

# Systematic evaluation, replication and validation of structural health economic modelling approaches

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# IMPACT



## Impact

### **Main Objective and Main Results**

This dissertation aimed to study the methodology and validity of published health economic models in the context of obesity, usually defined by a BMI  $>30$  kg/m<sup>2</sup> [1]. As obesity is a complex disease which impacts the human body in different ways, there are many diseases associated with obesity [2]. This means that the risk for a specific disease (e.g. coronary heart disease) is much higher in an obese person compared to a normal weight person [3]. In order to reduce this risk in obese persons, different approaches are available to reduce the person's weight, and other associated risk factors of obesity (e.g. high blood pressure), which can have positive impact on the life expectancy and quality of life.

To measure such long-term consequences with clinical studies would require a very long observation period, which would require massive funds to be invested in such studies. As time and funds are often not available, health economic models are instead used to predict the potential long-term consequences. This dissertation investigated the different methods used for such predictive obesity models, investigated how accurately these models predict the reality, and studied the impact of the modelling methodology on the health economic model outcomes. Furthermore, it tested whether the information usually published for such predictive models allows reprogramming of the model and reproduction of the results, a criterion for the quality of reporting of scientific experiments irrespective of the research field.

As presented in this dissertation, it was found that in the context of obesity (almost) every research team builds its own obesity model; this is reflected by the obtained diversity of obesity modelling approaches (chapter 2). This makes it difficult to compare model outcomes, as the structural and methodological differences could have a major impact on the modelling results. Furthermore, it was found, that one key limitation of these models is the lack of published external validation results which could provide valuable information on the predictiveness, and quality, of their event simulation approaches (chapter 3). Hence it is unclear whether decision-makers in the healthcare setting can rely on (trust) the results of those models. Therefore, the different modeling approaches were presented and discussed with experienced health economists, in order to create best practice recommendations for the key structural approaches for health economic obesity models (chapter 4). Using these expert recommendations, high quality health economic obesity models were selected and replicated (chapter 5). Here it was found that small changes to existing reporting criteria have the potential to increase the transparency of model reporting, and may increase the reproduction success of health economic modelling results. This may subsequently increase the transparency and acceptance

of health economic modelling studies. Finally (in chapter 6) it was found that in a severely obese population, the structure of a health economic model matters if clinical events are to be predicted most accurately. However, if the purpose of a health economic model is purely the incremental health economic comparison, this study suggests that the structure does not matter as much, as incremental health economic results are fairly comparable.

### **Scientific Impact**

The research presented in this dissertation highlighted the increasing importance of health economic models in obesity, which is primarily triggered by the increasing burden of obesity and the related increased need for efficient allocation of resources. This has also been confirmed by the large number of health economic obesity modelling studies identified by the systematic review reported in chapters 2 & 3.

This systematic review has furthermore shown strong variability in predictive modelling in obesity. This variability was investigated, for the first time, with a special emphasis on the presentation and categorization of different approaches for predicting obesity associated events. This strong variability in the structural modelling approaches highlighted the need for recommendations and/or minimal requirements to inform obesity models. In order to offer guidance for scientists and modelers, best practice criteria were developed (chapter 4). It is expected that these best practice criteria can help to better harmonize the applied modelling methodologies in obesity.

Using these best practice criteria, high quality obesity models were selected for replication. This replication exercise (chapter 5) provided evidence that even complex obesity models can be rebuilt if the reporting and hence the transparency is sufficient for those exercises. This study provided important input for the reporting criteria of health economic models and, as we shared the outcomes of our research with the committee responsible for updating the CHEERS II reporting criteria [4], led to changes in the newest CHEERS II update. In addition to the previous CHEERS version [25], it was now made clear in the updated example CHEERS II reporting tables, that the details and parameters of probability distributions are to be reported. This enables a 1:1 replication of the probability distributions, which was not possible for our replications, reported in chapter 5, as the related details were missing. Furthermore, for assessing the success of the reproduction results, we have applied different criteria as defined and proposed in a recently published review on this topic [5], and we proposed a combination of different criteria to determine “replication success” specifically for health economic modeling. As this was, to our knowledge, the first application of these success

criteria, further research and scientific dialogue is required to investigate and define how best rate the success of a health economic model replication.

The external validation and the health economic result comparison (chapter 6) shows there is still a need for more long-term intervention studies in obesity, to provide better understanding of the condition, and a broader information source for the external validation. Using the currently available evidence base, focusing on the SOS study reflecting a severely obese population [6], it was shown that BMI alone is no good predictor for obesity associated events, but that a broader approach, considering a broader set of risk factors, provides better event prediction results. Interestingly, considering the incremental health economic results, no large difference was observed between the approaches, which should enhance trust in the health economic outcomes produced by obesity models, irrespective of the chosen approach.

The findings of this thesis will help researchers, health economists and modelers to make better informed decisions on the choice of a suitable modelling methodology for obesity models, and offers guidance for future fields of research. The research and findings of this thesis are relevant for all chronic diseases, in which health economic modelling is frequently applied to translate surrogate parameters (such as BMI, high blood pressure, fasting glucose levels) into patient relevant endpoints (such as stroke or myocardial infarction). In all such cases the transparency of research reporting and the validation of a modeling approach are crucial to gaining trust and confidence in the health economic outcomes. Future research in the field of obesity and other chronic conditions is required to complement the findings of this thesis.

### **Social Impact**

Health economic research often has practical implications, namely informing decision makers on the most efficient and cost-efficient way of allocating scarce resources within a given healthcare system. Decision makers in the healthcare setting can be payers, politicians, administrators, clinicians or other central member of decision-making boards. Irrespective of the background and the specific perspective a decision maker has, they need to rely on the information provided by researchers. Health economists especially play a crucial role in informing such decisions, as they combine and synthesize information from different disciplines, in order to simulate the clinical and economic consequences of such decisions for individuals and for society. Therefore, trust and confidence in the health economic research are central factors in ensuring the best allocation of scarce resources. One central basis for informing decision makers are health economic models, that simulate the clinical and economic consequences of a (usually innovative) healthcare intervention and compare it to alternative routes of action (usually to

current standards). Health economists are aware of their responsibility as central health economic associations; the ISPOR and SMDM in particular point out that trust and confidence are critical to the success of such health care models [7].

The research presented in this thesis aims to increase this trust and confidence in health economic models used for decision making in the context of obesity. Hence a potential social impact of this thesis is that decision makers have better guidance on how a specific modelling approach might influence clinical and health economic model outcomes. This might lead to better informed decision making, and potentially to a better acceptance of health economic modeling studies in the context of obesity.

### **Dissemination of Research Results**

Besides the publication of this thesis as a whole, single components of this thesis (chapters 2-6) were all published in peer-reviewed scientific journals [8-12], whereas two papers were published open-access (chapter 5 and 6) [11, 12]. In addition, the publication of each paper was announced via social media channels to increase the awareness of researches and decision makers.

In order to enhance the dissemination of these findings, each chapter was additionally presented to at least one scientific congress, in which researchers and decision makers commonly participate. These congresses were organized by the following associations (in brackets the number of thesis related congress contributions is shown): German health economic association (n=3 congress contributions); International Society for Pharmacoeconomics and Outcomes Research (n=3 congress contributions); European Health Economic Association (n=1 congress contribution); International Health Economic Association (n=1 congress contribution); the society for Health Technology Assessment International (n=1 congress contribution).

These congress contributions were always presented before the publication of the full manuscript in order to obtain first feedback for the related research, and to potentially include a broader perspective in the related discussion of a specific research paper.

In addition to these presentation and publication activities, the findings of our research were shared with the International Health Economic Association special interest group members, "Economics of Obesity".

## References

1. World Health Organization. Fact Sheet on Obesity. 2003. [https://www.who.int/dietphysicalactivity/media/en/gsfs\\_obesity.pdf](https://www.who.int/dietphysicalactivity/media/en/gsfs_obesity.pdf). Accessed 09.02.2019.
2. World Health Organization. Updated Fact Sheet on Obesity. 2018. <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>. Accessed 09.02.2019.
3. Field AE, Coakley EH, Must A, Spadano JL, Laird N, Dietz WH et al. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. *Arch Intern Med.* 2001;161(13):1581-6. doi:10.1001/archinte.161.13.1581.
4. Husereau D, Drummond M, Augustovski F, de Bekker-Grob E, Briggs AH, Carswell C et al. Consolidated Health Economic Evaluation Reporting Standards (CHEERS) 2022 Explanation and Elaboration: A Report of the ISPOR CHEERS II Good Practices Task Force. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research.* 2022;25(1):10-31. doi:10.1016/j.jval.2021.10.008.
5. McManus E, Turner D, Sach T. Can You Repeat That? Exploring the Definition of a Successful Model Replication in Health Economics. *PharmacoEconomics.* 2019;37(11):1371-81. doi:10.1007/s40273-019-00836-y.
6. Sjöström L. Review of the key results from the Swedish Obese Subjects (SOS) trial - a prospective controlled intervention study of bariatric surgery. *J Intern Med.* 2013;273(3):219-34. doi:10.1111/joim.12012.
7. Eddy DM, Hollingworth W, Caro JJ, Tsevat J, McDonald KM, Wong JB. Model transparency and validation: a report of the ISPOR-SMDM Modeling Good Research Practices Task Force-7. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research.* 2012;15(6):843-50. doi:10.1016/j.jval.2012.04.012.
8. Schwander B, Hiligsmann M, Nuijten M, Evers S. Systematic review and overview of health economic evaluation models in obesity prevention and therapy. *Expert review of pharmacoeconomics & outcomes research.* 2016;16(5):561-70. doi:10.1080/14737167.2016.1230497.
9. Schwander B, Nuijten M, Hiligsmann M, Evers S. Event simulation and external validation applied in published health economic models for obesity: a systematic review. *Expert review of pharmacoeconomics & outcomes research.* 2018;18(5):529-41. doi:10.1080/14737167.2018.1501680.
10. Schwander B, Nuijten M, Hiligsmann M, Queally M, Leidl R, Joore M et al. Identification and expert panel rating of key structural approaches applied in health economic obesity models. *Health Policy and Technology.* 2020;9(3):314-22. doi:<https://doi.org/10.1016/j.hlpt.2020.03.005>.
11. Schwander B, Nuijten M, Evers S, Hiligsmann M. Replication of Published Health Economic Obesity Models: Assessment of Facilitators, Hurdles and Reproduction Success. *PharmacoEconomics.* 2021;39(4):433-46. doi:10.1007/s40273-021-01008-7.
12. Schwander B, Kaier K, Hiligsmann M, Evers S, Nuijten M. Does the Structure Matter? An External Validation and Health Economic Results Comparison of Event Simulation Approaches in Severe Obesity. *PharmacoEconomics.* 2022. doi:10.1007/s40273-022-01162-6.