fresh fruit and vegetable provided to all students.<br><br>**Comparison:** Matched controls | Effect on mean BMI.<br><br>FFVP participants had lower BMI percentile (3.8 pct pt fixed and 3.7 pct pt random effects) than Control.<br><br>Negative but insignificant coefficients were also found using another matching method that was less precise in achieved matching.<br><br>**Control for Factors:** Neighborhood characteristics and demography from American Community Surveys and geo-referenced food environment of student residences. Race, income, marital status, food desert, access to grocery, | Participating schools received $50 to $75 per student per year in funding. Average funding per school was: 2008-09 $27,334 2009-10 $21,382<br><br>**Component Included in Cost:** NR<br><br>**Data Source:** USDA funding | **Healthcare Cost:** NR<br><br>**Productivity:** NR<br><br>**Other Economic Costs:** NR | **No summary economic outcomes**<br><br>**Comments:** Finding based on panel data and matched comparison. |

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| | | | urban/rural, education attainment, etc.<br><br>Also controlled for self-selection and unobserved factors causing endogeneity. | | | |
| **Author (Year):**<br>Wagner et al. (2007)<br><br>**Design:** Cross-sectional<br><br>**Economic Method:**<br>Intervention cost and demand function estimation<br><br>**Funding:** McKnight Foundation<br><br>**Monetary Conversions:**<br>Index year 2002 in U.S. dollars | **Location:**<br>Minnesota<br><br>**School Type:**<br>All grades<br><br>**Population**<br>Data from 330 Minnesota school districts<br><br>**Demographics:**<br>Range of demographics representing school districts in all of Minnesota<br><br>**Time Horizon:**<br>Data from 330 districts over 5 school years, 1999-2004. | **Intervention:**<br>Policies regarding National School Lunch Program (NSLP) in Minnesota and assessment of cost to provide more nutritious and healthy meals and factors that impede the objective.<br><br>Cross-sectional assessment of data from 330 school districts in Minnesota.<br><br>Healthy Meals for Healthy Americans Act (P.L.103-448), passed in 1994, require that school meals comply with the 1995 Dietary Guidelines for Americans. Schools supposed to be evaluated every 5 years. | **Findings:**<br>Student demand for school meals is not negatively associated with nutrition content. More nutritious meals do not cost more to produce.<br><br>Healthier meals require a separate production process<br>Indirect cost imposed on food service by school boards reduce nutritional quality | 2005-2006 school years<br>USDA cash reimbursements<br>Free lunch $2.32<br>Reduced-price lunch $1.92<br>Full-priced lunch $0.22<br>USDA commodities supplied in value $0.175 per lunch meal<br>Subsidy from State of Minnesota $0.10 per lunch meal<br><br>**Component Included in Cost:**<br>NR<br><br>School district can levy cost for non-food production items such as janitorial, building, utilities, rent etc… which can be revenue for schools. | **Healthcare Cost:**<br>NR<br><br>**Productivity:**<br>NR<br><br>**Other Economic Costs:**<br>NR | **No summary economic outcomes**<br><br>**Limitations**<br>Cross-sectional.<br>No capital data for foodservice production. |

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| | | **Comparison:** None | | **Data Source:** School district food services, student population and demographics, USDA reimbursements, a la carte and vending sales. | | |

DALY, disability adjusted life year
DiD, difference in difference
NA, not applicable
NR, not reported
QALY, quality adjusted life year