Economic Perspectives on Pediatric Obesity: Impact on Health Care Expenditures and Cost-Effectiveness of Preventive Interventions

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Abstract

This chapter surveys two segments of the economic literature on pediatric obesity: first, research regarding the impact of childhood obesity on health care expenditure, and second, research evaluating the cost-effectiveness of programs to prevent pediatric obesity. Evidence in support of the hypothesis that obese children and adolescents have higher health care costs than their otherwise similar healthy-weight peers has been found for female adolescents. Studies trying to calculate the complete lifetime health care costs attributable to childhood obesity are missing. Only a small number of studies assessing the cost-effectiveness of preventive obesity interventions among children have been published until now. The results call for the inclusion of nutrition behavior as an intervention target. There is some evidence that childhood obesity prevention might be successful in combining health gains with cost savings. However, it is not possible to rank the interventions according to their cost-effectiveness or to assess the generalizability of their results. Cost-effectiveness increasingly will be a major consideration in public reimbursement decisions. Therefore, evaluation research has to pay more attention to the economic aspects of new health technologies. Without providing good value for money, those technologies probably will not turn from inventions to innovations in health care. Moreover, future research should address various methodological and conceptual challenges and limitations which economic evaluations of preventive interventions into childhood obesity are faced with.
Introduction

Obesity is not only a health but also an economic phenomenon. There are underlying economic causes, such as technological developments and associated changes in the prices of goods and commodities, behind the obesity epidemic. Obesity has serious economic consequences such as lower skill attainment and academic outcomes, worse labor market outcomes, and increasing obesity-related health care expenditures. Because of the high societal costs of obesity, and the fact that the majority of these costs are compulsorily financed by taxpayers or payers of contributions to public health insurance, there is a strong motivation for governments to intervene into the obesity epidemic and to reduce the costs related to it. This raises questions about the economic rationales for public interventions to control obesity. Given the assumption that, from an economic perspective, public intervention to reduce obesity is justified either on efficiency or on equity grounds, the question follows how policy makers should choose between the potentially many possible ways to prevent or treat obesity. There is a rapidly increasing economic literature on all these issues, regarding obesity in general as well as childhood obesity in particular. The purpose of this chapter is to present a short survey on two selected segments of this literature: first, research on the economic consequences of childhood obesity in terms of its impact on health care expenditure, and second, research evaluating the cost-effectiveness of interventions to prevent pediatric obesity. Economic research on the causes of rising childhood obesity is completely out of the scope of this chapter; the interested reader is referred to Anderson et al. [1] as an informative review of this issue.

Impact of Rising Pediatric Obesity on Health Care Expenditures

Economists have studied various potential non-health consequences of childhood obesity, including, e.g., lower skill attainment and academic outcomes, and worse labor market outcomes in terms of earnings and probability of employment. In this chapter, the focus is exclusively on how rising pediatric obesity affects health care expenditure.

Using different methodologies, previous empirical research has demonstrated that obesity is associated with a substantial economic burden in terms of health care costs. For example, for Germany a recent study has shown that in 2003, total health care expenditure attributable to obesity added up to EUR 11.3 billion, corresponding to about 6% of total health expenditure [2]. Furthermore, it has been shown for the adult population in the KORA study region (Augsburg, Germany) that in 1999/2001 severe obesity (BMI ≥35) was associated with incremental health care costs of EUR 1,720 per person per year compared with normal weight [3].
Comparable data for children and adolescents are few. There are some studies focusing on the impact of childhood obesity on hospital care costs. These studies demonstrate that in the US and in Ireland the annual costs of children's and adolescents' hospital stays with obesity listed as a principal or secondary diagnosis increased much more than total expenditure for hospital care over time [4–6]. However, it remains unclear to what extent this increase reflects a growing awareness of childhood obesity being a clinically relevant condition and/or changes in coding behavior or a real increase in the proportion of obesity-attributable health care costs.

Pediatric obesity can lead to various adverse health outcomes already in childhood. Therefore, it is plausible to assume that obese children concurrently have more health care utilization and higher health care costs than their otherwise similar healthy-weight peers. However, the evidence resulting from studies applying this incremental or excess cost approach is mixed:

- There are three US studies examining health care expenditure for special child populations (HMO members [7]; utilizers of a primary care clinic for well-child care visits [8], Medicaid insurees [9]) and reporting higher costs for obese children than for normal-weight children. However, not all findings were statistically significant, and their generalizability to the total child population remains an open question.

- There are four studies using data from the nationally representative US Medical Expenditure Panel Surveys (MEPS). Johnson et al. [10] used data from the 1998 MEPS on children between 4 and 17 years. They found that being obese increased the probability of obtaining medical care, but had no effect on the level of expenditure conditional on the expenditure being positive. Skinner et al. [11] examined 2002 MEPS data of children aged 6–17 years; they did not find any differences in expenditures between obese and healthy-weight children, neither for the probability of having any expenditure nor for average expenditures among those with any expenditure. Finkelstein and Trogdon [12] used pooled data from the 2001–2003 MEPS for children aged 8–19 years; they found a higher level of expenditures for obese children only in the age group of 14–19 years. Monheit et al. [13], who examined only adolescents and used also pooled data from the 2001–2003 MEPS, found statistically significant differences across bodyweight class not for male, but for female persons. Female obese and overweight adolescents were found to have expenditures that exceeded those of normal-weight females by nearly USD 800 per year with a substantial part of the differences in mental health expenditures.

In sum, there is only limited evidence that childhood obesity is associated with increased concurrent health care costs. However, children and adolescents who are overweight or obese tend to remain so over time, and therefore are confronted with increased risks of morbidity during adult-
hood. As there is compelling evidence that in adulthood obese individuals compared with normal-weight individuals have higher health care costs, in a lifetime perspective economic costs of childhood obesity might add up to a substantial amount. Only a few papers have attempted to quantify lifetime costs of obesity (see, e.g. [14] for the US, and [15] for The Netherlands). Unfortunately, these studies start in early adulthood and therefore are not suitable to calculate the health care costs attributable to obesity in childhood and adolescence. However, the studies provide some, but no definite, evidence that although obesity in adulthood results in higher annual medical spending, it may actually reduce lifetime medical spending due to a shorter life expectancy of obese persons. Therefore, it cannot be excluded that successful obesity prevention cannot stem the tide of increasing health care expenditures.

### Economic Evaluations of Interventions to Prevent Pediatric Obesity

There are probably many possible ways to prevent childhood obesity. Economists propose that policy makers should look at the results of economic evaluation studies and choose those interventions that provide the most ‘bang for the buck’. Until now, only a small number of studies assessing the cost-effectiveness of preventive obesity interventions among children have been published. Based on a PubMed search conducted in July 2009 in the literature published since 2001, economic evaluations of totally twelve preventive interventions could be identified. The major contribution to this research has been made by the ACE-Obesity (Assessing Cost-Effectiveness in Obesity) project which, in addition to five interventions targeted at overweight or obese children and adolescents, comprises the economic evaluation of eight obesity prevention programs [16, 17]. Furthermore, four more evaluations of several school-based programs were found [18–21]. The studies differ in a large number of methodological aspects such as study type, intervention target, target population, outcome measure, follow-up time horizon, costs included, and alternatives against which the interventions are assessed. Table 1 provides some information on these differences.

The results show with some degree of confidence that in order to reach acceptable cost-effectiveness values, interventions should include nutrition as an intervention target. In addition, there is some evidence in support of the expectation that childhood obesity prevention may be successful in combining health gains with cost savings. However, it is not possible to rank the interventions according to their comparative cost-effectiveness. This holds even for the interventions examined in the ACE-Obesity project, although a common evaluation methodology has been applied in this project. But priority to be included in the project was given not only to interventions with
sufficient evidence of effectiveness, but to interventions with high relevance to current policy-making, as well. Therefore, the quality of best available evidence actually used in the models was very different; in the worst case, there was almost no empirical evidence of effectiveness at all. In the framework of lifetime modeling, there was a serious lack of evidence, above all, concerning children’s BMI development after the end of the intervention or follow-up period. The ACE-Obesity approach assumed that the mean BMI change due to the intervention would be maintained over the life of the child, without specifying the basis for this questionable assumption. Furthermore, this approach did capture only those health benefits which were linked to changes in BMI. However, there are good reasons to assume that the examined interventions may generate health outcomes that are independent of changes in BMI [22].

It is even more difficult to assess the generalizability of the reported results. This finding supports the observation of Wolfenden et al. [23] noting a general lack of reporting of contextual factors in intervention trials that are critical in judging the relevance and applicability of findings in practice. Information on those elements is needed to make more confident conclusions about the potential effectiveness and successful dissemination of intervention evidence into practice settings.

Given the present state of knowledge, it is neither clear whether the most cost-effective solution to the problem of obesity is prevention or treatment, nor is it clear what the most cost-effective point of time for preventive interventions would be. Although a focus on obesity prevention in childhood may seem plausible, it might be that early interventions are not the most cost-effective way to attack obesity. Preventing obesity in adulthood may be more cost-effective, due to the more immediately occurring benefits of avoiding the otherwise high prevalence of obesity-related comorbidities that develop during adulthood. Unfortunately, those comparative studies are lacking. Therefore, the best strategy for the short run – while such cost-effectiveness data are still lacking – is not clear [24].

Despite all limitations, there is a clear message to be derived from the available findings on the cost-effectiveness of preventive child obesity interventions. The large variation in the incremental cost-effectiveness ratios even among studies based on the same methodological approach impressively underscores the urgent need for analyzing not only the effectiveness, but the efficiency of those interventions as well, in order to ensure the most economical use of the limited financial resources available for improving the young population’s health.

However, it is not sufficient to simply increase research on the efficiency of child obesity interventions. Economic evaluations of those interventions face a number of challenges and limitations, which are to be considered carefully when using the study results in the process of decision-making. They include the following issues:
<table>
<thead>
<tr>
<th>Reference</th>
<th>Intervention and setting</th>
<th>Intervention target</th>
<th>Target population</th>
<th>Study approach</th>
<th>Time horizon</th>
<th>Health gain measure</th>
<th>Cost per unit of health gain</th>
</tr>
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<tbody>
<tr>
<td>ACE-Obesity [16, 17]</td>
<td>Walking School Bus PA children aged 5–7 years</td>
<td>PA</td>
<td>children aged 5–7 years</td>
<td>model</td>
<td>lifetime</td>
<td>DALY</td>
<td>AUD 760,000</td>
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<tr>
<td>ACE-Obesity [16, 17]</td>
<td>TravelSMART PA children aged 10–11 years</td>
<td>PA</td>
<td>children aged 10–11 years</td>
<td>model</td>
<td>lifetime</td>
<td>DALY</td>
<td>AUD 260,000</td>
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<tr>
<td>ACE-Obesity [16, 17]</td>
<td>Active after School Community Program multi-faceted SBP without active PE component N, PA children aged 5–11 years</td>
<td>N, PA</td>
<td>children aged 5–11 years</td>
<td>model</td>
<td>lifetime</td>
<td>DALY</td>
<td>AUD 80,000</td>
</tr>
<tr>
<td>ACE-Obesity [16, 17]</td>
<td>multi-faceted SBP with active PE component N, PA children aged 6 years</td>
<td>N, PA</td>
<td>children aged 6 years</td>
<td>model</td>
<td>lifetime</td>
<td>DALY</td>
<td>cost saving</td>
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<tr>
<td>ACE-Obesity [16, 17]</td>
<td>SBP to reduce the consumption of sweetened carbonated drinks N children aged 7–11 years</td>
<td>N</td>
<td>children aged 7–11 years</td>
<td>model</td>
<td>lifetime</td>
<td>DALY</td>
<td>cost saving</td>
</tr>
<tr>
<td>ACE-Obesity [16, 17]</td>
<td>SBEP to reduce TV viewing reduction in TV advertising of high fat/high sugar foods and drinks directed at children ≤14 years</td>
<td>(N, PA)</td>
<td>children aged 8–10 years</td>
<td>model</td>
<td>lifetime</td>
<td>DALY</td>
<td>cost saving</td>
</tr>
<tr>
<td>Wang [18]</td>
<td>SBP Planet Health N, PA middle school children</td>
<td>N, PA</td>
<td>middle school children</td>
<td>model</td>
<td>lifetime</td>
<td>QALY</td>
<td>USD 4,305 (girls only)</td>
</tr>
<tr>
<td>Brown [19]</td>
<td>SBP CATCH N, PA children 8–11 years</td>
<td>N, PA</td>
<td>children 8–11 years</td>
<td>model</td>
<td>lifetime</td>
<td>QALY</td>
<td>USD 900</td>
</tr>
<tr>
<td>Study</td>
<td>Program</td>
<td>Target Population</td>
<td>Trial Duration</td>
<td>Outcome Measure</td>
<td>Cost ($)</td>
<td></td>
<td></td>
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<tr>
<td>Wang [20]</td>
<td>SBP FitKid</td>
<td>N, PA elementary school children</td>
<td>1 year</td>
<td>% body fat reduction</td>
<td>USD 417</td>
<td></td>
<td></td>
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<tr>
<td>McAuley [21]</td>
<td>SBP APPLE</td>
<td>N, PA children aged 5–13 years</td>
<td>4 years</td>
<td>kg weight gain prevented</td>
<td>NZD 664–1,708</td>
<td></td>
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PA = Physical activity; N = nutrition; SBP = school-based program; SBEP = school-based education program; PE = physical education; DALY = disability-adjusted life year; QALY = quality-adjusted life year. Parentheses signify indirect impact of intervention on behavior expected.
Outcome identification and measurement. A major problem in the conduct of economic evaluations of preventive interventions is the appropriate identification and measurement of their benefits. Looking only at the changes in body mass and the health gains to be expected from reduced risk of obesity might too narrowly define health benefits to be expected from improvement of eating and physical activity behavior. In addition, community-based programs may have social diffusion effects into other population groups.

Measuring quality of life. Including all health outcomes of obesity interventions in only one measure of effectiveness requires to apply a generic measure of health benefits. Economists prefer to use QALYs which are derived from preference-based evaluations of states of health, as they are described in generic measures of health-related quality of life. However, until now there is no consensus on how health-related quality of life should be defined and measured in pediatric populations [25]. Moreover, proxy rating for measuring quality of life and, above all, for valuing states of health, is unavoidable, which may compromise the validity and reliability of those data.

Attributing outcomes to interventions. Interventions may reduce future ill health over a very long time period. Estimating such consequences obviously raises considerable study design and measurement problems. In general, some sort of modelling is needed to estimate these effects to be expected to occur beyond the end of the trial. In modelling, all relevant evidence is used, including the synthesis of evidence from studies of different experimental and non-experimental design. However, the use of non-experimental data always bears the risk of biased estimates of the impact of an intervention on the target variable. In the end, to accurately calculate the lifetime health gains produced by specific interventions, studies with longer follow-up are urgently needed to determine the persistence of changes observed in a short-term perspective.

Unrelated health care costs in life years gained. A further issue is whether any potential saving in costs from one disease needs to be adjusted for the higher health care costs that may arise from extending people's lives. While preventive interventions may reduce diseases and expenditures related to the risk factors, they will increase diseases and expenditures unrelated to those risk factors primarily in gained life years. For obesity, the costs of these unrelated diseases have been demonstrated to potentially outweigh the savings on related diseases [14, 15]. Following the highly questionable recommendations of many national guidelines, current health economic evaluations usually exclude the costs of unrelated diseases in life years gained. This may result in too favorable estimations of cost-effectiveness, feeding the unfounded optimism among policymakers who tend to regard effective lifestyle interventions as a cost-saving option [26].
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- **Discounting future costs and benefits.** In order to adjust for the individuals’ positive time preference, future costs and benefits are discounted in economic evaluations to their present value. Typically, discounting is done at a time-constant discount rate, equal for costs and benefits. The choice of the discount rate can profoundly affect the result of an economic evaluation, especially if there is a large time distance between the cost of the intervention and its health outcomes. Therefore, the cost-effectiveness of a childhood obesity prevention program critically depends on the discount rate applied. There is not only an ongoing debate on how the appropriate discount rate should be determined. If an increasing value is attached to health over time, a discount rate for health benefits should be used, which is lower than the rate applied to costs [27]. Furthermore, uncertainty about the future economic development of society may require time-declining discount rates [28]. Finally, there is some evidence that people devaluate future health gains of their children less than their own future health benefits [29]. This finding would require to apply a discount rate for child health gains lower than the rate for adult health gains.

- **The maximization rule.** Economic evaluation of health care programs is based the decision rule of maximum benefit, i.e. it is endorsing the ethical position that it is the total sum of health gains produced what matters, no matter how that sum is distributed among people. However, evidence about the public’s perspective on the allocation of health care resources convincingly demonstrates that people consistently articulate views that conflict with health gain maximization [30] by taking into account, in addition to efficiency, a broad range of fairness and equity principles. As prevention activities frequently are motivated by the intention to tackle socioeconomic health inequalities, prioritizing according to the maximization criterion without considering the equity issue may be particularly inappropriate.

**Conclusions**

To design effective public policies to curb the obesity epidemic, a more detailed and more precise knowledge is necessary on the long-term costs associated with overweight and obese children as a first step in determining cost-effective treatment and prevention interventions. However, until now a large part of our empirical knowledge on the potential health and non-health consequences of rising obesity is based on survey methods representing short-term measures of calorie intake and consumption, health status, and health care utilization and costs. Calculating more precise estimates of the lifetime health care costs attributable to obesity and its overall societal
costs requires longitudinal data about diet quality and physical activity for better understanding the links between overweight and obesity and chronic disease risks as well as longitudinal data about health care consumption and costs.

Systematic cost-effectiveness analyses are not widespread in studies on childhood obesity interventions. Remarkably, there are no studies at all evaluating the efficiency of interventions aiming at influencing gestational weight gain or preventing pre-school obesity, nor are there studies analyzing the cost-effectiveness of interventions based on the use of typical economic incentives such as taxes on less healthy foods and/or subsidies for relatively healthy foods. The reasons for this lack of economic evaluations are unknown, but it highlights the need to design intervention trials with translation and dissemination in mind. There is little doubt that cost-effectiveness increasingly will be a major consideration in decision-making by health politicians and third-party payers. Therefore, evaluation research has to pay more attention to the economic aspects of new health technologies. Without providing good value for money, those technologies probably will not turn from inventions to innovations in health care.

However, the economic evaluation of preventive interventions into childhood obesity faces various methodological and conceptual challenges including the definition and measurement of intervention outcomes, the definition and measurement of health-related quality of life in pediatric populations, the attribution of outcomes to interventions if RCTs are not feasible to test causal relations, how to deal with unrelated health care costs in life years gained, how to value future costs and benefits, and finally, how to integrate considerations of equity and fairness into economic evaluations. These challenges are to be addressed in future research if the full potential of economic evaluation as an aid to decision-making is to be exhausted.

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References

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Discussion

**Dr. Bier:** I don’t quite know how to frame it because I don’t know the economic terms but what is the cost of being thin. I am really talking about personal economics because people have obviously voted on cost. If it was cheaper to a person to be thin than fat we would all be thin. People are fat, so on a personal level they have decided it cost them less to be fat than thin, and the costs of being thin involve your spouse being unhappy because you are not home with the children when you are at the club doing exercise and all the other things of this sort. So how do we determine that?

**Dr. John:** You are describing the choice between being thin and being fat in terms of economics, where individuals are assumed to compare the costs and benefits of alternative courses of action and to choose the option with the largest net benefit. The cost-of-illness perspective on obesity is much narrower: it looks at obesity’s economic impact in terms of its ‘direct costs’, the costs of resources consumed because of the associated illnesses (including medical care, travel costs, etc.), and ‘indirect costs’, the value of lost production due to reduced working time [for a critical review of cost of illness methodology, see 1]. Of course, cost-of-illness methodology could be applied to the problem of underweight as well. In the same way as we have calculated the costs of overweight and obesity, one can measure the costs of underweight by calculating the cost differences between underweight and normal-weight children. However, this is only a descriptive analysis of the magnitude of the two health problems. Comparing the costs of overweight and the costs of underweight neither guides the individual in her or his decision between being fat or being thin, nor provides enough information in order to decide whether and how health policy should intervene in these health problems. In both cases, a comparison of costs and benefits of the available options is required for a rational decision.

**Dr. Ivarsson:** I am involved in health economic studies exploring celiac disease screening in Sweden, and I increasingly appreciate that scientific field. I find health economic studies extremely helpful when trying to motivate politicians and health care decision makers to take action against public health threats. However, in your example of teenagers and obesity, you don’t show us the full potential of such studies. Firstly, in my opinion, you need to use a life course approach also taking the long-term consequences of obesity into account, even though that would involve modeling and thereby introducing a larger extent of uncertainty. Secondly, when taking only health care expenditures into account you may not see the whole picture, as future decreased productivity also needs to be considered, as well as the estimated value of decreased health and well-being. Thirdly, I agree that health economic studies can’t tell us how to design the interventions needed to prevent or treat obesity. However, such studies can help us by estimating how much the individual and society would save economically if we succeeded in developing an effective intervention, and could thus guide priority setting. Thus, in my opinion the discipline of health economics has an even larger role to play in the future than you bring forward in your lecture.

**Dr. John:** I agree with all you have said, especially with your statement that health economics can and should play a larger role in supporting policy decisions. However, looking at the various unsolved methodological challenges of health economic evaluation, it seems to me that health economics can and should inform, but not guide policy decisions. Regarding your comment on modeling, I would like to underscore that modeling of course is an ‘unavoidable fact of life’ [2]. Moreover, and perhaps more important, we should be aware of the fact that decisions will always be taken under conditions of uncertainty, and decision-analytic modeling provides strong instruments.
to deal with uncertainty in decision-making in a rational way. However, economic evaluation using decision-analytic modeling in order to identify the preferred option should be based on the decision-maker's value function, and I have some doubt whether the decision rules incorporated in standard economic evaluation can always be regarded as valid representations of this value function.

Dr. Hussain: I just want to add that it is an established fact that childhood obesity or increased BMI leads to a high risk of coronary artery disease and atherosclerosis in adulthood, that’s another economic pattern. Having said that, there is not much data as yet from developing countries, only data from Delhi by Sachdev et al. [3]. They say that although it is not an established indicator, increased BMI is a risk factor in developing countries, but in the countries with a rapid economic growth the affluent class of population definitely has a high risk of coronary heart disease. Do you have any comment on this?

Dr. John: It’s not really in my competence to comment on the issue of increasing BMI in the perspective of low-income and lower-middle-income countries. Meanwhile, it is well known that in those countries there is very often a coincidence of malnutrition and obesity in the course of rapid economic development. The question how to solve this problem under the economic constraints of these countries is a difficult one, and it needs special knowledge and experience, which unfortunately is beyond my expertise.

Dr. Greer: On your early slide, you showed that in the US it is very difficult to show the cost of pediatric obesity, particularly in the young children between the ages of 0 and 12. I hear this every day from the 55,000 members of the Academy of Pediatrics, that basically nobody thinks these kids are ill. The parents don’t think these kids are ill, most of the pediatricians don’t think these kids are ill, the private insurance companies don’t think these kids have a problem and even the government-sponsored insurance programs don’t think these kids are ill. If a pediatrician should become interested in trying to do something about obesity in this age group, there is absolutely no reimbursement for this activity. The reason given for the lack or reimbursement is that there is no cost-effective treatment for this age group. Is the situation in Western Europe similar? The real problem in our country is that nobody wants to pay for obesity treatment for children.

Dr. John: Yes, we have similar problems in Germany. For example, take the case of weight-reducing drugs, which are not covered by Germany’s National Health Insurance (NHI). However, the exclusion of those drugs from the list of reimbursed drugs is not based on effectiveness or cost-effectiveness considerations. The key issue is that these drugs are regarded as primarily lifestyle medications, and according to the current legal regulations, they are thus excluded from the benefit basket of NHI. I have some doubts about the cost-effectiveness of designing the health care benefit basket the way we’ve done it until now in Germany. However, as I have already mentioned, health politicians’ and third party payers’ willingness to pay for interventions into obesity is a slowly changing landscape, and in the near future we might expect some regulatory changes in Germany as well.

Dr. Spieldenner: It is right that programs addressing behavioral change and environmental factors at the same time, e.g. the EPODE program in France, are cost effective. Policy makers, however, often prefer projects that are behavioral projects for school children as they transmit a good image, but often they are not effective. From the perspective of health economics, the society as such has to assume most of the health care costs.

Dr. Bier: The society is made up of the people, so imposing society is not always the same as the society coming to that solution I think.
References