

Overweight and obesity in Switzerland

Part 1: Cost burden of adult obesity in 2007

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EXECUTIVE SUMMARY

Although it appears obvious to everyone that obesity is and remains a serious public health problem, there are only a limited number of studies published that address, besides the current magnitude of the problem, the future trends and offer some predictions regarding the expected prevalence rates in the decades to come. Therefore, the aims of the present study were to a) assess the cost burden of adult obesity in Switzerland based on the prevalence data from the fourth Health Survey carried out in 2007, b) to compare it to the cost of illness data evaluated on the basis of the previous Health Survey from 2002 and, c) to evaluate trends including a forecast until 2022, in the development of adult obesity in Switzerland based on a modelling approach.

Epidemiology

- This report presents key information about overweight and obesity among the adult population (age 15 or older) in Switzerland, based on data from the four cross sectional national surveys carried out so far.
- The development of overweight (BMI >25) over the period between 1992 and 2007 clearly shows that the part of the population suffering from overweight increased considerably over the last 15 years from 30.3% to 37.3% of the total Swiss population. This increase in overweight was caused by a predominant increase in the proportion of overweight individuals with BMI 25-30 by 4.3% (from 24.9% to 29.2%) and a concomitant increase of the obese population by 2.7% (from 5.4% to 8.1%).
- This development is particularly obvious in the male part of the population, whereas it appears that a steady state may have been reached in the female part of the population.
- Clearly, the presently available data on the prevalence of overweight and obesity in adults are not yet perfectly suited for an accurate forecasting. Nevertheless, based on the observed development in the prevalence in overweight and obesity since the early nineties until last year, a stabilization at or only slightly above the present levels may be expected when using a logistic regression model.

Future projections until 2022

- Indeed, projection of the further development from 2007 until 2022 based on the prevalence data from 1992 to 2007 by a nonlinear curve fitting approach following a 3-parameter logistic function, yields an estimated minimal increase to 37.7% (from 37.3%) in the adult Swiss population with BMI \geq 25. This projection indicates, that the development of overweight in the entire Swiss population may have already reached its peak as the expected minimal



increase in overweight prevalence in the coming 15 year period remains within the uncertainty of the evaluation method. The total overweight population (BMI ≥ 25) as well as the obese population segment (BMI ≥ 30) may be expected to basically stabilize between 2007 and 2022 at about the 2007 level.

- In the adult Swiss male population with BMI ≥ 25 the projected development until 2022 reached an approximate prevalence of 48.7% (from 46.4% in 2007). The expected prevalence of 8.3% in 2022 (down from 8.6% in 2007) in the obese population segment (BMI ≥ 30) underscores the likelihood that the increase in the obese male Swiss population has come to a virtual halt. Again, if confirmed by future prevalence findings, it appears that the overweight segment of the Swiss male population may begin to stabilize in the coming 15 years on a high level just below 50%.
- Anticipation of the further development until 2022 shows a potential prevalence of 29.0% in the adult female Swiss population with BMI ≥ 25 , virtually unchanged compared to 28.6% in 2007. The estimated prevalence in 2022 in the female obese population segment (BMI ≥ 30) is anticipated to slightly decrease to 7.3% from 7.7% in 2007. It appears that the female overweight segment of the Swiss population has already reached a stable level since about 2000 and may remain at this level over the next 15 years.
- **In conclusion**, although the results of coming surveys are required to confirm the predicted levelling off in prevalence, it appears that the peak level in the adult overweight and obese segment of the Swiss population may be reached in the near future, i.e. the next few years, or – under best circumstances – may have been passed already.

Health problems associated with overweight and obesity

- In our previous report on the economic burden of overweight and obesity in Switzerland, we identified 26 different diseases as overweight- and obesity-related comorbidities. In the present study this number was slightly increased to 32 diseases owing to the fact, that more information on the relationship between obesity and yet other diseases is reported every year.
- In 2004 we were able to assign costs to 18 diseases considered as comorbidities clearly associated with obesity. In the present study we evaluated a smaller number of comorbidities, i.e. 12, as cost-relevant diseases for Switzerland. Irrespective of this restriction, the total (obesity-linked) disease costs of overweight and obesity in Switzerland more than doubled from CHF 2'648 (cost basis 2001) to CHF 5'755 Mio (cost basis 2006).



Economic burden of overweight and obesity in 2007

- Four diseases, diabetes Type 2, coronary heart disease, osteoarthritis (knee & hip) and asthma, did amount to a total sum of CHF 4'548 Mio representing 79% of the total obesity-attributable health care costs.
- In our previous study, costs estimates of only three obesity-linked comorbidities were based on actual Swiss cost data. The present economic evaluation relies on seven Swiss based cost estimates, three of them (diabetes Type 2, coronary heart disease and asthma) belonging to the top four with regard to cost relevance.
- The direct overweight- and obesity-linked disease costs of CHF 3'830 million represent about 7.3% of the total healthcare expenses in Switzerland of CHF 52.7 billions in 2006 (Bundesamt für Statistik 2007).
- The exclusively obesity-linked costs (direct comorbidity costs only) of CHF 1'866 Mio represent about 0.38% of the national gross domestic product (GDP) of CHF 486.2 billions in 2006. According to a recent study on the health-economic burden of obesity in Europe, the estimated obesity-related costs range from 0.09 to 0.61% of the total annual gross domestic income in Western European countries. Thus, our results for Switzerland are comparable to estimates from other European countries.

Conclusions and recommendations

- A clear implication of our findings is that the observed rapid increase in prevalence of overweight and obesity in Switzerland over the past two decades is slowing down at a relatively high level for men (~50% of the total adult male population) and a lower but still substantial level for women (~30% of the total adult female population).
- What does such a development mean for the Swiss population in general and for the Swiss health care system in particular? Is it acceptable that a substantial percentage of the Swiss population is and shall remain overweight or obese? Are the high health care costs occurring in this segment of the population acceptable to the rest of the population? These questions will have to be answered in the years to come.
- Considering the epidemiological development over the coming two decades in Switzerland, we obviously need to allocate a significant amount of health care resources for the care of the elderly from the "baby boom generation". The present direct costs of close to CHF 4 billion attributable to overweight and obesity may thus represent too large a portion of the national health care budget to be acceptable as a fixed expenditure for the overweight and obese portion of the Swiss population at the projected level.



- In a previous study we have documented that lifestyle intervention leads safely to improvements in metabolic abnormalities such as increased body weight, dyslipidemia, elevated blood pressure and decreased insulin sensitivity that are linked to the development of obesity and obesity-linked diseases such as diabetes Type 2 and cardio-vascular disease. Furthermore, it was shown that lifestyle intervention is an effective prevention tool with beneficial effects maintained for more than three years.
- In addition, a previous economic analysis clearly indicated that lifestyle intervention is cost-effective in the long-term prevention and treatment of obesity. Thus, lifestyle intervention allows allocation of limited health care resources while ensuring that any additional cost is justified by the additional benefits such as increased survival duration and quality of life over lifetime.
- **In conclusion**, given the high cost attributable to obesity and associated comorbidities, we recommend that lifestyle interventions should be considered the first line therapy in prevention and treatment of obesity and that corrective programs/policies are implemented to avoid the inevitable consequences of accepting a large part of the Swiss population to remain overweight or obese.



KURZFASSUNG

Obwohl es offensichtlich erscheint, dass Adipositas ein ernsthaftes Problem für die öffentliche Gesundheit ist und bleibt, wurde bisher nur eine beschränkte Zahl von Studien veröffentlicht, die neben der derzeitigen Grössenordnung des Problems auch die künftigen Trends untersuchen und Prognosen bezüglich der erwarteten Prävalenzraten in den kommenden Jahrzehnten enthalten. Deshalb werden mit dieser Studie die folgenden Ziele angestrebt: a) Abschätzung der Kostenlast von Adipositas bei Erwachsenen in der Schweiz anhand der Prävalenzdaten der vierten Gesundheitsbefragung, die 2007 durchgeführt wurde, b) Vergleich mit den Daten zu den Krankheitskosten gestützt auf die Gesundheitsbefragung 2002 und c) Beurteilung von Trends, einschliesslich einer Prognose bis 2022, in der Entwicklung der Adipositas bei Erwachsenen in der Schweiz anhand einer Modellbildung.

Epidemiologie

- In diesem Bericht werden die wichtigsten Informationen zu Übergewicht und Adipositas bei Erwachsenen (ab dem Alter von 15 Jahren) in der Schweiz anhand von Daten aus den vier bisher durchgeführten bereichsübergreifenden nationalen Erhebungen präsentiert.
- Aus der beobachteten Entwicklung des Übergewichts (BMI >25) im Zeitraum von 1992 bis 2007 geht klar hervor, dass sich der Anteil der Bevölkerung, der an Übergewicht leidet, in den letzten 15 Jahren erheblich erhöht hat: Er stieg von 30,3% auf 37,3% der Gesamtbevölkerung der Schweiz. Diese Zunahme ist hauptsächlich auf einen Anstieg des Anteils der Übergewichtigen mit einem BMI von 25-30 um 4,3 Prozentpunkte (von 24,9% auf 29,2%) sowie auf eine gleichzeitige Erhöhung der Gruppe der adipösen Personen um 2,7 Prozentpunkte (von 5,4% auf 8,1%) zurückzuführen.
- Besonders ausgeprägt ist diese Entwicklung bei der männlichen Bevölkerung, während bei den Frauen möglicherweise ein stationärer Zustand erreicht wurde.
- Die gegenwärtig verfügbaren Daten zur Übergewichts- und Adipositasprävalenz bei Erwachsenen eignen sich noch nicht für genaue Prognosen. Wird ein logistisches Regressionsmodell angewandt, ist jedoch gestützt auf die beobachtete Entwicklung der Übergewichts- und Adipositasprävalenz seit Anfang der Neunzigerjahre bis 2007 eine Stabilisierung auf dem derzeitigen Niveau oder knapp darüber zu erwarten.

Vorausschätzungen bis 2022

- Die künftige Entwicklung von 2007 bis 2022 wurde anhand der Prävalenzdaten von 1992 bis 2007 mittels einer nichtlinearen Kurvenanpassung nach einer logistischen Funktion mit drei Parametern vorausgeschätzt. Für die



Erwachsenen mit einem BMI ≥ 25 in der Schweiz ergab sich dabei ein geschätzter minimaler Anstieg auf 37,7% (Ausgangswert: 37,3%). Diese Vorausschätzung weist darauf hin, dass die Entwicklung des Übergewichts in der Gesamtbevölkerung der Schweiz möglicherweise bereits ihren Gipfel erreicht hat, da sich die erwartete minimale Erhöhung der Übergewichtsprävalenz innerhalb der nächsten 15 Jahren innerhalb der Unsicherheit der Schätzmethode bewegt. Grundsätzlich kann davon ausgegangen werden, dass sich sowohl die Gesamtgruppe der Übergewichtigen (BMI ≥ 25) als auch das Segment der adipösen Personen (BMI ≥ 30) zwischen 2007 und 2022 etwa auf dem Niveau von 2007 stabilisiert.

- Für die männlichen Erwachsenen mit einem BMI ≥ 25 in der Schweiz wird gemäss der vorausgeschätzten Entwicklung bis 2022 mit einer ungefähren Prävalenz von 48,7% (ausgehend von 46,4% im Jahr 2007) gerechnet. Die erwartete Prävalenz von 8,3% im Jahr 2022 (ausgehend von 8,6% im Jahr 2007) für das Segment der adipösen Personen (BMI ≥ 30) stützt die Annahme, dass bei den adipösen Männern in der Schweiz praktisch kein Anstieg mehr zu verzeichnen ist. Wird dies durch künftige Prävalenzdaten bestätigt, könnte es sein, dass sich der Anteil der Übergewichtigen an der männlichen Bevölkerung der Schweiz in den nächsten 15 Jahren auf einem hohen Niveau von knapp 50% zu stabilisieren beginnt.
- Die Prognose der weiteren Entwicklung bis 2022 ergibt für die erwachsenen Frauen mit einem BMI ≥ 25 in der Schweiz eine potenzielle Prävalenz von 29,0% und somit im Vergleich zu den 28,6% im Jahr 2007 praktisch keine Veränderung. Die für das Jahr 2022 geschätzte Prävalenz von 7,3% für das Segment der adipösen Frauen (BMI ≥ 30) entspricht einer geringen Abnahme gegenüber 2007 (7,7%). Es scheint somit, dass der Anteil der übergewichtigen Frauen an der Bevölkerung der Schweiz schon etwa seit dem Jahr 2000 stabil ist und in den nächsten 15 Jahren auf diesem Niveau bleiben dürfte.
- **Abschliessend** sind zwar die Resultate künftiger Befragungen notwendig, um die vorausgesagte Abflachung der Prävalenzkurve zu bestätigen, doch die Anteile der übergewichtigen und adipösen Erwachsenen an der Bevölkerung der Schweiz scheinen möglicherweise in naher Zukunft, d. h. in den nächsten paar Jahren, ihren Spitzenwert zu erreichen oder diesen – im besten Fall – bereits überschritten zu haben.

Mit Übergewicht und Adipositas verbundene Gesundheitsprobleme

- In unserem früheren Bericht zum volkswirtschaftlichen Schaden von Übergewicht und Adipositas in der Schweiz haben wir 26 verschiedene Krankheiten als Komorbiditäten von Übergewicht und Adipositas eruiert. In der vorliegenden Studie erhöhte sich diese Zahl leicht auf 32 Krankheiten, da



jedes Jahr neue Informationen zum Zusammenhang zwischen Adipositas und weiteren Krankheiten verfügbar werden.

- 2004 konnten wir die Kosten von 18 Krankheiten zuweisen, die als Komorbiditäten gelten, bei denen ein klarer Zusammenhang zu Adipositas besteht. In der vorliegenden Studie beurteilten wir eine geringere Zahl von Komorbiditäten, d. h. zwölf, als kostenrelevante Krankheiten für die Schweiz. Ungeachtet dieser Einschränkung stiegen die gesamten (mit Adipositas verbundenen) Krankheitskosten von Übergewicht und Adipositas in der Schweiz von CHF 2648 Mio. (Kostenbasis 2001) auf CHF 5755 Mio. (Kostenbasis 2006), was mehr als einer Verdoppelung entspricht.

Volkswirtschaftlicher Schaden von Übergewicht und Adipositas 2007

- Für vier Krankheiten – Diabetes Typ 2, koronare Herzkrankheiten, Osteoarthritis (Knie und Hüfte) und Asthma – ergab sich eine Gesamtsumme von CHF 4548 Mio., was 79% der gesamten Gesundheitskosten entspricht, die sich Adipositas zuschreiben lassen.
- In unserer früheren Studie beruhten nur die Kostenschätzungen zu drei Komorbiditäten von Adipositas auf effektiven Kostendaten aus der Schweiz. Die vorliegende volkswirtschaftliche Analyse stützt sich auf sieben Kostenschätzungen anhand von Daten aus der Schweiz; drei davon (Diabetes Typ 2, koronare Herzkrankheiten und Asthma) gehören bezüglich der Kostenrelevanz zu den vier wichtigsten Krankheiten.
- Die direkt mit Übergewicht und Adipositas verbundenen Krankheitskosten von CHF 3830 Millionen entsprechen etwa 7,3% der gesamten Gesundheitskosten der Schweiz, die sich 2006 auf CHF 52,7 Milliarden beliefen (Bundesamt für Statistik 2007).
- Die ausschliesslich mit Adipositas verbundenen Kosten (nur direkte Komorbiditätskosten) von CHF 1866 Mio. entsprechen etwa 0,38% des Bruttoinlandprodukts (BIP) von CHF 486,2 Milliarden im Jahr 2006. Gemäss einer kürzlich durchgeführten Studie zur gesundheitsökonomischen Belastung durch Adipositas in Europa liegen die geschätzten mit Adipositas verbundenen Kosten zwischen 0,09 und 0,61% des gesamten jährlichen Bruttoinlandkommens der westeuropäischen Länder. Unsere Resultate für die Schweiz sind somit mit den Schätzungen aus anderen europäischen Ländern vergleichbar.

Schlussfolgerungen und Empfehlungen

- Unsere Feststellungen weisen klar darauf hin, dass sich der rasche Anstieg der Übergewichts- und Adipositasprävalenz, der in den letzten zwei Jahrzehnten in der Schweiz zu beobachten war, verlangsamt und dass sich die



Prävalenz bei den Männern auf einem relativ hohen Niveau (~50% der erwachsenen männlichen Bevölkerung) und bei den Frauen auf einem tieferen, aber immer noch erheblichen Niveau einpendelt (~30% der erwachsenen weiblichen Bevölkerung).

- Was bedeutet eine derartige Entwicklung für die Bevölkerung der Schweiz im Allgemeinen und für das Gesundheitssystem im Besonderen? Ist es akzeptabel, dass ein erheblicher Prozentsatz der Bevölkerung der Schweiz übergewichtig oder adipös ist und bleiben wird? Sind die hohen Gesundheitskosten, die in dieser Bevölkerungsgruppe entstehen, für den Rest der Bevölkerung annehmbar? Diese Fragen müssen in den kommenden Jahren beantwortet werden.
- Angesichts der epidemiologischen Entwicklung in den nächsten zwei Jahrzehnten werden wir in der Schweiz einen erheblichen Teil der Ressourcen des Gesundheitssystems für die Versorgung der älteren Menschen der "Babyboom"-Generation einsetzen müssen. Die derzeitigen direkten Kosten von beinahe CHF 4 Milliarden, die sich Übergewicht und Adipositas zuschreiben lassen, könnten somit einen zu hohen Teil des nationalen Gesundheitsbudgets darstellen, um im hochgerechneten Umfang als laufende Ausgaben für den übergewichtigen und adipösen Teil der Schweizer Bevölkerung akzeptabel zu sein.
- In einer früheren Studie haben wir dokumentiert, dass auf den Lebensstil ausgerichtete Massnahmen zu Verbesserungen bei Stoffwechselstörungen wie erhöhtes Körpergewicht, Dyslipidämie, Hypertonie und verminderte Insulinempfindlichkeit führen, die mit der Entwicklung von Adipositas und Folgeerkrankungen von Adipositas wie Diabetes Typ 2 und Herz-Kreislauf-Erkrankungen verbunden sind. Zudem wurde aufgezeigt, dass Massnahmen zur Veränderung des Lebensstils ein wirksames Präventionsinstrument sind, dessen positive Auswirkungen mehr als drei Jahre lang anhalten.
- Zusätzlich ergab eine frühere volkswirtschaftliche Analyse eindeutig, dass auf den Lebensstil ausgerichtete Massnahmen zur Langzeitprävention und Behandlung von Adipositas kostenwirksam sind. Massnahmen zur Veränderung des Lebensstils ermöglichen somit die Zuteilung von beschränkten Ressourcen des Gesundheitssystems, während zugleich sichergestellt wird, dass zusätzliche Kosten durch zusätzlichen Nutzen wie längere Überlebensdauer und Lebensqualität über die gesamte Lebenszeit gerechtfertigt wird.
- **Abschliessend** empfehlen wir angesichts der hohen Kosten, die sich Übergewicht und Adipositas zuschreiben lassen, auf den Lebensstil ausgerichtete Massnahmen als Mittel der Wahl zur Prävention und Behandlung von Adipositas zu betrachten und Abhilfeprogramme/-strategien vorzusehen, um den unausweichlichen Folgen vorzubeugen, die sich ergeben



werden, wenn einfach hingenommen wird, dass ein grosser Teil der Bevölkerung übergewichtig oder adipös bleibt.

SYNTHÈSE

S'il ne fait pas de doute que l'obésité constitue un grave problème de santé publique, il n'existe qu'un nombre limité d'études publiées qui, en plus d'évoquer l'ampleur actuelle du problème, portent sur les évolutions à venir et proposent des estimations des taux de prévalence dans les prochaines décennies. La présente étude a donc pour objectifs a) d'estimer les coûts liés à l'obésité chez l'adulte en Suisse en se fondant sur les données relatives à la prévalence tirées de la quatrième Enquête suisse sur la santé menée en 2007, b) de les comparer aux données sur les dépenses de santé évaluées d'après l'Enquête suisse sur la santé réalisée en 2002 et c) d'évaluer, dans le cadre d'une modélisation, l'évolution future de l'obésité chez l'adulte en Suisse, en incluant des prévisions jusqu'en 2022.

Épidémiologie

- Le présent rapport fournit des informations-clés sur le surpoids et l'obésité parmi la population adulte (à partir de 15 ans) en Suisse en s'appuyant sur des données provenant des quatre enquêtes transversales nationales menées à ce jour.
- L'évolution du surpoids (IMC ≥ 25) entre 1992 et 2007 indique clairement que la part de la population souffrant de surcharge pondérale a considérablement augmenté durant les 15 dernières années, passant de 30,3 % à 37,3 % de l'ensemble de la population suisse. Cette hausse est due à la forte augmentation (+ 4,3 points de base) de la proportion de personnes en surpoids avec un IMC de 25 à 30 (qui est passée de 24,9 % à 29,2 %) et à l'augmentation concomitante de 2,7 points de base de la population obèse (qui est passée de 5,4 % à 8,1 %).
- Cette évolution est particulièrement manifeste au sein de la population de sexe masculin alors qu'il semble que les chiffres se soient stabilisés dans la population de sexe féminin.
- De toute évidence, les données actuellement disponibles sur la prévalence du surpoids et de l'obésité chez l'adulte ne permettent pas encore d'établir des prévisions précises. Néanmoins, en se basant sur l'évolution de la prévalence du surpoids et de l'obésité du début des années 90 jusqu'à l'année dernière, on peut prévoir une stabilisation au même niveau ou à un niveau tout au plus légèrement supérieur, et ce, en s'appuyant sur un modèle de régression logistique.



Projections jusqu'en 2022

- En effet, en estimant l'évolution du surpoids et de l'obésité entre 2007 et 2022, à partir des données de prévalence de 1992 à 2007, en appliquant une méthode d'ajustement non-linéaire suivant une fonction logistique à trois paramètres, l'on obtient une faible augmentation de la proportion d'adultes en Suisse présentant un IMC ≥ 25 , de 37,3 % à 37,7 %. Cette projection met en évidence le fait que la progression du surpoids dans l'ensemble de la population suisse pourrait déjà avoir atteint son pic, d'autant que la faible augmentation de la prévalence du surpoids prévue pour les 15 années à venir se situe dans la marge d'incertitude de la méthode d'évaluation utilisée. On peut s'attendre à ce qu'entre 2007 et 2022, l'ensemble de la population en surpoids (IMC ≥ 25) tout comme le segment de population obèse (IMC ≥ 30) se stabilise à peu près au niveau de 2007.
- S'agissant de la population suisse adulte de sexe masculin avec un IMC ≥ 25 , l'évolution projetée jusqu'en 2022 a atteint une prévalence d'environ 48,7 % (contre 46,4 % en 2007). La prévalence de 8,3 % prévue pour 2022 (inférieure aux 8,6 % de 2007) dans le segment de population obèse (IMC ≥ 30) souligne qu'il est probable que le nombre d'hommes obèses en Suisse a quasiment cessé d'augmenter. De même, si les prévalences constatées à l'avenir le confirment, il se pourrait que le segment d'hommes en surpoids en Suisse commence à se stabiliser à un niveau élevé, légèrement inférieur à 50 %, dans les 15 prochaines années.
- Si l'on anticipe l'évolution jusqu'en 2022, il en résulte une prévalence potentielle de 29 % au sein de la population suisse adulte de sexe féminin avec un IMC ≥ 25 , pratiquement la même qu'en 2007 (28,6 %). On prévoit qu'en 2022, la prévalence du segment de femmes obèses (IMC ≥ 30) diminuera légèrement par rapport à 2007, passant de 7,7 % à 7,3 %. Il semble que le segment de femmes en surpoids en Suisse ait déjà atteint un niveau stable depuis l'an 2000 environ et qu'il pourrait rester à ce niveau durant les 15 prochaines années.
- **En conclusion**, même si les résultats des prochaines enquêtes sont nécessaires pour confirmer la diminution prévue de la prévalence, il semble que le segment d'adultes en surpoids et obèses en Suisse pourrait atteindre son point culminant dans un avenir proche, c.-à-d. dans les prochaines années, ou – dans le meilleur des cas – pourrait déjà l'avoir atteint.

Problèmes de santé associés à la surcharge pondérale et à l'obésité

- Dans notre précédent rapport sur le fardeau économique découlant de la surcharge pondérale et de l'obésité en Suisse, nous avons identifié 26



maladies comme des comorbidités liées au surpoids et à l'obésité. Dans la présente étude, leur nombre a légèrement augmenté, passant à 32 maladies en raison du plus grand nombre d'informations rassemblées chaque année sur le lien entre l'obésité et d'autres maladies.

- En 2004, nous avons pu déterminer les coûts de 18 maladies considérées comme des comorbidités clairement associées à l'obésité. Dans la présente étude, nous avons examiné un nombre restreint de comorbidités, 12 en tout, en tant que maladies ayant un impact sur les coûts en Suisse. Sans tenir compte de cette restriction, l'ensemble des dépenses de santé (liées à l'obésité) résultant du surpoids et de l'obésité en Suisse a plus que doublé, passant de 2648 millions de francs (base en 2001) à 5755 millions de francs (base en 2006).

Fardeau économique découlant de la surcharge pondérale et de l'obésité en 2007

- Quatre maladies – diabète de type 2, maladie coronarienne, ostéoarthrose (genou et hanche) et asthme – ont totalisé des coûts s'élevant à 4548 millions de francs, ce qui représente 79 % de l'ensemble des coûts de santé attribuables à l'obésité.
- Dans notre précédente étude, les coûts de trois comorbidités liées à l'obésité seulement avaient été estimés d'après des données actuelles sur les coûts en Suisse. La présente évaluation économique se fonde sur sept estimations de coûts en Suisse, trois d'entre elles (diabète de type 2, maladie coronarienne et asthme) appartenant aux quatre principales maladies en termes de coûts.
- D'un montant de 3830 millions de francs, les coûts de santé directement liés au surpoids et à l'obésité représentent environ 7,3 % du total des dépenses de santé en Suisse qui s'élevaient à 52,7 milliards de francs en 2006 (Office fédéral de la statistique 2007).
- Les coûts exclusivement liés à l'obésité (coûts de comorbidité directs uniquement), d'un montant de 1866 millions de francs, représentent environ 0,38 % du produit intérieur brut (PIB) qui s'élevait à 486,2 milliards de francs en 2006. Selon une étude récente sur les coûts sanitaires et économiques de l'obésité en Europe, les coûts liés à l'obésité sont estimés entre 0,09 et 0,61 % du revenu intérieur brut annuel dans les pays européens occidentaux. Ainsi, nos résultats pour la Suisse sont comparables aux estimations provenant d'autres pays européens.



Conclusions et recommandations

- Les données présentées impliquent clairement que l'augmentation rapide de la prévalence du surpoids et de l'obésité en Suisse observée durant les vingt dernières années ralentit pour atteindre un niveau relativement élevé pour les hommes (~50 % de l'ensemble de la population adulte de sexe masculin) et un niveau important, bien que plus faible, pour les femmes (~30 % de l'ensemble de la population adulte de sexe féminin).
- Que signifie une évolution de cette nature pour la population suisse en général et pour le système de santé suisse en particulier ? Est-il acceptable qu'un pourcentage important de la population suisse reste en surpoids ou obèse ? Les coûts élevés des soins de santé pour ce segment de la population sont-ils acceptables pour le reste de la population ? Telles sont les questions auxquelles il conviendra d'apporter des réponses dans les années à venir.
- Compte tenu de l'évolution épidémiologique au cours des vingt prochaines années en Suisse, nous devons manifestement allouer des ressources importantes aux soins de santé destinés aux personnes âgées de la « génération du baby boom ». S'élevant actuellement à près de 4 milliards de francs, les coûts directs attribuables au surpoids et à l'obésité pourraient donc représenter une part bien trop grande du budget national attribué aux soins pour qu'ils soient acceptés, au niveau projeté, en tant que dépenses fixes pour la part des personnes en surpoids et obèses en Suisse.
- Dans une précédente étude, nous avons attesté qu'une intervention sur le mode de vie améliorerait de façon certaine les anomalies métaboliques telles que l'excès de charge pondérale, la dyslipidémie, la tension artérielle élevée ou la baisse de la sensibilité à l'insuline qui sont liées au développement de l'obésité et aux maladies associées à l'obésité comme le diabète de type 2 et les maladies cardio-vasculaires. De plus, il a été démontré que l'intervention sur le mode de vie était un moyen de prévention efficace dont les bénéfices durent plus de trois ans.
- Par ailleurs, une précédente analyse économique a clairement indiqué que l'intervention sur le mode de vie est rentable en matière de prévention à long terme et dans le traitement de l'obésité. Ainsi, l'intervention sur le mode de vie permet d'allouer des ressources limitées pour les soins de santé tout en assurant que chaque coût supplémentaire est justifié par un bénéfice supplémentaire tel que l'augmentation de la durée de vie et la qualité de la vie.
- **En conclusion**, étant donné les coûts élevés imputables à l'obésité et aux comorbidités qui lui sont associées, nous recommandons de considérer les interventions sur le mode de vie comme une thérapie majeure dans la



prévention et le traitement de l'obésité ainsi que de mettre en place des politiques et des programmes correctifs pour pallier les conséquences qu'entraîne inévitablement le fait d'accepter qu'une grande part de la population suisse reste en surpoids ou obèse.



SINTESI

Per quanto sia evidente a tutti che l'adiposità è e rimane un grave problema di sanità pubblica, sono pochi gli studi pubblicati che, oltre a trattare l'attuale dimensione del problema, affrontano il tema delle tendenze future e presentano previsioni sui tassi di prevalenza per i decenni a venire. Pertanto, gli obiettivi del presente studio sono: a) allestire una stima dei costi dell'adiposità in età adulta in Svizzera utilizzando come base i dati di prevalenza della quarta Indagine sulla salute eseguita nel 2007; b) confrontare la stima con i dati sul costo della malattia valutati sulla base della precedente Indagine sulla salute del 2002 e c) valutare le tendenze (compresa una previsione fino al 2022) dello sviluppo dell'adiposità in età adulta in Svizzera sulla base di un approccio modellistico.

Epidemiologia

- Questo rapporto presenta informazioni essenziali su sovrappeso e adiposità tra la popolazione adulta (dai 15 anni in poi) in Svizzera, utilizzando come base i dati delle quattro indagini trasversali finora realizzate a livello nazionale.
- Lo sviluppo del sovrappeso (BMI >25) nel periodo compreso tra il 1992 e il 2007 mostra chiaramente che la percentuale della popolazione colpita da tale problema è aumentata fortemente durante questo lasso di tempo, passando dal 30,3 % al 37,3 % del totale della popolazione svizzera. Tale dato è stato determinato da un preponderante aumento della percentuale di individui in sovrappeso con BMI 25-30 pari al 4,3 % (dal 24,9 al 29,2 %), nonché da un concomitante aumento della popolazione affetta da adiposità pari al 2,7 % (dal 5,4 all'8,1 %).
- Questo sviluppo è particolarmente evidente nella popolazione di sesso maschile, mentre nella popolazione di sesso femminile sembra essersi determinata una situazione stazionaria.
- Non c'è dubbio che i dati attualmente disponibili sulla prevalenza di sovrappeso e adiposità negli adulti non sono ancora perfettamente idonei per la formulazione di una previsione accurata. Ciononostante, basandosi sullo sviluppo osservato nella prevalenza di sovrappeso e adiposità a partire dall'inizio degli anni Novanta fino al 2007 e utilizzando un modello di regressione logistica, si può prevedere una stabilizzazione intorno o appena superiore agli attuali livelli.

Proiezioni future fino al 2022

- Una proiezione dell'ulteriore sviluppo dal 2007 al 2022, basata sui dati di prevalenza 1992-2007 attraverso un approccio non lineare curve fitting e seguendo un modello logistico a 3 parametri, fornisce un aumento minimo stimato fino al 37,7 % (rispetto al 37,3 %) nella popolazione adulta svizzera



con BMI ≥ 25 . Da questa proiezione si deduce che lo sviluppo del sovrappeso nell'insieme della popolazione svizzera potrebbe aver già raggiunto la sua punta massima, considerato che l'aumento minimo previsto della prevalenza del sovrappeso nei prossimi 15 anni rimane entro il margine d'incertezza del metodo di valutazione. Pertanto, è lecito presumere che il totale della popolazione in sovrappeso (BMI ≥ 25) e il segmento di popolazione affetta da adiposità (BMI ≥ 30), sostanzialmente, si stabilizzino tra il 2007 e il 2022 all'incirca al livello del 2007.

- Nella popolazione maschile adulta svizzera con BMI ≥ 25 , lo sviluppo stimato fino al 2022 ha raggiunto una prevalenza approssimativa del 48,7 % (rispetto al 46,4 % nel 2007). Nel segmento di popolazione affetta da adiposità (BMI ≥ 30), la prevista prevalenza dell'8,3 % nel 2022 (in calo rispetto all'8,6 % nel 2007) rende ancora più probabile l'ipotesi che l'aumento della popolazione maschile svizzera affetta da adiposità abbia di fatto subito un arresto. I risultati futuri sulla prevalenza potrebbero fornire un'ulteriore conferma dell'inizio di una stabilizzazione su un livello elevato di poco inferiore al 50 % del segmento in sovrappeso della popolazione maschile svizzera.
- La previsione dello sviluppo atteso fino al 2022 mostra una prevalenza potenziale del 29,0 % nella popolazione femminile adulta svizzera con BMI ≥ 25 , praticamente invariato in confronto al 28,6 % del 2007. La prevalenza stimata per il 2022 nel segmento della popolazione femminile affetta da adiposità (BMI ≥ 30) è in leggera diminuzione: 7,3 % rispetto al 7,7 % nel 2007. Risulta quindi che il segmento femminile in sovrappeso della popolazione svizzera ha già raggiunto dal 2000 circa un livello stabile che potrebbe mantenersi invariato per i prossimi 15 anni.
- **Conclusioni.** Per quanto sia necessario che i risultati delle future indagini confermino la prevista stabilizzazione della prevalenza, emerge che il livello massimo del segmento della popolazione svizzera adulta in sovrappeso e affetta da adiposità potrebbe essere raggiunto in un futuro vicino, ossia nei prossimi anni, oppure, nell'ipotesi più favorevole, essere già stato superato.

Problemi di salute associati al sovrappeso e all'adiposità

- Nel nostro precedente rapporto sugli oneri economici del sovrappeso e dell'adiposità in Svizzera abbiamo identificato 26 diverse malattie che costituiscono comorbidità collegate a sovrappeso e adiposità. Nel presente studio questo numero è leggermente aumentato, passando a 32. Ciò è dovuto alla maggiore quantità di informazioni messe a disposizione ogni anno sulla relazione tra adiposità e altre malattie.
- Nel 2004, siamo riusciti a definire i costi di 18 malattie considerate comorbidità chiaramente associate all'adiposità. Nel presente studio abbiamo valutato un numero ridotto di comorbidità, ossia 12, che costituiscono malattie onerose in



termini di costi per la Svizzera. Senza tener conto di questa limitazione, i costi complessivi (associati all'adiposità) di sovrappeso e adiposità in Svizzera sono più che raddoppiati, passando da 2648 (base 2001) a 5755 (base 2006) mln di franchi.

Oneri economici del sovrappeso e dell'adiposità nel 2007

- I costi riconducibili a quattro malattie, ossia il diabete di tipo 2, la cardiopatia coronarica, l'osteoartrite (ginocchio e anca) e l'asma, si sono elevati a un totale di 4548 mln di franchi, pari al 79 % dei costi sanitari complessivi dovuti all'adiposità.
- Nel nostro precedente studio, le stime dei costi di tre sole comorbidità associate all'adiposità erano basate sui dati dei costi svizzeri effettivi. La presente valutazione economica si fonda su sette stime dei costi che utilizzano dati relativi alla Svizzera. Tre di queste stime si riferiscono al diabete di tipo 2, alla cardiopatia coronarica e all'asma, comprese tra le quattro malattie più costose.
- I costi delle malattie direttamente associate al sovrappeso e all'adiposità, pari a 3830 milioni di franchi, rappresentano il 7,3 % circa del totale delle spese sanitarie in Svizzera, che nel 2006 ammontavano a 52,7 miliardi di franchi (Ufficio federale di statistica 2007).
- I costi esclusivamente associati all'adiposità (solo costi della comorbidità diretta), pari a 1866 mln di franchi, rappresentano lo 0,38 % circa del prodotto interno lordo (PIL) nazionale, che nel 2006 ammontava a 486,2 miliardi di franchi. Secondo uno studio recente sugli oneri sanitari ed economici legati all'adiposità in Europa, la stima dei costi collegati oscilla tra lo 0,09 e lo 0,61 % dell'intero reddito interno lordo annuo nei Paesi dell'Europa occidentale. I nostri risultati concernenti la Svizzera sono comparabili alle stime valide per gli altri Paesi europei.

Conclusioni e raccomandazioni

- I risultati cui siamo giunti permettono di affermare con sicurezza che il rapido aumento osservato nella prevalenza del sovrappeso e dell'adiposità in Svizzera nel corso degli ultimi due decenni sta rallentando. La prevalenza rimane a livelli relativamente alti per gli uomini (~50 % dell'intera popolazione maschile adulta) e a un livello inferiore, ma pur sempre consistente, per le donne (~30 % dell'intera popolazione femminile adulta).
- Che cosa significa una tale evoluzione per la popolazione svizzera in generale e per il sistema sanitario svizzero in particolare? Si può accettare che una percentuale consistente della popolazione svizzera sia e resti in sovrappeso o affetta da adiposità? Gli elevati costi sanitari che si registrano in questo



segmento della popolazione possono essere accettati dal resto della popolazione? Nei prossimi anni queste domande dovranno trovare risposta.

- Considerando l'evoluzione epidemiologica dei due prossimi decenni in Svizzera, se ne deduce che sarà sicuramente necessario destinare una parte consistente di risorse sanitarie alla cura delle persone anziane della «generazione del baby boom». Gli attuali costi diretti di circa 4 miliardi di franchi, riconducibili al sovrappeso e all'adiposità, potrebbero quindi rappresentare una parte troppo importante del budget sanitario nazionale per essere accettabile come spesa fissa da destinare alla percentuale prevista di popolazione svizzera in sovrappeso e affetta da adiposità.
- In un precedente studio abbiamo dimostrato che gli interventi sullo stile di vita portano sicuramente a un miglioramento di alterazioni metaboliche quali l'aumento ponderale, la dislipidemia, la pressione sanguigna elevata e la ridotta insulino-sensibilità, associate allo sviluppo di adiposità e malattie collegate, quali il diabete tipo 2 e le malattie cardiovascolari. Inoltre, è stato dimostrato che gli interventi sullo stile di vita sono uno strumento di prevenzione efficace, i cui benefici effetti hanno una durata superiore a tre anni.
- Oltre a ciò, una precedente analisi economica ha indicato chiaramente che gli interventi sullo stile di vita sono efficaci in termini di costi nella prevenzione a lungo termine e nel trattamento dell'adiposità. In questo modo, gli interventi sullo stile di vita consentono di utilizzare risorse sanitarie limitate e, al tempo stesso, garantiscono che ogni costo aggiuntivo è giustificato da vantaggi aggiuntivi, quali una maggiore durata e una migliore qualità della vita.

Conclusioni. Visti i costi elevati riconducibili ad adiposità e comorbidità associate, raccomandiamo di considerare gli interventi sullo stile di vita come terapia di prima linea nella prevenzione e nel trattamento dell'adiposità e di realizzare politiche/programmi correttivi, utili a evitare le immancabili conseguenze implicite nell'accettare che una gran parte della popolazione svizzera resti in sovrappeso o affetta da adip

1. INTRODUCTION

Obesity has been identified as a worldwide epidemic for more than two decades and yet the numbers of overweight and obese adults continue to grow among virtually all age groups, including pre-school and school-age children. Particularly worrisome is the fact that among European school-age children (as an indicator of trends among older children and, eventually, adults in the decades to come), the prevalence rates of overweight are not only rising, but appear to be accelerating (1). It is most alarming that the current prevalence rate of childhood obesity is more than 10 times higher than it was in the 1970s. By 2010 it is estimated that 26 million children in the EU countries will be overweight, including 6.4 million who will be obese (2).

Switzerland is no exception in the context of the other European countries. Data from the third Health Survey conducted by the Swiss Federal Institute of Statistics in 2002 showed that the prevalence of obesity in the general adult population defined as a body mass index (BMI) of 30 or higher had increased by approximately 2% points since the previous Health Survey from 1992/93 (3). Public polls, however, have limitations because they are based on self-reported weight and height. Obesity prevalence estimates based on self-reported data tend to be lower than those based on measured data (4). Thus, the true increase in adult obesity in Switzerland in the 1990s may have been somewhat higher.

Goals of the present study are to

- assess the cost burden of adult obesity based on the prevalence data from the fourth Health Survey carried out in 2007 and to compare it to the cost of illness data evaluated on the basis of the previous Health Survey from 2002 (3), and,
- evaluate trends including a forecast until 2022 in the development of adult obesity in Switzerland based on the four Health Surveys conducted over a 15 year period from 1992 to 2007 by modelling approach

The present study will provide us with an answer, if the rate of increase in overweight and obesity, in Swiss children and adults, continues at the previously observed, alarming rate and how the situation in the next ten years may possibly look like. Furthermore, the economic burden related to overweight and obesity will be updated from our last estimate done in 2004. New scientific findings regarding the association of overweight and obesity with other, in particular chronic diseases will be evaluated to gain a more accurate picture regarding the development on the health care costs within this context.

Whatever the case may be, it is already obvious now that obesity threatens the health and well-being of individuals to a considerable degree and places an increasing burden on the Swiss society in terms of health care costs, on employers through a rise in lost productivity and on families because of the increasing burden of long-term chronic disability.



2. METHODS

2.1 Definition of overweight and obesity

Overweight and obesity are defined via the body mass index, which represents a measure of weight relative to height, defined as weight (kg) divided by height (m²). The BMI range for normal weight = 18.5–24.9kg/m²; overweight = 25–29.9kg/m², obese = 30–40kg/m² and morbidly obese ≥ 40kg/m². In the present study the above definitions of overweight and obesity were being applied.

2.2 Epidemiology

The Health Surveys for Switzerland is a series of surveys, first instituted in 1992/3 and carried out in 5 year intervals, is part of an overall program of surveys commissioned by the *Bundesamt für Gesundheit* (BAG) designed to provide regular information on various aspects of the nation's health. The data from the four Health Surveys conducted in 1992/3, 1997, 2002 were used to estimate the prevalence of overweight and obesity of the adult Swiss population. The results from the last survey from 2007 were used to calculate the actual numbers of Swiss population grouped by age, gender and BMI in the year 2007.

2.2.1 Trend analysis and forecast to 2022

Data from the four available Health Surveys for Switzerland were used to model recent trends in obesity and overweight prevalence. These data are available from 1992/3 to 2007 for the adult Swiss population. The trends discernible have been projected forward to 2022 using a non-linear regression model approach with a 3-parameter logistic function and analysed in relation to population estimates for 2022 to forecast the number and proportion of the population estimated to be obese and overweight, if the current trend continues. The results presented show the expected proportions of Swiss adults who will be overweight and obese in 2022. The obtained rates are plotted as a nonlinear curve.

2.3 Costs

Cost estimates are separated from those covering actual treatment costs of overweight and obesity per se and from estimates of costs related to comorbidities attributable to obesity including both direct and indirect costs. Direct costs comprise



all the costs that incur directly by treatment of overweight and obesity and by preventive measures to avoid obesity, e.g. medication, dietician and physician visits, surgical procedures, hospital stays and others. Indirect costs are represented by productivity losses (lost wages) caused by obesity-related work absenteeism, early retirement, and premature death before retirement age. However, work absenteeism, invalidity, or premature deaths related to obesity are predominantly linked to the occurrence of comorbidities. Therefore, all indirect costs were handled in the context of estimating the costs of these comorbidities whereas for overweight and obesity only direct treatment costs were estimated.

2.3.1 Direct costs

Direct costs comprise all the costs that incur directly by treatment, prevention, etc. of overweight and obesity, e.g. medication, physician visits, hospital stays etc. Indirect costs are productivity losses (lost wages) caused by the disease through work absenteeism, early retirement, and premature death. However, work absenteeism, invalidity, or (premature) deaths that occur in the context of obesity are essentially linked to the obesity-associated comorbidities. Therefore, all indirect costs were handled under cost estimates for comorbidities (see point 2.3.2 below) whereas for obesity and overweight only direct treatment costs were estimated. Obesity related direct costs were assessed by a top-down approach as it was not possible to exactly assign a certain resource use to an overweight person. The usual approach for treating overweight - diet modification and increased physical activity – cannot be linked to a certain monetary value and was therefore omitted. Visits to a physician occur mostly in the context of a comorbidity and are therefore included in this evaluation. For this reason, direct obesity related costs are restricted to prescribed medication, to consultations with nutritionists, and to bariatric surgical interventions. To estimate the total costs of drugs used in the treatment of obesity (Reductil[®], Xenical[®] and Accomplia[®]) the public price of the total volume sold in the year 2007 in Switzerland was used (information obtained from IMS Health, Zug, Switzerland). To calculate the annual costs for nutritional consultations associated to overweight, the number of these consultations in the year 2006 (provided by the Schweizerische Verband diplomierter ErnährungsberaterInnen) was multiplied with the monetary value according to the tariff contract between SVDE and Santésuisse dated 1.1.2002. This value was CHF 99.— for a first consultation and CHF 77.— for follow-up consultations. The costs of bariatric surgical interventions were estimated by multiplying the number of bariatric surgical procedures carried out in 2007 (provided by the Bundesamt für Statistik (BFS), Neuenburg) with the costs estimates for surgery derived via AP-DRG calculation (DRG 288 and 297; cost basis 2006) for the following CHOP-codes 44.31/ 44.38/ 44.39/ 44.68/ 44.69/ 44.93/ 44.94/ 44.95 and 44.96 in the indications E 66.0 and E 66.9. For total direct costs of obesity in Switzerland, the costs of medication, consultation, and surgery were aggregated.



2.3.2 Indirect costs

Several conditions are associated with overweight and obesity. They include, to mention the most important ones, type 2 diabetes, hypertension, coronary heart disease and stroke, metabolic syndrome, osteoarthritis, depression and cancer (5).

All data used for cost estimates related to comorbidities attributable to obesity, were extracted from current literature and/or official national statistics. The following 9 complications of obesity were included in the cost estimate: hypertension; Type II (non-insulin-dependent) diabetes mellitus (NIDDM); stroke; coronary heart disease (CHD); breast cancer; gallstones; osteoarthritis; depression; and road traffic accidents due to sleep apnea. Additional comorbidities partly attributable to obesity such as hypercholesterolemia, various cancers (colon, esophagus, pancreas, stomach, liver, prostate, uterus), gout, edemas or gastric reflux were not included because of low population attributable risks and/or missing cost data. To estimate the extent to which a disease and its management costs can be attributed to overweight and obesity the population attributable risks (PAR) was employed. We calculated the population attributable risks (PAR) based on odds ratios (OR) or the relative risk ratios (RR) for selected obesity related chronic diseases using the following equations:

$$PAR = \frac{p (OR - 1)}{p (OR - 1) + 1}$$

or

$$PAR = \frac{p (RR - 1)}{p (RR - 1) + 1}$$

PAR = population attributable risk, p = probability of being obese in a given population; OR = odds ratio for the specific chronic disease of an obese subject developing a disease and RR = relative risk ratio for the specific chronic disease of an obese subject developing a disease.

Odds ratios (OR) and relative risk ratios (RR) for the various diseases were taken from recently published literature concentrating on specific, new, and evidence-based findings and generally favouring a conservative approach. It was assumed that the relationship between obesity and a given comorbidity is comparable among Western countries. The calculated PAR was then applied to annual total costs (direct and indirect costs) of the selected obesity-related diseases mentioned. Data about disease costs were also extracted from the most recent existing literature using Swiss-specific cost data whenever available. Cost data were adjusted to the price level of 2006. This cost adaptation was made based on the consumer price (inflation) index in the health care sector (Bundesamt für Statistik 2008).



Table 1 Development of health care costs in Switzerland – changes on a yearly basis in % (*Bundesamt für Statistik 2008*)

1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
2.0	4.2	3.2	4.2	6.4	4.0	4.0	3.5	2.0	1.4

<http://www.bfs.admin.ch/bfs/portal/de/index/infothek/publ.Document.111650.pdf> accessed 8.9.2008

Where no Swiss cost data were available, data from industrial countries with comparable health care levels (predominantly from Germany) were substituted. Such cost data were adapted to Swiss conditions by using OECD purchasing power parities (PPPs) and by converting costs according to actual population numbers. PPPs are currency conversion rates that both convert to a common currency and equalise the purchasing power of different currencies, i.e. the differences in price levels between countries in the process of conversion are being eliminated. Finally, costs were adjusted to price levels of 2006. Included in these total cost estimates of the various diseases were always direct as well as indirect costs. Estimates for both overweight and obesity were calculated separately.



3. RESULTS

3.1 Prevalence of overweight and obesity in adults in Switzerland: evolution from 1992/93 to 2007

All estimates in this study are based upon prevalence data from the four telephone surveys “Schweizerische Gesundheitsbefragung” carried out by the Bundesamt für Statistik (BFS) between 1992 and 2007. Overweight was defined as BMI (body mass index) 25 - 29.9kg/m² and obesity as BMI ≥ 30kg/m². It is known, however, that public polls have limitations because they are based on self-reported weight and height. On average, body weight is underestimated and body height overestimated (6).

A first survey (*Schweizerische Gesundheitsbefragung 1992/93*) conducted in 1992/93 involved 15'288 people (age ≥ 15) across Switzerland (representative random sample, quota of participants 71 %) (7). The observed prevalence for obesity was 5.6%, for overweight 25.9% (Table 2).

Table 2 Schweizerische Gesundheitsbefragung 1992/93 (7)

age	Overweight BMI 25 - 29.9		Obesity BMI ≥ 30	
	females %	males %	females %	Males %
15-24	6.1	11.8	0.7	1.1
25-34	9.4	26.0	2.4	3.8
35-44	13.7	34.5	4.3	5.3
45-54	19.0	41.7	5.4	8.8
55-64	27.8	48.7	8.7	10.7
>64	30.3	41.6	7.9	8.5
Total		25.9		5.6

The second survey (*Schweizerische Gesundheitsbefragung 1997*) was conducted in 1997 and involved 13'004 people (age ≥ 15) across Switzerland (representative random sample, quota of participants 69%) (8). The observed prevalence for obesity was 7.0%, for overweight 28.5% (Table 3).



Table 3 Schweizerische Gesundheitsbefragung 1997 (8)

age	Overweight BMI 25 - 29.9		Obesity BMI ≥ 30	
	females %	males %	females %	Males %
15-34	11.0	19.7	2.7	3.7
35-49	18.9	39.5	5.5	5.7
50-64	29.1	49.0	11.4	10.7
>64	32.1	44.2	11.2	9.7
Total		28.5		7.0

Five years later, in 2002, a third survey (*Schweizerische Gesundheitsbefragung 2002*) (9) was carried out involving 19'471 individuals (age ≥ 15) and living in private households. The results showed a prevalence of 7.7% for obesity and 29.4% for overweight in this randomly selected cohort of the Swiss population, yielding a total of 37.1% (Table 4).

Table 4 Schweizerische Gesundheitsbefragung 2002 (9)

age	Overweight BMI 25 - 29.9		Obesity BMI ≥ 30	
	females %	males %	females %	Males %
15-24	5.4	12.7	2.6	1.6
25-34	15.0	32.4	4.3	4.5
35-44	18.6	39.2	6.2	6.8
45-54	22.0	46.1	9.3	11.9
55-64	30.8	46.3	10.5	12.0
65-74	37.5	47.2	11.9	12.0
>74	31.1	46.7	9.5	9.5
Total		29.4		7.7

The latest public poll (*Schweizerische Gesundheitsbefragung 2007*) (10) was conducted in 2007 involving 18'760 individuals (10'336 females and 8'424 males (age ≥ 15), living in private households) and yielded the following results in a randomly selected cohort of the Swiss population: a prevalence of 8.1% for obesity and 29.2% for overweight, yielding a total of 37.3% (Table 5).



Table 5 Schweizerische Gesundheitsbefragung 2007 (10)

age	Overweight BMI 25 - 29.9		Obesity BMI ≥ 30	
	females %	males %	Females %	Males %
15-24	6.0	13.6	1.7	1.8
25-34	14.2	33.6	5.4	5.8
35-44	18.2	41.3	6.5	8.0
45-54	19.8	43.1	10.3	12.1
55-64	30.2	47.6	10.4	12.9
65-74	34.1	45.9	12.7	12.2
>74	33.8	48.1	9.6	8.5
Total		29.2		8.1

In absolute numbers, as shown in Table 6, a total of more than 2.3 Mio adult inhabitants of Switzerland have to be considered overweight using the presently accepted definition of having a BMI ≥ 25 . As described above, this part of the population represent more than one third of the total Swiss population in 2007. The number of overweight men is with 1.4 Mio considerably higher than the corresponding number of overweight women (0.9 Mio). Looking at the segment of the actually obese adult Swiss (BMI ≥ 30), the difference between male and female inhabitants becomes somewhat smaller as approximately 245'000 obese women compare to approximately 257'000 obese men.



Table 6

Schweizerische Gesundheitsbefragung 2007

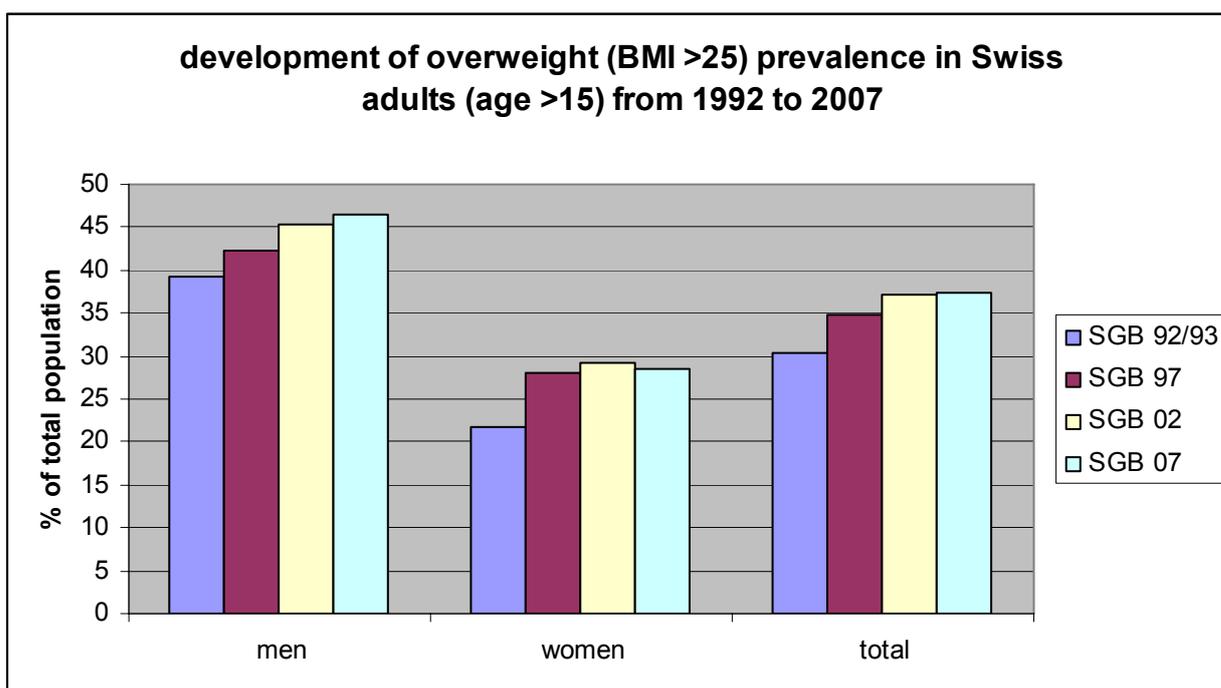
Bundesamt für Statistik, personal communication 27.October 2008

Age	Women						Men						Overall
	population count	BMI 25-30 %	count	BMI >30 %	count	total	population count	BMI 25-30 %	count	BMI >30 %	count	total	
15-24	458'298	6	27'498	1.7	7'791	35'289	486'648	13.6	66'184	1.8	8'760	74'944	110'233
25-34	480'758	14.2	68'268	5.4	25'961	94'229	468'107	33.6	157'284	5.8	27'150	184'434	278'663
35-44	609'483	18.2	110'926	6.5	39'616	150'542	607'772	41.3	251'010	8	48'622	299'632	450'174
45-54	530'330	19.8	105'005	10.3	54'624	159'629	534'117	43.1	230'204	12.1	64'628	294'833	454'462
55-64	451'788	30.2	136'440	10.4	46'986	183'426	443'326	47.6	211'023	12.9	57'189	268'212	451'638
65-74	326'924	34.1	111'481	12.7	41'519	153'000	283'727	45.9	130'231	12.2	34'615	164'845	317'846
>74	307'182	33.8	103'828	9.6	29'489	133'317	198'251	48.1	95'359	8.5	16'851	112'210	245'527
Total			663'445		245'987	909'432			1'141'295		257'815	1'399'110	2'308'542



The development of overweight (BMI ≥ 25) over the period between 1992 and 2007 is depicted in Figure 1 and clearly shows that the part of the population suffering from overweight increased considerably over the last 15 years. This development is particularly obvious in the male part of the population, whereas it appears that a steady state may have been reached in the female part of the population.

Figure 1



3.2 Prevalence of overweight and obesity in adults, forecasting to 2022

The data from the four available Health Surveys for Switzerland shown in the previous chapter were used to model the future trends in obesity and overweight prevalence. These data are available from 1992/3 to 2007 for the adult Swiss population. The trends discernible have been projected forward to 2022 using a logistic regression model approach and analysed in relation to population estimates for 2022 to forecast the number and proportion of the population estimated to be obese and overweight, if the current trend continues. The results presented show the expected proportions of adults who will be overweight and obese in 2022.



Entire population:

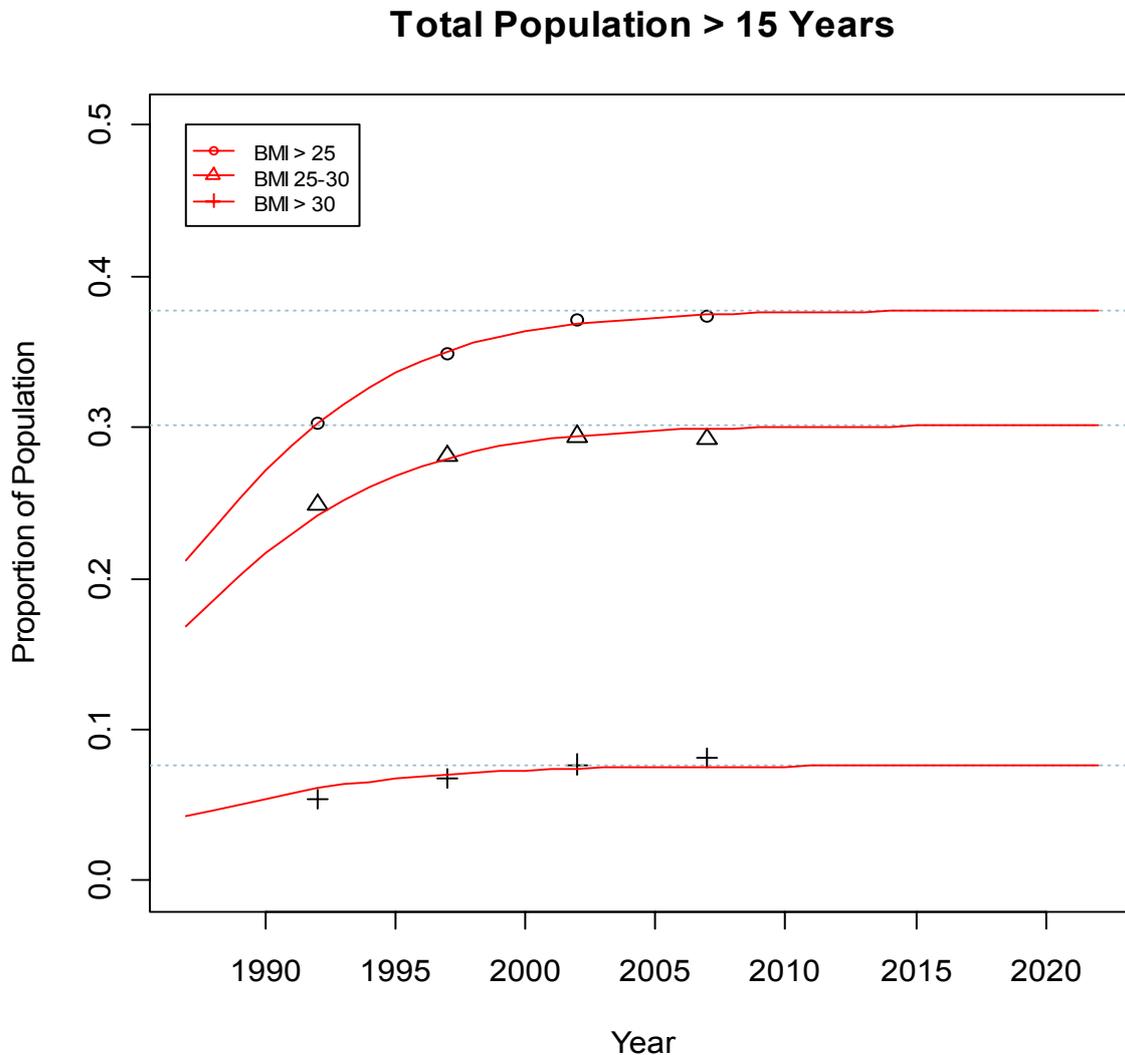
Table 7 Data input, prevalence overweight and obesity in the entire population in the years 1992, 1997, 2002 and 2007

Schweizerische Gesundheitsbefragungen 1992- 2007								
<i>Bundesamt für Statistik, personal communication 27.October 2008</i>								
year	total population count	BMI 25-29.9		BMI ≥ 30		BMI ≥ 25		count
		%	count	%	count	%	count	
1992	5'683'260	24.9	1'415'132	5.4	306'896	30.3	1'722'028	
1997	5'880'186	28.1	1'652'332	6.8	399'853	34.9	2'052'185	
2002	6'017'638	29.4	1'769'186	7.7	463'358	37.1	2'232'544	
2007	6'186'711	29.2	1'806'520	8.1	501'124	37.3	2'307'643	

As shown in Table 7 and can be seen in Figure 2, the rapid and significant increase in the prevalence of overweight (BMI ≥ 25) in the adult Swiss population (age 15 years or older) by 7% between 1992 and 2007, from 30.3% to 37.3% of the total population, was caused by a predominant increase in the proportion of overweight individuals with BMI 25-29.9 by 4.3% (from 24.9% to 29.2%) and a concomitant increase of the obese population by 2.7% (from 5.4% to 8.1%).



Figure 2: Expected development of overweight and obesity in the adult Swiss population (age ≥ 15) based on the prevalence from 1992 to 2007



Projection of the further development from 2007 until 2022 based on the prevalence data from 1992 to 2007 by a nonlinear curve fitting approach following a 3-parameter logistic function, yields an estimated minimal increase to 37.7% (from 37.3%) in the adult Swiss population with BMI ≥ 25 indicating a considerable drop in prevalence increase compared to the preceding 15 year period reaching a plateau just below the 40% mark. This projection indicates that the development of overweight in the entire Swiss population may have reached its peak as the expected minimal increase in overweight prevalence in the coming 15 year period remains within the uncertainty of the evaluation method. The corresponding prevalence in 2022 in the population segment with BMI 25 – 29.9 is expected to be around 30.1%, an estimated minimal increase by 0.9% from 29.2% in 2007. The total overweight population (BMI ≥ 25) as



well as the obese population segment (BMI ≥ 30) may be expected to basically stabilize between 2007 and 2022 at about the 2007 level. Provided, this projected development in the overweight population (BMI ≥ 25) is corroborated by corresponding prevalence numbers by the upcoming 3 health surveys (2012, 2017, 2022) it may be concluded that the overweight segment of the Swiss population has reached a stable plateau.

Male population:

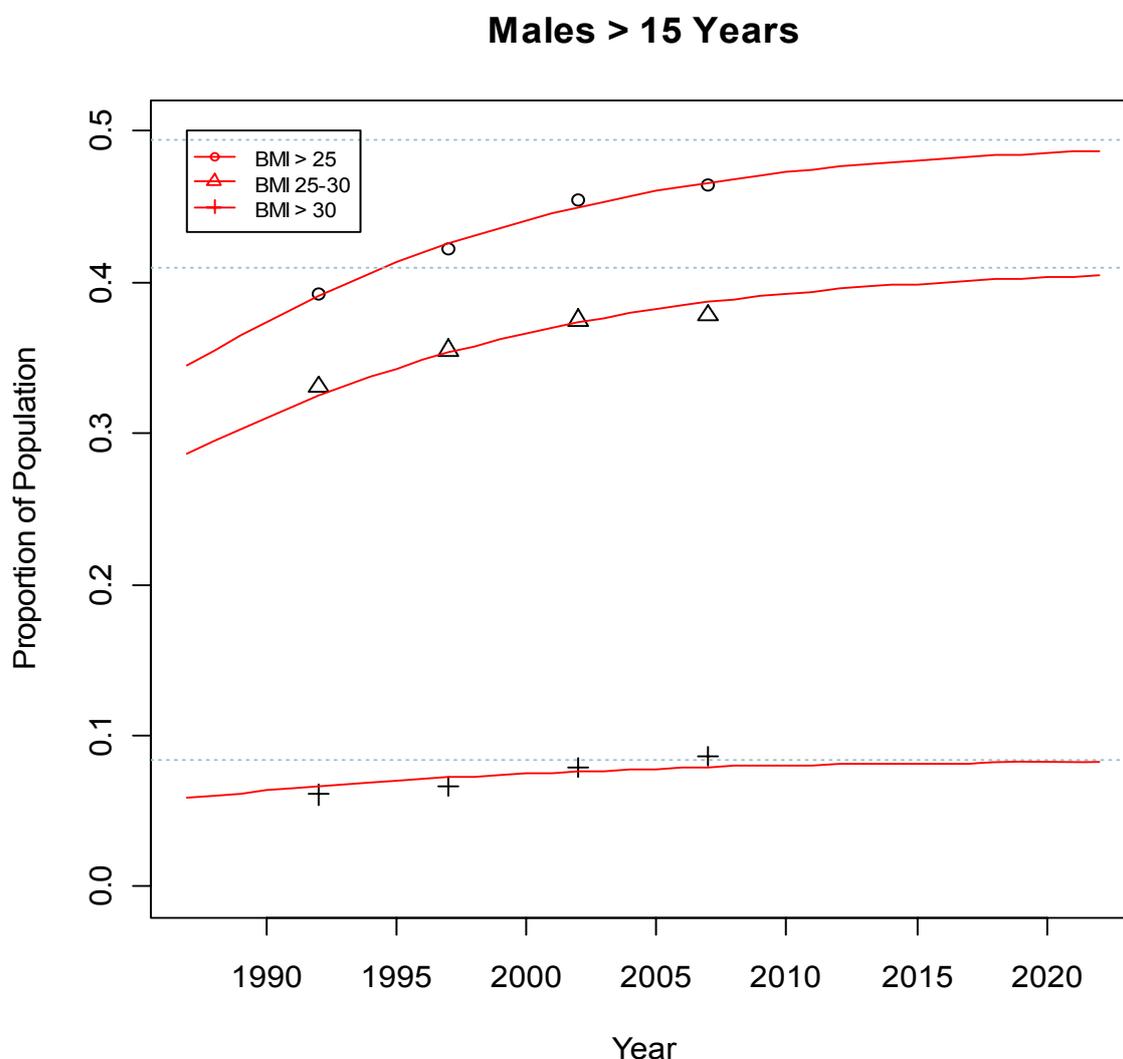
Table 8 Data input, prevalence overweight and obesity in the adult Swiss male population in the years 1992, 1997, 2002 and 2007

Schweizerische Gesundheitsbefragungen 1992- 2007							
<i>Bundesamt für Statistik, personal communication 27. October 2008</i>							
male population							
year	count	BMI 25-29.9		BMI ≥ 30		BMI ≥ 25	
		%	count	%	count	%	count
1992	2'735'471	33.1	905'441	6.1	166'864	39.2	1'072'305
1997	2'827'975	35.5	1'003'931	6.7	189'474	42.2	1'193'405
2002	2'909'185	37.5	1'090'944	7.9	229'826	45.4	1'320'770
2007	3'021'948	37.8	1'142'296	8.6	259'888	46.4	1'402'184

As shown in Table 8 as well as Figure 3, the increase in the prevalence of overweight (BMI ≥ 25) in the adult Swiss male population (age > 15) by 7.2% between 1992 and 1997 reaching a total of 46.4% of the total male population. This means that – based on the presently used definition of overweight – almost half of the male Swiss population suffers from overweight. The corresponding increase in the proportion of overweight males with BMI 25 - 29.9 amounted to 4.6% (from 33.1% to 37.8% of the total male population) and the obese male population grew by 2.5% (from 6.1% to 8.6%).



Figure 3: Expected development of overweight and obesity in the adult male Swiss population (age ≥ 15) based on the prevalence from 1992 to 2007



The projected development from 2007 until 2022 shows a considerable slow down in the anticipated increase in the adult Swiss male population with BMI ≥ 25 to reach an approximate prevalence of 48.7% (from 46.4% in 2007). The expected prevalence in 2022 in the male population segment with BMI 25 - 29.9 of around 40.4%, up from 37.8% in 2007, confirms the observed slow down in the entire male overweight population and the projected prevalence of 8.3%, down from 8.6% in 2007, in the obese population segment (BMI ≥ 30) underscores the likelihood that the increase in the obese male Swiss population has come to a virtual halt. Again, if confirmed by future prevalence findings, it appears that the overweight segment of the Swiss male population may begin to stabilize in the coming 15 years on a high level just below 50%.



Female population:

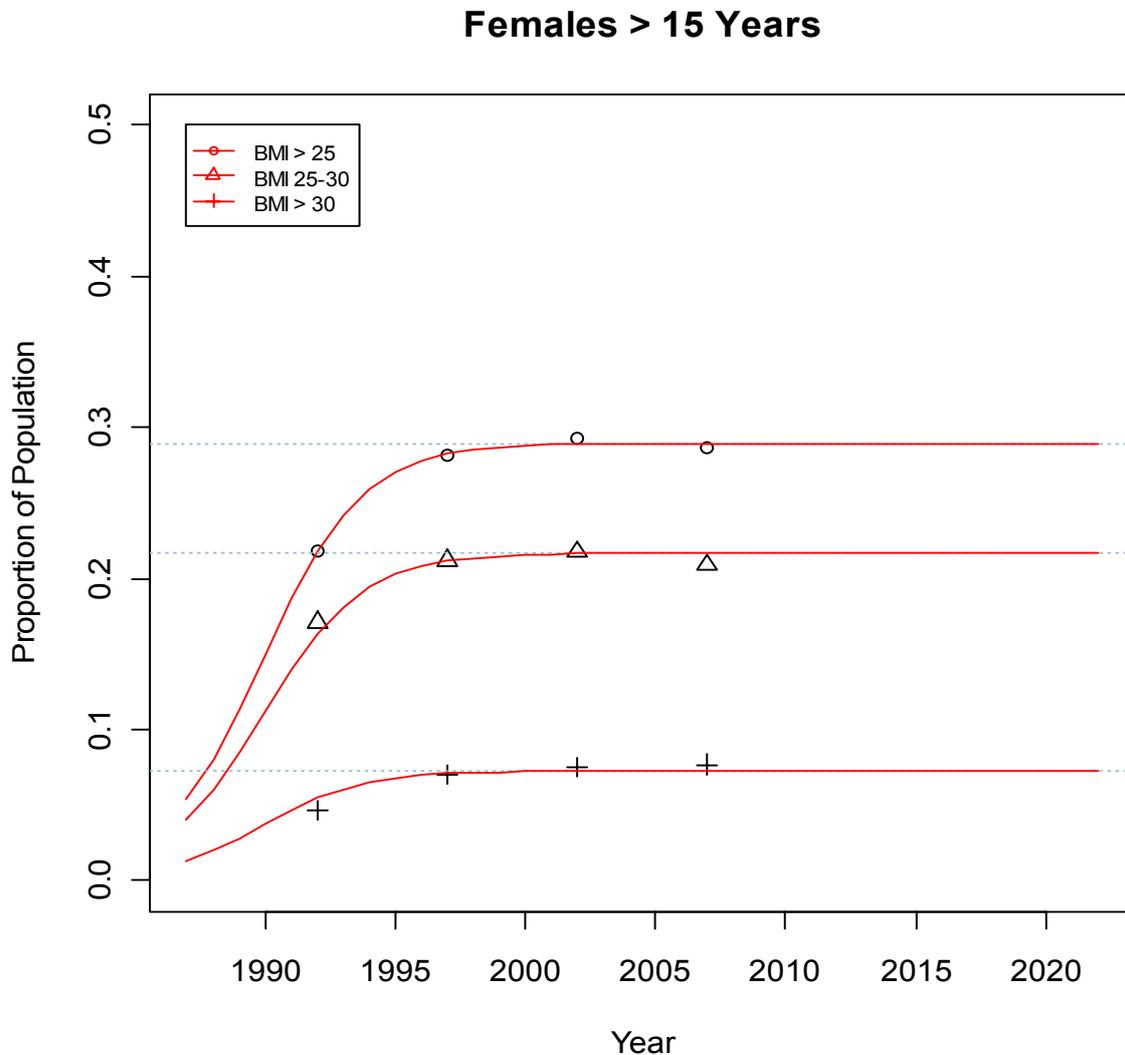
Table 9 Data input, prevalence overweight and obesity in the Swiss female population in the years 1992, 1997, 2002 and 2007

Schweizerische Gesundheitsbefragungen 1992- 2007							
<i>Bundesamt für Statistik, personal communication 27.October 2008</i>							
female population		BMI 25-29.9		BMI ≥ 30		BMI ≥ 25	
year	count	%	count	%	count	%	count
1992	2'947'789	17.1	504'072	4.7	138'546	21.8	642'618
1997	3'052'211	21.2	647'069	7.0	213'655	28.2	860'724
2002	3'108'453	21.8	677'643	7.5	233'134	29.3	910'777
2007	3'164'763	20.9	661'435	7.7	243'687	28.6	905'122

In Table 9 and Figure 4 the evolvement of the BMI situation in the female segment of the Swiss population is shown. As can be seen, the female overweight population (BMI ≥ 25) increased by 6.6 % from an absolute value of 22.0% in 1992 to 28.6% in 2007. Compared to the male overweight segment of the Swiss population, the female overweight segment is considerably smaller (28.6% vs. 46.4%) in 2007 although the relative increase from 1992 to 2007 was only slightly lower between women and men (6.6% vs. 7.2%). The corresponding increase in the proportion of overweight females with BMI 25 - 29.9 amounted to 3.6% (from 17.3% to 20.9% of the total female population) whereas the obese female population grew by 3% (from 4.7% to 7.7%).



Figure 4: Expected development of overweight and obesity in the adult female Swiss population (age ≥ 15) based on the prevalence from 1992 to 2007



Anticipation of the further development until 2022 shows a potential prevalence of 29.0% in the adult female Swiss population with BMI ≥ 25 , compared to 28.6% in 2007, indicating a virtually stable prevalence compared to the observed increase in prevalence (6.6%) over the preceding 15 year period. The estimated prevalence in 2022 in the female population segment with BMI 25 - 29.9 is expected to be around 21.7% (remaining stable in comparison to 21.9% in 2007) and the one in the obese population segment (BMI ≥ 30) is anticipated to slightly decrease to 7.3% from 7.7% in 2007. In summary, if this projected development in the overweight female population (BMI ≥ 25) is corroborated by corresponding prevalence numbers in the upcoming 3 health surveys in 2012, 2017 and 2022, it appears that the female



overweight segment of the Swiss population has already reached a stable level since about 2000 and may remain at this level over the next 15 years.

Age segment 15-24:

The actual development of the overweight prevalence in the youngest segment of the Swiss population, i.e. the age group between 15 and 24 years, over the past 15 years is indicative for the trend in future development of the entire overweight segment. For this reason we did analyse this population segment separately.

Entire population: age group 15 – 24

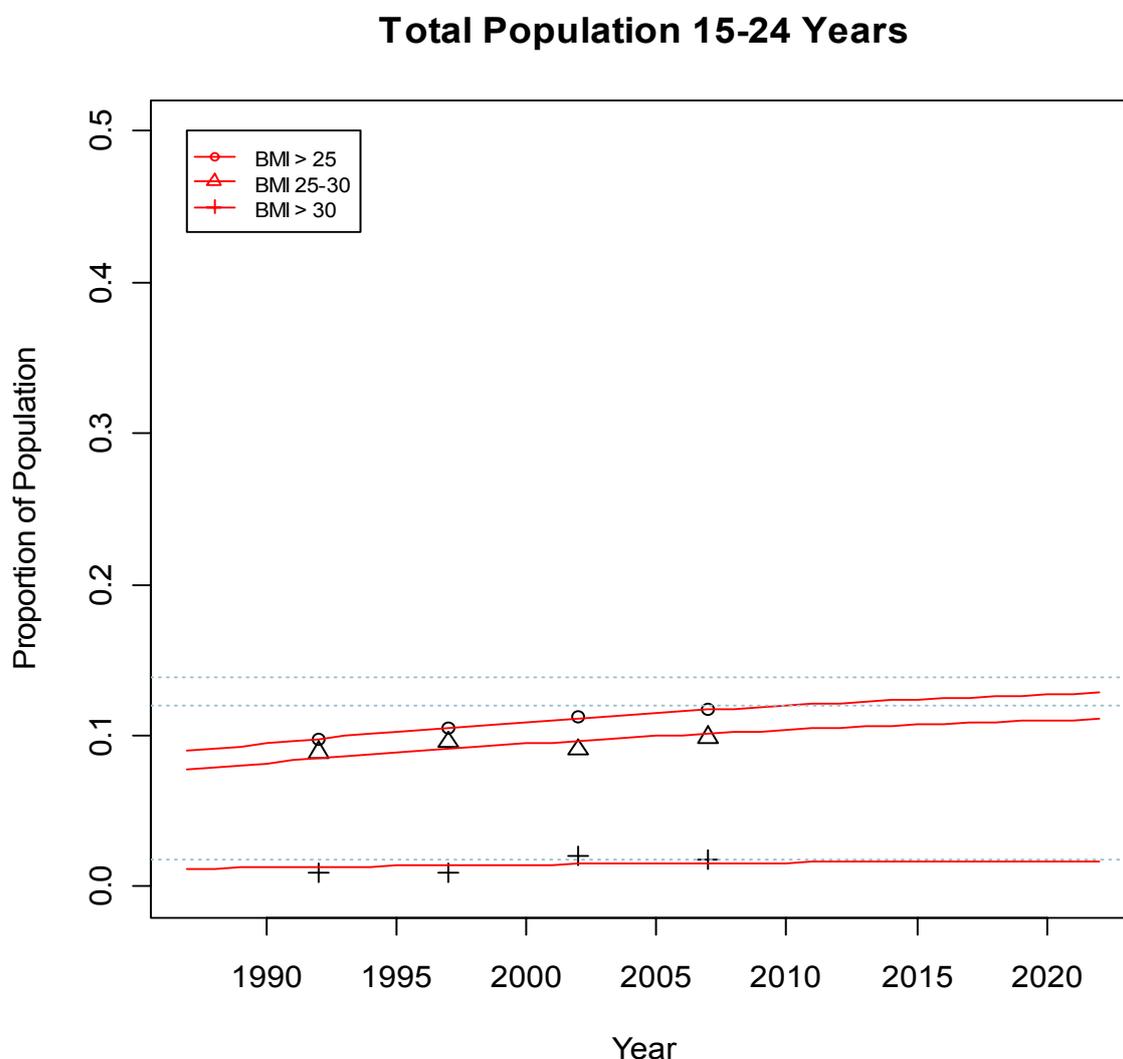
Table 10 Data input, prevalence overweight and obesity in the age group 15-24 years of the entire Swiss population in the years 1992, 1997, 2002 and 2007

Schweizerische Gesundheitsbefragungen 1992- 2007							
<i>Bundesamt für Statistik, personal communication 27.October 2008</i>							
total population, age 15-24							
year	BMI 25-29.9		BMI ≥ 30		BMI ≥ 25		count
	count	%	count	%	count	count	
1992	855'752	8.9	76'162	0.9	7'702	9.8	83'864
1997	807'739	9.6	77'543	0.9	7'270	10.5	84'813
2002	844'807	9.1	76'877	2.1	17'741	11.2	94'618
2007	944'947	9.9	93'550	1.8	17'009	11.7	110'559

In Table 10 and Figure 5 the prevalence rates in the years 1992, 1997, 2002 and 2007 and the expected development from 2007 to 2022 for overweight individuals between 15 and 24 years of age are depicted. As shown, the overweight population (BMI ≥ 25) in the age segment 15-24 increased by 1.8 % from an absolute value of 9.9% in 1992 to 11.7% in 2007. The corresponding increase in the proportion of overweight individuals with BMI 25 - 29.9 amounted to 1% (from 8.9% to 9.9% of the entire population) and the obese population grew by 0.9% (from 0.9% to 1.8%).



Figure 5: Expected development of overweight and obesity in the adult Swiss population (age 15-24) based on the prevalence from 1992 to 2007



Projection of the assumed prevalence in 2022 based on the prevalence data from 1992 to 2007 shows a small increase to 12.8% (from 11.7% in 2007) in the adult Swiss population, 15-24 years of age, with BMI \geq 25. Similarly, there is a slight increase in prevalence expected until 2022 in the population segment with BMI 25 - 29.9, to 11.1% compared to 9.9% in 2007, and the prevalence in the obese population segment (BMI \geq 30) may remain stable at 1.7% (1.8% in 2007). Assuming this projected development in the youngest segment (15-24 years) of the overweight population (BMI \geq 25) is confirmed by corresponding findings in the upcoming 3 health surveys (2012, 2017, 2022), it may be concluded that the total overweight segment of the Swiss population may indeed reach its maximum in the coming 15 years.



Male population: age 15 – 24

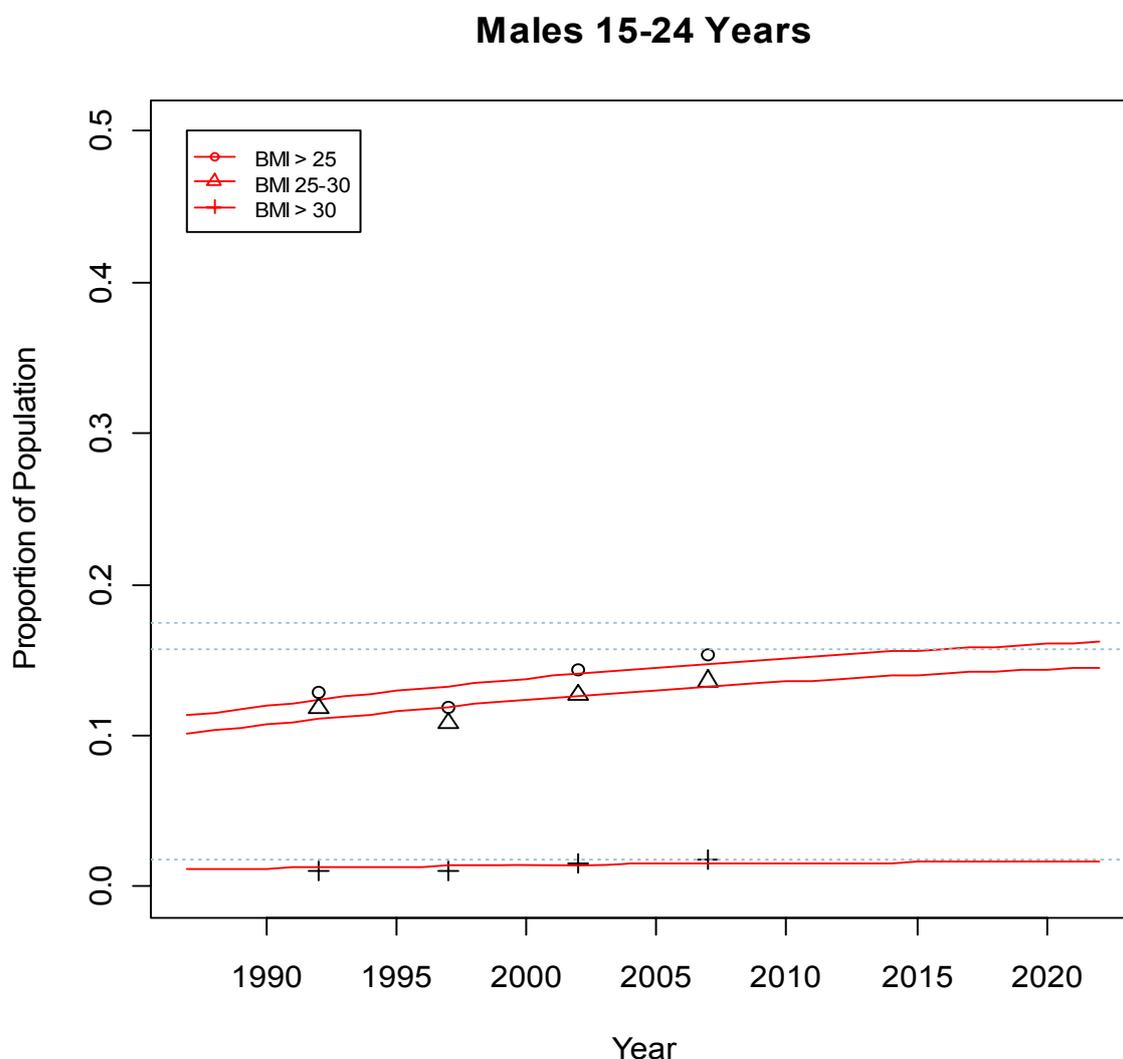
Table 11 Data input, prevalence overweight and obesity in the age group 15-24 years of the Swiss male population in the years 1992, 1997, 2002 and 2007

Schweizerische Gesundheitsbefragungen 1992- 2007							
<i>Bundesamt für Statistik, personal communication 27. October 2008</i>							
men, age 15-24							
year	BMI 25-29.9		BMI ≥ 30		BMI ≥ 25		count
	count	%	count	%	count	count	
1992	432'646	11.8	51'052	1.1	4'759	12.9	55'811
1997	406'866	10.8	43'942	1.1	4'476	11.9	48'417
2002	430'144	12.7	54'628	1.6	6'882	14.3	61'511
2007	486'648	13.6	66'184	1.8	8'760	15.4	74'944

In Table 11 and Figure 6 the prevalence rates in the years 1992, 1997, 2002 and 2007 and the expected development from 2007 to 2022 for overweight males between 15 and 24 years of age are shown. The prevalence rate increased by 2.5% between 1992 and 1997 reaching a total of 15.4% of the total male population. The corresponding increase in the proportion of overweight males, age 15-24, with BMI 25 - 29.9 amounted to 1.8% (from 11.8% to 13.6% of the total male population) and the obese male population grew by 0.7% (from 1.1% to 1.8%).



Figure 6: Expected development of overweight and obesity in the adult male Swiss population (age 15-24) based on the prevalence from 1992 to 2007



Projection of the development until 2022 shows an anticipated prevalence of 16.2% in the adult male Swiss population, 15-24 years of age, with BMI >25 indicating a 0.8% increase in prevalence compared to 2007 (15.4%). There is a prevalence of 14.5% expected in 2022 in the male population segment with BMI 25 - 29.9 (up by 0.9% from 13.6% in 2007), whereas the prevalence in the obese male population segment (BMI \geq 30) is expected to remain basically unchanged at 1.7%, compared to 1.8% in 2007. Assuming this projected development in the youngest segment (15-24 years) of the male overweight population (BMI \geq 25) is corroborated by corresponding findings in the upcoming 3 health surveys (2012, 2017, 2022), it may safely be concluded that the overweight segment of the Swiss male population aged 15-24 will approach its maximum in the next 15 years.



Female population: age 15 – 24

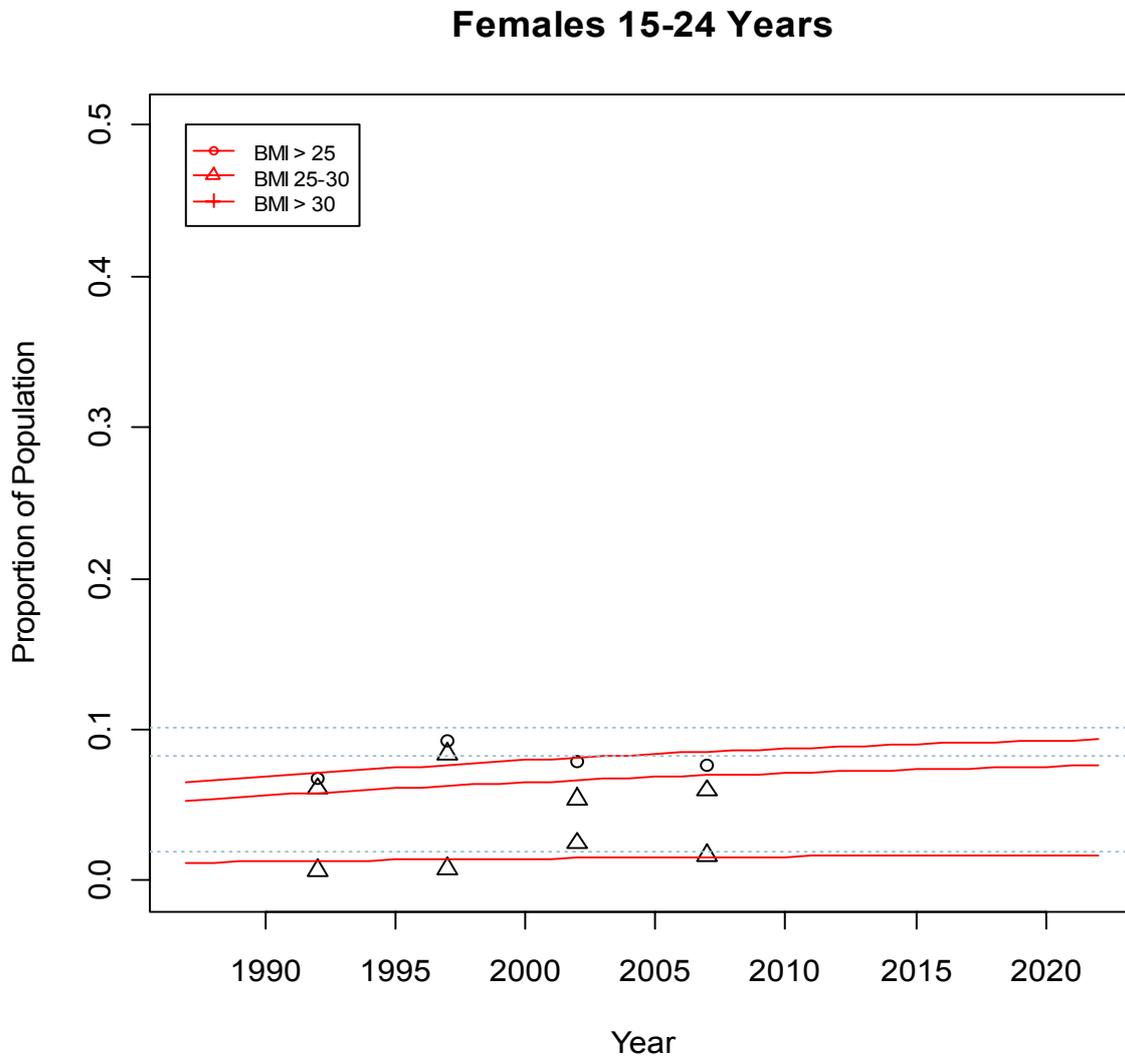
Table 12 Data input, prevalence overweight and obesity in the age group 15-24 years of the Swiss female population in the years 1992, 1997, 2002 and 2007

Schweizerische Gesundheitsbefragungen 1992- 2007							
<i>Bundesamt für Statistik, personal communication 27. October 2008</i>							
women, age 15-24							
year	Count	BMI 25-29.9		BMI ≥ 30		BMI ≥ 25	
			%	count	%	count	
1992	423 107		6.1	25'810	0.7	2'962	6.8 28'771
1997	400 874		8.4	33'673	0.8	3'207	9.2 36'880
2002	414 663		5.4	22'392	2.5	10'367	7.9 32'758
2007	458 298		6.0	27'498	1.7	7'791	7.7 35'289

Table 12 and Figure 7 depicts the evolvement of the BMI situation in the youngest adult female segment, aged 15 – 24, of the Swiss population. As shown, the female overweight population (BMI ≥ 25), aged 15-24, increased by 1.1% from an absolute value of 6.8% in 1992 to 7.7% in 2007. Compared to the male overweight segment, aged 15-24, of the Swiss population, the corresponding female overweight segment was about 50% smaller (14.1% vs. 7.7%) in 2007 although the relative increase from 1992 to 2007 was only slightly lower between women and men (1.1% vs. 1.7%). The corresponding proportion of overweight females with BMI 25 - 29.9 decreased by 0.1% (from 6.1% to 6.0% of the total female population) whereas the obese female population grew by 1.0% (from 0.7% to 1.7%).



Figure 7: Expected development of overweight and obesity in the adult female Swiss population (age 15-24) based on the prevalence from 1992 to 2007



Anticipation of the further development until 2022 shows a potential prevalence of 9.3% (up 1.6% from 7.7% in 2007) in the adult female Swiss population, age 15-24, with BMI ≥ 25 indicating a small increase. There is an equivalent small increase expected until 2022 (from 6.0% in 2007 to 7.6% in 2022) in the youngest female population segment with BMI 25 - 29.9 whereas the prevalence in the corresponding obese population segment (BMI ≥ 30) is anticipated to remain stable at 1.7% until 2022. If this projected development in the overweight female population (BMI ≥ 25) is confirmed by corresponding prevalence numbers in the upcoming 3 health surveys in 2012, 2017 and 2022, it appears likely that also the female overweight segment of the Swiss population will reached a plateau in the 15 years until 2022.



3.3 Obesity related health problems

In our previous report (11) scientific evidence was cited for the following 26 diseases to be associated with obesity: Hypertension, dyslipidemia (hypercholesterolemia, hypertriglyceridemia), diabetes mellitus Type 2, ischemic stroke, coronary heart disease (CHD), cancer (breast, colon, esophagus, pancreas, stomach, liver, gall bladder, prostate, kidney, urinary tract, leukemia, non-Hodgkin's lymphoma, endometrial (cervix, uterus, ovaries)), osteoarthritis (hip, knee), depression, gallbladder disease/gallstones, sleep apnea, thrombosis, gout, polycystic ovary syndrome (PCOS) and miscarriage.

From all these obesity-associated diseases, **diabetes mellitus Type 2** is the leading comorbidity carrying the highest risk of developing in the course of body weight increase. Clearly, the growing prevalence of obesity is the major factor driving the increasing prevalence of diabetes mellitus Type 2 (12). As a consequence, the number of adults with diabetes mellitus Type 2 is predicted to almost double over the next 25 years on a worldwide scale, from approx. 171 million in 2000 to 366 million by the year 2030 (13).

The Behavioral Risk Factor Surveillance System in the US has provided compelling evidence that the increase in Type 2 diabetes in adults is correlated with the observed increase in obesity (14). Comparable relationships between the prevalence of obesity as well as of Type 2 diabetes are observed worldwide (15). Switzerland certainly does not pose an exception from this rule and it can be expected that the prevalence of Type 2 diabetes in Switzerland in the coming decade will increase in parallel with the observed increase in prevalence of overweight and obesity over the past 15 years.

A similar relationship is observed between obesity, elevated plasma glucose and the occurrence of **risk factors for cardiovascular disease such as hypertension and dyslipidemia** (12, 16). The results from a multi-state screening project in the US clearly reflect the influence of obesity (as defined by BMI) on the cardiovascular risk factors of hypertension (systolic blood pressure) and dyslipidemia (hypercholesterolemia) and highlight the impact of obesity on **cardiovascular disease** (17).

While the above mentioned obesity-related diseases and risk factors are well established, the existence of an association between obesity and mental disorders, in particular **depression**, in the general population has been subject of controversy for some time (18, 19). Recently published results, however, clearly demonstrate statistically, albeit modest associations between obesity and depressive disorders in single countries (20) as well as in pooled data across countries (21, 22).



Due to a relatively high life time prevalence ranging from 2-15% and its association with substantial disability, depression has become an important global health issue (23).

In its 2007 report (24), the World Cancer Research Fund (WCRF) concluded that there is convincing evidence, that overweight and obesity are associated with an increased risk of **oesophageal adenocarcinoma** and with **cancers** of the **pancreas**, **colorectum**, **breast** (postmenopausal), **kidney** and **endometrium**. A probable association was described for gallbladder cancer. In a systematic review and metaanalysis of prospective observational studies regarding the effect of BMI on the incidence of cancer published in 2008 (25), it was found that **in men**, BMI was strongly associated with oesophageal adenocarcinoma and with **thyroid**, **colon** and renal cancers. **In women**, strong associations were recorded between an increased BMI and **endometrial**, **gallbladder**, oesophageal adenocarcinoma and renal cancers. Weaker associations were noted for increased BMI and rectal cancer and malignant melanoma in men; postmenopausal breast, pancreatic, thyroid and colon cancers in women; as well as leukaemia, multiple myeloma and non-Hodgkin lymphoma in both genders. Associations were generally similar in studies from North America, Europe, Australia and the Asia-Pacific region.

In conclusion, it appears that obesity is one of the strongest emerging risk factors for many cancers in Western countries (26). The mechanism through which obesity may cause these cancers is still unknown, but interventions such as bariatric surgery in morbid obesity cases demonstrate a significant decrease in cancer mortality due to long lasting weight loss (27, 28).

Overweight is considered to be the best known, age-dependent risk factor for **gallstone disease** (29, 30, 31). Delayed gallbladder and decreased small bowel motility have been associated with obesity and gallstone disease (32). Increased risk of gallstone formation was also confirmed in obese, hypertriglyceridemic diabetics (33).

Polycystic ovary syndrome (PCOS) is the most common metabolic abnormality in women of reproductive age with a 6% to 7% prevalence reported worldwide (34, 35). The most often observed clinical features of PCOS are menstrual dysfunction incl. infertility, hirsutism and skin disorders such as acne. Global obesity often characterizes women with PCOS (36). In the US, overweight is present in 24% and obesity in 42% of PCOS patients (37), compared to 10% and 20%, respectively, observed in Spain (38). It has been demonstrated that weight loss can improve the fertility of obese women with PCOS through the recovery of spontaneous ovulation (39).

Excess body weight was also determined as a risk factor for **venous thromboembolic disease**, i.e. pulmonary embolism or deep venous thrombosis (40, 41, 42).



Venous thromboembolism is a common disease with an incidence of 1.4 per 1000 person-years (43). Its major clinical implications are recurrence of disease (fatal in approx. 5% of all cases) and morbidity due to the post-thrombotic syndrome. The risk of recurrence of venous thromboembolism was found to increase additionally with an increase in BMI (44, 45)

Gout is the most common inflammatory arthritis in men (46) more than 80% of all gout patients are male (47). The single most important risk factor for developing gout is a raised level of serum uric acid, i.e. hyperuricemia (48) and BMI was demonstrated to have the strongest correlation with hyperuricemia of all components of insulin resistance (49)

Osteoarthritis is a multifactorial disease with both environmental and genetic determinants. Obesity is most strongly associated with osteoarthritis of the knee (50, 51) and several population studies have found a cross-sectional link between obesity and osteoarthritis of the tibiafemoral joint of the knee (52, 53).

Both, obesity and **sleep apnea** are prevalent health conditions that frequently coaggregate (54, 55). Obstructive sleep apnea-hypopnea syndrome involves recurring episodes of total obstruction (apnea) or partial obstruction (hypopnea) of airways during sleep (56).

Obesity during pregnancy is considered a high-risk state because it is associated with many complications, amongst them **miscarriage** (57, 58). In a study of embryo transfer, for example, it was observed that the rate of spontaneous miscarriage increased as the BMI increased (59). Other studies have shown similar findings (60).

Compared to our previous report we identified two additional, major diseases as directly linked to obesity: **asthma** and **chronic kidney disease**. Both diseases are prevalent disorders, each with a significant public health impact:

A growing body of literature suggests that there is an association between obesity and **asthma**. Although the exact nature of this association remains unclear, many investigators have interpreted the data to suggest that obesity increases the risk of incident asthma (61-64). Further, recent findings suggest that obesity is associated with worse asthma outcome, especially an increased risk of asthma-related hospitalizations (65). Interestingly and consistent with the expectation, a recently published systematic review on the effects of weight loss on asthma prevalence and severity found a fairly consistent association between weight loss and improved asthma (66).

The number of patients with **chronic kidney disease** (CKD) and end stage renal disease (ESRD) is increasing steadily on a world wide basis (67, 68). Obesity is associated with increased risk of developing stage 3 **chronic kidney disease** (69)



and chronic renal failure (70). The relationship between obesity and stage 3 CKD appears to be mediated through the presence of known cardiovascular risk factors such as hypertension, diabetes and dyslipidemia, which often accompany obesity (69).

Table 13: Relative risk of diseases associated with obesity

Greatly increased (RR greater than 3)	Moderately increased (RR 2- 3)	Slightly increased (RR 1-2)
diabetes mellitus Type 2	hypertension	cancer (breast, colon, esophagus, pancreas, stomach, liver, gall bladder, prostate, kidney, urinary tract, endometrial)
kidney disease	dyslipidemia	depression
gallbladder disease/gallstones	coronary heart disease	polycystic ovary syndrome
sleep apnea	osteoarthritis	thromboembolism
	gout	miscarriage
	ischemic stroke (men only)	
	asthma	

3.4 Direct costs

Pharmacological therapy costs

At present there are three registered products available in Switzerland for drug treatment of overweight and obesity. Table 14 lists the mechanism of action of the 3 medications evaluated and their most frequently observed side effects.

Table 14: Medications used for weight loss in Switzerland

Drug	Mechanism of action	Side effects
Orlistat (Xenical®)	Lipase inhibitor: decrease absorption of fat	Diarrhea, flatulence, bloating, abdominal pain, dyspepsia
Sibutramine (Reductil®)	Appetite suppressant: combined norepinephrine and serotonin reuptake inhibitor	Modest increases in heart rate and blood pressure, nervousness, insomnia
Rimonabant (Acomplia®)	Appetite suppressant: inverse agonist for the cannabinoid receptor CB1	severe depression

Based on the total volume of these three compounds reported for 2007 the costs were estimated at CHF 24.5 mio.



Bariatric surgical therapy costs

Based on information from Swiss Study Group for Morbid Obesity the number of bariatric surgical procedures from 2001 to 2006 were as follows:

Table 15: Number of obesity related (bariatric) surgical procedures in Switzerland on a yearly basis

2001	2002	2003	2004	2005	2006
703	769	818	781	731	848

Unfortunately, this statistical registry was discontinued.

In 2006 and 2007, based on the yearly report (BFS -Medizinische Statistik der Krankenhäuser 2007/8), surgical procedures used in bariatric surgery were distributed over 8 CHOP-codes as follows:

Table 16: CHOP-codes, description and number surgical procedures including bariatric surgery carried out in 2007

CHOP-code	Description	number of procedures	
		2006	2007
44.31	Hoher Magen-Bypass	839	949
44.38	Laparoskopische Gastroenterostomie	105	254
44.39	Sonstige Gastroenterostomie	173	274
44.68	Laparoskopische Gastroplastik	57	31
44.93	Einsetzen eines Magenballons	8	13
44.94	Entfernen eines Magenballons	9	11
44.95	Laparoskopisch restriktive Magenoperation	44	57
44.96	Laparoskopische Revision von restriktiven Magenoperationen	27	51
Total		1262	1640

The above procedures were classified into two AP-DRGs, either into 288 (44.31/ 44.38/ 44.39/ 44.68/ 44.95/ 44.96) with a costweight Cw=1.394 or 297 (44.93/ 44.94) with Cw=0.668.

Calculations were based on a non-complicated patient without comorbidities, 50 years of age and a length of hospital stay of 3 days using the AP DRG grouper version 1.6 for 2006 and costweight version 5.1. For Cw=1 a base rate of CHF 8'000 was applied.



Table 17: Cost estimate (on 2006 cost base) of surgical procedures including bariatric surgery carried out in 2007

CHOP-code	number of procedures	AP-DRG	Costweight (Cw)	Costs per procedure	Total costs per CHOP code
44.31	949	288	1.394	11'152	20'872'528
44.38	254	288	1.394	11'152	2'832'608
44.39	274	288	1.394	11'152	3'055'648
44.68	31	288	1.394	11'152	354'712
44.93	13	297	0.668	5'344	69'472
44.94	11	297	0.668	5'344	58'784
44.95	57	288	1.394	11'152	635'664
44.96	51	288	1.394	11'152	568'752
Total cost	1640				28'448'168

Assuming similar proportions between the surgical procedures including bariatric surgery (n=1262) and the actual bariatric procedures reported by the Swiss Study Group for Morbid Obesity in 2006 (n=848), the actual number of bariatric procedures in 2007 is estimated to reach 1100. Based on this assumption the estimated cost of bariatric surgery amounts to approximately CHF 19 Mio in 2007.

The above cost estimate for bariatric surgery in Switzerland in 2007 represents a conservative estimate. The true costs may be considerably higher since many obese patients suffer from comorbidities and the risk for postoperative complications for such patients is increased.

Dietary counselling

The total number of dietary consultations reported by the "Schweizerische Verband diplomierter ErnährungsberaterInnen" (SVDE) in 2006 reached 73'870, an increase of approx. 5% since 2002. According to the SVDE the proportional share of overweight/obesity related consultations remained unchanged since 2002 resulting in approx. 7000 primary consultations and approx. 31'300 follow up consultations. To estimate the annual costs for dietary consultations associated with overweight and obesity for 2006, the number of these consultations was multiplied with the monetary value according to the tariff contract between SVDE and Santésuisse dated 1.1.2002. This value was CHF 99.– for a first consultation and CHF 77.– for follow-up consultations.



Table 18: Costs for dietary counselling in relation with overweight and obesity in 2006

	Estimated number of consultations	Tariff (per consultation)	costs
Primary consultation	7'000	99	693'000
Follow-up consultation	31'300	77	2'410'000
Total costs			3'103'000

In conclusion, **direct treatment costs** for obesity in Switzerland were estimated at **CHF 46.5 million** for the year 2007. Included in this sum are drug costs of CHF 24.5 million, counselling costs (nutritionists) of CHF 3 million and costs for surgical interventions at a minimum of CHF 19 million.

Compared to the cost estimate for **direct treatment costs** of overweight and obesity in 2001 of CHF 42 Mio, the present cost estimate of CHF 46.5 Mio indicates a modest increase by ca. 10% for 2007.

3.5 Indirect costs

The dramatic rise in overweight and obesity in Westernized countries has already contributed to substantial increases in hypertension, cardiovascular disease and diabetes. In recent years, however, the link between weight gain and the development of many other diseases has been investigated and demonstrated. In the following section we provide an update on the relationship between overweight and obesity and various diseases, as such a link has been elucidated and confirmed in recent years.

The probabilities of a person of presently being overweight respectively obese in Switzerland, i.e. the relative risk ratios (RR) or the odds ratios (OR) of the presently known diseases linked to overweight and obesity and the corresponding population attributable risk for Switzerland are shown in Table 19.



Tabelle 19: Probabilities (p), risk ratios (RR), odds ratios (OR) and population attributable risks (PAR) for Switzerland for the most important diseases linked to overweight and obesity

<i>Obesity linked disease</i>		p	RR	OR	Total PAR in %	Reference
Hypertension	female – overweight	0.210		1.9	35.6	71
	female – obese	0.078		3.3		
	male – overweight	0.378		1.8		
	male – obese	0.085		3.4		
Hypercholesterolemia	female – overweight	0.210	1.1		6.6	72
	female – obese	0.078	0.9			
	male – overweight	0.378	1.3			
	male – obese	0.085	1.2			
Diabetes Typ 2 (NIDDM)	female – overweight	0.210	4.8		98.1	73
	female – obese	0.078	14.7			
	male – overweight	0.378	3.4			
	male – obese	0.085	14.1			
Stroke	female – overweight	0.210		1.4	31.0	75
	female – obese	0.078		3		
	male – overweight	0.378		2		
	male – obese	0.085		2.8		
CHD („heart disease“)	female – overweight	0.210	1.43		19.1	76
	female – obese	0.078	2.44			
	male – overweight	0.378	1.33			
	male – obese	0.085	2.12			
Breast cancer	female - overweight *	0.210	1.12		4.4	25
	female - obese *	0.078	1.25			
Colorectal cancer	female – overweight	0.210	1.03		6.2	78
	female – obese	0.078	1.07			
	male – overweight	0.378	1.19			
	male – obese	0.085	1.47			
Colon cancer	female – overweight	0.210	1.09		6.7	25
	female – obese	0.078	1.06			
	male – overweight	0.378	1.19			
	male – obese	0.085	1.55			
Rectum cancer	male – overweight	0.378	1.09		4.9	79



<i>Obesity linked disease</i>		p	RR	OR	Total PAR in %	Reference
	male – obese	0.085	1.19			
Esophageal adenocarcinoma	female – overweight	0.210		1.5	25.6	80
	female – obese	0.078		2.1		
	male – overweight	0.378		1.8		
	male – obese	0.085		2.4		
Pancreatic cancer	female – overweight	0.210	1.12		4.1	25
	female – obese	0.078	1.25			
	male – overweight	0.378	1.07			
	male – obese	0.085	1.14			
Liver cancer	male – overweight	0.378	1.09		4.9	25
	male – obese	0.085	1.19			
Gall bladder cancer	female – overweight	0.210	1.59		13.3	25
	female – obese	0.078	2.53			
	male – overweight	0.378	1.09			
	male – obese	0.085	1.19			
Prostate cancer	male – overweight	0.378	1.03		1.6	25
	male – obese	0.085	1.06			
Renal cancer	female – overweight	0.210	1.34		12.6	25
	female – obese	0.078	1.8			
	male – overweight	0.378	1.24			
	male – obese	0.085	1.54			
Non-Hodgkin's lymphoma	female – overweight	0.210	1.07		2.9	25
	female – obese	0.078	1.14			
	male – overweight	0.378	1.06			
	male – obese	0.085	1.12			
Leukaemia	female – overweight	0.210	1.17		5.3	25
	female – obese	0.078	1.37			
	male – overweight	0.378	1.08			
	male – obese	0.085	1.17			
"Multiple myeloma"	female – overweight	0.210	1.11		5.0	25
	female – obese	0.078	1.23			
	male – overweight	0.378	1.11			
	male – obese	0.085	1.23			



<i>Obesity linked disease</i>		p	RR	OR	Total PAR in %	Reference																																																																																																																																																										
Endometrial cancer	female - overweight *	0.210	1.59		21.7	25																																																																																																																																																										
	female - obese *	0.078	2.53				Ovarian cancer	female - overweight *	0.210	1.03		1.1	25	female - obese *	0.078	1.06		Thyroid cancer	female – overweight	0.210	1.14		11.2	25	female – obese	0.078	1.3		male – overweight	0.378	1.33		male – obese	0.085	1.77		Thromboembolism	female – overweight	0.210		1.9	21.1	71	female – obese	0.078		2.5	male – overweight	0.378		1.3	male – obese	0.085		1.7	Osteoarthritis-hip	female – overweight	0.210		1.2	8.5	53	female – obese	0.078		1.4	male – overweight	0.378		1.1	male – obese	0.085		1.8	Osteoarthritis-knee	female – overweight	0.210		2.3	47.5	53	female – obese	0.078		5.4	male – overweight	0.378		2.1	male – obese	0.085		3.7	Depression	female - obese	0.078	1.3		2.3	21	Sleep apnea	female – overweight	0.210		1.87	37.9	81	female – obese	0.078		4.17	male – overweight	0.378		1.74	male – obese	0.085		3.69	Gallstones	f. & m. – overweight	0.257		1.86	34.3	31	f. & m. – obese	0.081		3.38	Gout	male – overweight	0.378	1.95		39.8	82	male – obese	0.085	2.33		PCOS	female – overweight	0.210	1.16		7.0	83	female – obese	0.078	1.5		Misscarriage	female – overweight	0.210	1.26		8.0	84	
Ovarian cancer	female - overweight *	0.210	1.03		1.1	25																																																																																																																																																										
	female - obese *	0.078	1.06				Thyroid cancer	female – overweight	0.210	1.14		11.2	25	female – obese	0.078	1.3			male – overweight	0.378	1.33				male – obese	0.085	1.77		Thromboembolism	female – overweight	0.210		1.9	21.1	71	female – obese		0.078		2.5	male – overweight			0.378		1.3	male – obese	0.085		1.7	Osteoarthritis-hip	female – overweight	0.210		1.2		8.5	53	female – obese	0.078				1.4	male – overweight	0.378		1.1	male – obese	0.085		1.8	Osteoarthritis-knee	female – overweight		0.210		2.3	47.5			53	female – obese	0.078		5.4	male – overweight	0.378		2.1	male – obese	0.085		3.7	Depression	female - obese	0.078	1.3		2.3		21	Sleep apnea	female – overweight	0.210				1.87	37.9	81	female – obese	0.078		4.17	male – overweight	0.378		1.74	male – obese	0.085		3.69	Gallstones	f. & m. – overweight	0.257		1.86	34.3	31	f. & m. – obese	0.081		3.38	Gout	male – overweight	0.378	1.95		39.8	82	male – obese	0.085	2.33		PCOS	female – overweight	0.210	1.16		7.0	83	female – obese	0.078	1.5		Misscarriage	female – overweight	0.210	1.26
Thyroid cancer	female – overweight	0.210	1.14		11.2	25																																																																																																																																																										
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	male – overweight	0.378		1.74																																																																																																																																																												
	male – obese	0.085		3.69																																																																																																																																																												
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Misscarriage	female – overweight	0.210	1.26		8.0	84																																																																																																																																																										



Obesity linked disease		p	RR	OR	Total PAR in %	Reference
	female – obese	0.078	1.37			
Asthma	female – overweight	0.210	1.8		41.0	85
	female – obese	0.078	3			
	male – overweight	0.378	2.6			
	male – obese	0.085	3.3			
Chronic kidney disease	female – overweight	0.210	1.5		26.6	70
	female – obese	0.078	2.4			
	male – overweight	0.378	1.8			
	male – obese	0.085	2.4			

* only postmenopausal women (age \geq 50 years)
 overweight (BMI 25-29.9 kg / m²)
 obese (BMI \geq 30 kg / m²)

Relative risks for the various diseases were taken from recently published literature concentrating specifically on new, evidence-based findings and generally favouring a conservative approach. We were particularly interested in evidence linking obesity with a given disease, which was based on a meta-analysis of a substantial number of prospective observational studies. In the study of Renehan et al (25), for example, 221 datasets including 282'137 cases of cancer were analyzed to investigate whether BMI is associated with cancer risk. As can be seen in Table 19 above, many cancer types were strongly associated with the occurrence of certain cancers such as oesophageal adenocarcinoma or renal cancer in both genders, others such as thyroid and colon cancer were strongly linked to BMI increases in men, whereas gallbladder cancer was strongly linked to increased BMI in women. The relationship of higher levels of BMI in men and women with oesophageal adenocarcinoma was confirmed by another meta-analysis using 14 studies (80). Another meta-analysis with 31 studies with 70'000 events did significantly link obesity with the occurrence of colorectal cancer in both sexes (78).

Another approaches such as the Health Professional Follow-up Study, is an ongoing longitudinal investigation of more than 50'000 male health professionals that were used to examine the changes in body weight as risk factors for clinical diabetes Type 2 (74) as well as the incidence of gout (82). Similarly, a 14 year follow-up study in 68'000 nurses from the Nurses Health Study cohort resulted in a significant relative risk ratio between body weight increase and the incidence of diabetes mellitus Type 2 in women (73). For both, men and women, the risk of an overweight or obese person of turning into a diabetic was very high resulting in a population attributable risk (PAR) of 98%.



Depression, which had just been established as a comorbidity to obesity in both, men and women, at the time of our previous evaluation (11), emerged in the mean time as being solely linked to BMI increase in women (21) at a much lower relative risk ratio than previously assumed (RR of 1.3 vs. 1.8).

The relationship between BMI and incidence of severe knee and hip osteoarthritis was also confirmed in a large prospective population based study in more than 28'000 Swedish men and women (53). A BMI increase showed the strongest relative risk gradient with incidence of knee osteoarthritis leading to arthroplasty, whereas the incidence of hip osteoarthritis, although statistically significant, was related to overweight and obesity at a considerably lower risk.

Lately, two additional comorbidities linked to increased bodyweight with considerable potential, risk- and cost-wise, were identified: asthma and chronic kidney disease (61-64, 69, 70). The next few years we will see, if the presently described, obesity related risks for asthma (85) and for CKD (70) will be corroborated by additional evaluations in large cohort studies.

Last but not least, it was hypothesised that the relationship between overweight and obesity and a given comorbidity disease is comparable in Western countries and therefore applicable to Switzerland. Table 20 shows the population attributable risks (PAR) for overweight and obesity related diseases separated according to BMI 25-30 and BMI > 25 in Switzerland.

Table 20 Population attributable risks (PAR) for Switzerland for the most important diseases separated according to overweight and obesity (in %)

	PAR for BMI 25-30	PAR for BMI >30
Hypertension	19.6	16.1
Hypercholesterolemia	6.1	0.4
Diabetes Type 2 (NIDDM)	46.0	52.2
Stroke	17.6	13.4
CVD („heart disease“)	9.7	9.4
Breast cancer	2.5	1.9
Colorectal cancer	3.9	2.3
Colon cancer	4.3	2.5
Rectum cancer	3.3	1.6
Esophageal adenocarcinoma	16.4	9.3
Pancreatic cancer	2.5	1.5
Liver cancer	3.3	1.6
Gall bladder cancer	7.2	6.1
Prostate cancer	1.1	0.5



Renal cancer	7.5	5.1
Non-Hodgkin's lymphoma	1.8	1.0
Leukaemia	3.2	2.1
"Multiple myeloma"	3.1	1.8
Endometrial cancer	11.0	10.7
Ovarian cancer	0.6	0.5
Thyroid cancer	7.0	4.2
Thromboembolism	13.0	8.0
Osteoarthritis-hip	3.8	4.7
Osteoarthritis-knee	25.4	22.1
Depression		2.3
Sleep apnea	16.7	19.2
Gallstones	18.1	16.2
Gout	29.6	10.2
PCOS	3.3	3.8
Miscarriage	6.2	2.8
Asthma	26.0	14.9
Chronic kidney disease	16.4	10.2

Of the Swiss overweight and obese population about 38% are expected to suffer from sleep apnea (AHI > 15) according to Young et al (81). This corresponds to approx. 870'000 persons. In Switzerland 74.4% of all women above 18 years of age and 89.2% of the male population have a driver's licence (BFS 2007). Assuming a similar proportion of driver licences in the overweight population with sleep apnea as in the entire Swiss population, then the number of drivers (males and females) with BMI >25 and suffering from sleep apnea amounts to approximately 730'000 resulting in a prevalence of 0.118.

Based on a study by Teran-Santos et al (86) a strong association between sleep apnea (as determined by AHI) and the risk of traffic accidents exists. They describe an odds ratio of 5.8 (unadjusted) for being involved in a traffic accident when suffering from sleep apnea. Using the above prevalence of 0.118 the PAR for traffic accidents caused by drivers with BMI > 25 suffering from sleep apnea is estimated at 36.2% as shown in Table 21.

Tabel 21 Probability, odds ratio and population attributable risk for traffic accidents due to sleep apnea in drivers with BMI >25

	p	OR	Total PAR in %
Sleep apnea related traffic accidents male/female BMI >25	0.118	5.8	36.2



Cost of diseases linked to overweight and obesity

All data used for cost estimates related to comorbidities attributable to obesity, were extracted from current literature and official national statistics. The following complications of obesity were included in the analysis: hypertension; non-insulin-dependent diabetes mellitus (NIDDM); stroke; coronary heart disease (CHD); breast cancer; colorectal cancer; gallstones (gall bladder disease); osteoarthritis (knee and hip); depression; gout; road traffic accidents (due to sleep apnea); asthma and chronic kidney disease. Additional comorbidities partly attributable to obesity, some of them with high relative risk or odds ratios, such as many cancer types, thromboembolism, gout, poly cystic ovary syndrome (PCOS) were not included because of missing cost data. To estimate the extent to which a disease and its management costs can be attributed to overweight and obesity the population attributable risk (PAR) was employed. PAR includes the relative risk of obese persons of developing a disease as well as the prevalence of obesity in the population and yields the percentage of patients with a given comorbidity that is attributable directly to overweight and obesity.

The calculated PAR was applied to annual total costs (direct and indirect costs) of the above mentioned obesity-related diseases. Information about disease costs were also extracted from existing literature using Swiss-specific cost data whenever available. Where no Swiss cost data were available, data from Germany - with one exception, i.e. gall bladder disease –, having a comparable health care level, were employed. Such cost data were adapted to Swiss conditions by using OECD purchasing power parities (PPPs) and by converting costs according to actual population number. PPPs are currency conversion rates that both convert to a common currency and equalise the purchasing power of different currencies. In other words, they eliminate the differences in price levels between countries in the process of conversion. Cost data were adjusted to the price level of 2006.

Table 22a shows the total (where available) disease costs (in Mio) and their adaptation to Swiss conditions for the year 2006 and Table 22b shows the direct (where available) disease costs (in Mio) and their adaptation to Swiss conditions for the year 2006. The latter were calculated to allow a more precise estimate of the percentage of the overweight and obesity linked economic burden with respect to the total health care expenditure in Switzerland.

The **total costs, direct and indirect**, caused by comorbidities attributable to overweight and obesity are given in detail in Table 23a. Of the total of **CHF 5'755 million** about half can be assigned to each the two population segments, the overweight and the obese, respectively.



The attributable risk of the **direct (overweight and obesity linked) disease costs** are detailed in Table 23b. With **CHF 3'830 million** the total of the direct costs is considerable lower compared to the total costs including the indirect costs.



Table 22a: Total (direct and indirect) costs (in Mio) of diseases linked to obesity and their adaptation to Swiss conditions for 2006

	Reference	Country	type of cost	cost year	currency	cost in €	PPP€→CHF	cost in CHF	exchange rate**	population adjusted cost§	2006 cost in CHF
Hypertension	87	D	direct	2002	€	8'100	1.77	14'337		1270	1470
Diabetes (NIDDM)	88	CH	total	2000	CHF					1654	2110
Stroke	89	CH	total	2004	€	304			1.544	469	502
Coronary heart disease	90	CH	total	1993	CHF					2163	2891
Breast cancer	91	CH	direct	2006	CHF						160
Colorectal cancer	92	D	direct	2002	€	1558	1.77	2758		244	283
Gallstones	93	US		1998	US\$	5'800	1.88	10'904		287	396
Osteoarthritis (knee & hip)	94	D	total	2002	€	11'828	1.77	20'935		1855	2148
Depression	89	CH	total	2004	€	5'595			1.544	8639	9248
Traffic accidents (sleep apnea)	95	CH	direct	2006	CHF					413	413
Asthma	96	CH	total	1997	CHF					1252	1763
Chronic kidney disease	97	D	total	2002	€	103§	1.77	182		16	19

* via PPP converted into CHF via €

** Quelle: Schweiz. Nationalbank: Devisenkurse in der Schweiz; <http://www.bfs.admin>

§ based on ICD codes N18 & N19 (chronic kidney insufficiency) in 2002 in Germany (total 50'792 cases)

Population: D (2002): 82.536.680
CH (2002): 7.313.853

USA (1998): 270.300.000
CH (1998): 7.123.500



Table 22b: Direct costs (in Mio) of diseases linked to obesity and their adaptation to Swiss conditions for 2006

	Reference	Country	type of cost	cost year	currency	cost in €	PPP€→CHF	cost in CHF	exchange rate**	population adjusted cost§	2006 cost in CHF
Hypertension	87	D	direct	2002	€	8'100	1.77	14'337		1270	1470
Diabetes (NIDDM)	98	CH	direct	1998	CHF					880	1215
Stroke	89	CH	total	2004	€	304			1.544	469	502
Coronary heart disease	90	CH	direct	1993	CHF					1017	1359
Breast cancer	91	CH	direct	2006	CHF						160
Colorectal cancer	92	D	direct	2002	€	1558	1.77	2758		244	283
Gallstones	93	US	direct	1998	US\$	5'800	1.88	10'904		287	396
Osteoarthritis (knee & hip)	94	D	direct	2002	€	7'188	1.77	12'723		1127	1305.0
Depression	89	CH	total	2004	€	5'595			1.544	8639	9248
Traffic accidents (sleep apnea)	95	CH	direct	2006	CHF					413	413
Asthma	96	CH	direct	1997	CHF					762	1073
Chronic kidney disease	97	D	total	2002	€	103§	1.77	182		16	19

* via PPP converted into CHF via €

** Quelle: Schweiz. Nationalbank: Devisenkurse in der Schweiz; <http://www.bfs.admin>

§ based on ICD codes N18 & N19 (chronic kidney insufficiency) in 2002 in Germany (total 50'792 cases)

Population: D (2002): 82.536.680 USA (1998): 270.300.000
 CH (2002): 7.313.853 CH (1998): 7.123.500



Table 23a Attributable risk of the total (obesity linked) disease costs

Disease	total disease costs (Mio CHF)	PAR in %		PAR based costs (Mio CHF)		attributable total costs BMI ≥25
		BMI 25-30	BMI >30	BMI 25-30	BMI >30	
Hypertension	1470	19.6	16.1	288	237	523
Diabetes (NIDDM)	2110	46	52.2	968	1102	2070
Stroke	502	17.6	13.4	88	68	156
Cornary heart disease	2891	9.7	9.4	280	272	552
Breast cancer	160	2.5	1.9	4	3	7
Colorectal cancer	283	3.9	2.3	11	7	18
Gallstones	396	18.1	16.2	72	64	136
Osteoarthritis (knee & hip)	2148	29.2	26.8	627	576	1203
Depression	9248	0	2.3		212	212
Traffic accidents	413					150
Asthma	1763	26	14.9	458	265	723
Chronic kidney disease	19	16.4	10.2	3	2	5
Total costs of comorbidities (Mio CHF)				2'799	2'808	5'755

Table 23b Attributable fraction of the direct (obesity linked) disease costs

Disease	direct disease costs (Mio CHF)	PAR in %		PAR based costs (Mio CHF)		attributable direct costs BMI ≥25
		BMI 25-30	BMI >30	BMI 25-30	BMI >30	
Hypertension	1470	19.6	16.1	288	237	523
Diabetes (NIDDM)	1215	46	52.2	559	634	1192
Stroke	502	17.6	13.4	88	68	156
Cornary heart disease	1359	9.7	9.4	132	128	260
Breast cancer	160	2.5	1.9	4	3	7
Colorectal cancer	283	3.9	2.3	11	7	18
Gallstones	396	18.1	16.2	72	64	136
Osteoarthritis (knee & hip)	1305.0	29.2	26.8	381	351	731
Depression	9248	0	2.3		212	212
Traffic accidents	413					150
Asthma	1073	26	14.9	280	160	440
Chronic kidney disease	19	16.4	10.2	3	2	5
Direct costs of comorbidities (Mio CHF)				1'818	1'866	3'830



3.6 Total costs

Direct treatment costs for obesity in Switzerland were estimated at CHF 47 million for the year 2006. Included in this sum are drug costs of CHF 25 million, counselling costs (nutritionists) of CHF 3 million and costs for surgical interventions of CHF 19 million (Table 24).

The total costs, direct and indirect, caused by comorbidities attributable to overweight and obesity for the year 2006 are given in Table 24. Of the total of CHF 5.8 billion, half can be assigned to overweight, the other half to obesity. The direct treatment costs for obesity represent less than 1% of the total cost estimate (direct and indirect costs for comorbidities) for the burden of overweight and obesity in Switzerland. Taking exclusively the direct comorbidity costs into account, the actual direct treatment costs for overweight and obesity amount to 1.2% of total costs. Thus, in either case, the majority of the total costs (approx. 99%) are caused by comorbidities associated with overweight and obesity.

Table 24 Total costs of treatment of overweight and obesity as well as direct and indirect costs of obesity linked comorbidities

	Costs in CHF (Mio)
<i>Direct costs:</i>	
Medication	25
Bariatric surgery	19
Dietary counselling	3
<i>Costs of comorbidities:</i>	
Attributable costs	
- total (direct and indirect) costs	5'755
- direct costs only	3'830
Total:	
- direct and indirect	5'802
- direct only	3'877

For the comorbidities, the direct costs accounted for approx. 67% of the total costs, and the indirect costs for approx. 33%.

As the prevalence of overweight is much higher than the one of obesity (1.8 million vs 0.5 million persons) the *per person costs* are considerably higher for obesity (approx. CHF 5'800 vs CHF 1'600) taking into account the direct and indirect costs of the comorbidities. In case of the direct comorbidity costs only, the per person cost are



still more than 3-times higher (approx. CHF 3'900 vs CHF 1'100) for the obese than for overweight people.

Since the total healthcare expenses in Switzerland did amount to CHF 52.7 billions in 2006 (Bundesamt für Statistik 2007), about 7.3% (direct comorbidity costs only) of these expenses are spent on the treatment of overweight and obesity related comorbidities.

3.7 Sensitivity analysis

This estimate regarding the cost of overweight and obesity in Switzerland is, like many other cost evaluations, based on input data subject to uncertainties or variations of unknown magnitude. With the following sensitivity analysis we attempted to incorporate possible influences of given uncertainties into the final numbers provided in this report and discuss possible effects of unknown variations.

3.7.1 Direct treatment costs

Since the direct treatment costs represent around 1% of the total overweight and obesity related costs, even a doubling of the direct treatment costs would not substantially change the overall costs.

3.7.2 Comorbidity related costs

Prevalence of overweight and obesity in Switzerland

The most sensitive parameter in the PAR formula is represented by the prevalence (p) values for overweight and obesity in Switzerland. These prevalence values are based on the results of the "Gesundheitsbefragung 2007" of the adult Swiss population. The prevalence data from the four available Health Surveys, conducted by telephone, from 1992/3, 1997, 2002 and 2007 show a remarkably consistent development as shown in chapter 3.1. Based on these data there is little uncertainty about the actual prevalence value for 2007. It is known, however, that public polls have limitations because they are based on self-reported weight and height. On average, body weight is underestimated and body height overestimated (6).



Relative risk ratios or odds ratios for comorbidities

The relative risks of developing various obesity-related diseases in the published literature show wide variability. To minimize publication-based uncertainties we preferably employed evidence linking obesity with a given disease, which was based on a meta-analysis of a substantial number of prospective observational studies. For the same purpose we also used approaches such as ongoing longitudinal cohort investigations of more than 50'000 subjects with over 10 years of follow-up resulting in very reliable relative risk ratio between body weight increase and the incidence of a cost-intensive disease such as diabetes mellitus Type 2.

Diabetes Type 2 represents by far the most costly comorbidity of overweight and obesity (Table 23a & b). Any change in the relative risk of developing diabetes might therefore affect total costs associated with overweight and obesity.

It is known, however, that physical inactivity and obesity are strongly and independently associated with development of diabetes Type 2 (99). Thus, the likelihood of developing diabetes Type 2 is reduced under conditions of physical activity (99). The relative risk, for example, is reduced by 5 points from 13.7 to 8.7 with BMI >30. Taking such a reduced relative risk into account reduces the PAR (BMI >30) from 52.2% to 40.6% and reduces the corresponding attributable costs by CHF 140 Mio resulting in total direct costs of CHF 3'737 Mio. In relation to the total healthcare expenditure the overweight and obesity associated cost would thus be reduced only minimally from 7.3% to 7.1%.

Comorbidity-related costs

Cost estimates rely heavily on accurate prevalences as well as adequate costing measures. In our cost assessment we have to rely on sensitivity analyses provided by the authors of the original burden of illness analysis for a given comorbidity. In our analysis four comorbidities (diabetes mellitus, coronary heart disease, osteoarthritis and asthma) are responsible for close to 70% of the total direct overweight and obesity related costs. Therefore, we checked the original publications for provision of a basic sensitivity analysis on their specific cost estimate. Unfortunately, for the direct medical cost of diabetes Type 2 (98), for the direct osteoarthritis costs (94) as well as for the direct asthma costs (96), no sensitivity analysis was provided. For coronary heart disease (CHD) (89), a hypothetical increase in patient numbers by 10% translated into a 10% increase in direct inpatients cost resulting in an actual cost increase by CHF 26 Mio translating into an increase in total obesity related costs in Switzerland (CHF 3'877 Mio) of less than 1%.

In conclusion, based on the above sensitivity analysis and the many unknown variations, we estimate that the total direct costs of overweight and obesity and its associated comorbidities lay somewhere between CHF 3'700 and 4'200 Mio representing between 7 and 8% of the total health care expenses in Switzerland in 2006.



4. DISCUSSION

Since decades overweight and obesity have been recognised as important risk factors for developing a series of chronic diseases associated with long term morbidity. Often it has been speculated that lifestyle factors such as sedentary behaviour, i.e. a lack of baseline physical activity, and the consumption of high-fat, high-caloric food products are responsible for the substantial increase in body weight and BMI, respectively, observed in both industrialised as well as developing countries (100). As reported by the International Association for the Study of Obesity (IASO), the prevalence of obesity as defined by BMI >30 has surpassed the 20% population mark in many European countries (101). As a consequence, overweight and obesity are frequently making media headlines and are amongst the highest priority public health issues in the world (102). To make matters worse, current evidence suggests, that the prevalence of overweight and obesity is likely to remain on the rise in the US (103), in developing countries (104) but in Europe as well (105). Taking this worldwide development in obesity into account, one central question pops up automatically: Will the entire Western world become overweight or obese in the decades to come?

Part of the present study aims at providing a possible answer to this question with respect to the overweight and obesity situation in Switzerland. It was a primary goal to thoroughly analyse the nationally representative survey data collected over the past 15 years, from 1992 to 2007, and to provide, based on this analysis, projections regarding the further development of the prevalence of overweight and obesity in the coming 15 years until 2022.

Between 1992 and 2007 a rapid and significant increase in the prevalence of overweight (BMI >25) in the adult Swiss population (age 15 years or older) of 7%, from 30.3% to 37.3%, was caused by a predominant increase in the proportion of overweight individuals with BMI 25-30 by 4.3% (from 24.9% to 29.2%) and a concomitant increase of the obese population by 2.7% (from 5.4% to 8.1%).

Projection of the further development from 2007 until 2022 based on the above prevalence data by a nonlinear curve fitting model, offers an estimated minimal increase to 37.7% (from 37.3% in 2007) in the adult Swiss population with BMI >25 indicating a considerable slow down in prevalence increase compared to the preceding 15-year period reaching a plateau just below the 40% mark. This projection indicates, that the development of overweight in the entire Swiss population may have reached its peak since the expected minimal increase in overweight prevalence in the coming 15-year period remains within the uncertainty of the evaluation method. The corresponding prevalence in 2022 in the population segment with BMI $\geq 25 < 30$ is expected to be around 30.1%, an estimated minimal increase by 0.9% from 29.2% in 2007. The total overweight population (BMI >25) as well as the obese population segment (BMI >30) may be expected to basically stabilize between 2007 and 2022 at about the 2007 level. If this assumption is confirmed by the results of the upcoming 3



health surveys (2012, 2017, 2022), it may be concluded that the overweight segment of the Swiss population has reached a stable plateau.

Our prediction of the expected development of the obesity epidemic in Switzerland is not as grim as the outlook for the US, which forecasts that, by 2048, all American adults would become overweight or obese, while black women will reach this state by 2034 (106). In the context of this gloomy projection for the US population it has to be mentioned that for the US projections a linear regression model was used to extrapolate future prevalence rates. Obviously such a model does not adequately reflect the complexity of the situation, but produces merely a linearization of the detectable trend based on the presently available data. Under these circumstances you cannot detect a curve approaching an actual saturation kinetic. Using a non-linear regression model approach with a 3-parameter logistic function (the third parameter setting an upper limit), however, allows exactly to do this while matching with the already available prevalence data can be achieved in addition.

How does the situation present itself in the neighbour countries of Switzerland such as Austria, France, Germany and Italy?

Based on recently published data from an OECD Health working paper (107), a significant increase in the prevalence of overweight (BMI >25) in the adult Austrian population (15-64 years of age) of 11.2%, from 35.1% to 46.3%, was observed from 1983 to 2006, while the prevalence in the obese segment rose by 6.2% (from 6% to 12.2%).

In France (107), the prevalence of overweight (BMI >25) in the adult French population (15-64 years of age) rose by 6.5%, from 28.4% to 34.9%, in the 15-year period between 1990 and 2004, whereas the prevalence in the obese population increased by 3.8% (from 5.5% to 9.3%).

In Italy (107), the prevalence of overweight (BMI >25) in the adult Italian population (15-64 years of age) rose by 4.5%, from 35.3% to 39.8%, in the 10-year period between 1994/5 and 2005, whereas the prevalence in the obese population increased by 2.3% (from 6.3% to 8.6%).

In Germany, a survey in primary care practices carried out in 2005 showed a high prevalence in overweight (47.5% in males, 30.6% in females) and obesity (24.7% in males, 23.3% in females) in the adult German population (18 years and older) (108).

In all of the above countries with nationally representative data collections over the past 1-2 decades, a rapid increase in the prevalence of overweight and obesity during the last 20-30 years reaching epidemic proportions. While the development in France showed a comparable increase in overweight and obesity to Switzerland over a comparable time period, the other German speaking countries Austria and Germany reached considerably higher proportions in the overweight and obese segments of the



adult population, whereas our neighbour to the south, Italy, shows higher prevalence rates for overweight and obesity than Switzerland, but lower ones compared to Austria and Germany.

Unfortunately, there is no obvious explanation for the observed differences between these industrialized countries located in central Europe. It can only be speculated that differences in the obesogenic environments (aspects of physical, social and economic environments that favour obesity development) exist between these countries that are responsible for the observed differences in overweight and obesity prevalence rates developed over time.

In our previous report on the burden of overweight and obesity in Switzerland (3), we identified 26 diseases as overweight and obesity related comorbidities. In the present study this number was slightly increased to 32 diseases indicative of the fact, that more information on the relationship between obesity and yet other diseases is reported every year. In 2004 we were able to assign costs to 18 diseases considered as comorbidities clearly associated with obesity. In the present study we included a smaller number of comorbidities, i.e. 12, as cost-relevant diseases for Switzerland. Irrespective of this restriction in cost-relevant diseases, the total (obesity linked) disease costs of overweight and obesity in Switzerland more than doubled from CHF 2'648 (cost basis 2001) to CHF 5'755 Mio (cost basis 2006). For the cost estimate reported in 2004, four diseases contributed to a large part (88.6%) to the final result: diabetes mellitus Type 2 (54.5%), coronary heart disease (15.8%), hypertension (9.5%), and depression (8.8%). Depression, which exclusion is based on recent findings of a lower attributable risk with overweight and obesity as previously anticipated, and hypertension did drop out of the top four cost-relevant diseases in the present study and were replaced by osteoarthritis (knee & hip) and asthma. These four diseases amount to a total sum of CHF 4'548 Mio representing 79% of the total obesity-attributable costs. In contrast to our previous study where costs estimates of only three of the comorbidities were based on actual Swiss data, the present cost evaluation relies on seven Swiss based cost estimates, three of them (diabetes Type 2, coronary heart disease and asthma) belonging to the top four with regard to cost relevance.

The attributable fraction of the direct overweight- and obesity-linked disease costs of CHF 3'830 million representing about 7.3% of the total healthcare expenses in Switzerland of CHF 52.7 billions in 2006 (Bundesamt für Statistik 2007), is considerable lower compared to the total costs including the indirect costs of CHF 5'755 Mio.

The exclusively obesity-linked costs (direct comorbidity costs only) of CHF 1'866 Mio represent about 0.38% of the national gross domestic product (GDP) of CHF 486.2 billions in 2006 (Statistisches Jahrbuch der Schweiz 2008). According to a recent study on the health-economic burden of obesity in Europe, the estimated obesity-



related costs range from 0.09 to 0.61% of the total annual gross domestic income in Western European countries (109). Thus, our present results for Switzerland are comparable to estimates from other European countries, but also to other non-European populations such as Canada and New Zealand having similar obesity-related costs ranging from 0.2 to 0.6% of the GDP (110, 111). In the United States – one of the countries with the highest overweight and obesity prevalence reported – the total costs in the year 2000 amounted to US\$ 117 billions (112) and the direct health-care costs projected into the year 2010 are estimated to be between US\$ 175 - 194 billions (106). Cost attributable to obesity ranged from 0.95 to 1.34% of the GDP (113, 114) and are considerably higher than reported above for European as well as non-European countries, a finding which is consistent with the even higher prevalence of obesity observed in the US compared to the other countries (103).

As usual, our study has certain limitations. As mentioned earlier, the model used for our projections is based on a number of assumptions. Future trends, developments or events may prove these assumptions to be wrong. Furthermore, despite our efforts to identify costs of obesity-linked comorbidities based on Swiss estimates, we only were able to provide Swiss-based data on seven comorbidities out of the twelve diseases considered to be cost-relevant. Four cost estimates of comorbidities were based on German data and for one disease (gallstones) US data were used for a corresponding cost estimate. In addition, direct as well as indirect costs represent an underestimation of the true costs for the Swiss society since obesity and obesity-linked comorbidities are cause for additional problems such as increased postoperative complications, prolonged rehabilitation periods, increased incidence of invalidity and unemployment, which all are not taken into account in this report.

In summary, in 2007 close to 40% of the adult Swiss population (>15 years) were either overweight or obese (BMI > 25). More than 8% (8.8% of the males, 7.7% of the female population) were considered obese (BMI > 30). However, projection of the further development until 2022 based on the available prevalence data (nationally representative survey data collected from 1992 to 2007) by a nonlinear curve fitting model, indicates a considerable slow down in prevalence increase compared to the preceding 15-year period (1992 to 2007) reaching a plateau just below the 40% mark. This projection suggests, that the development of overweight and obesity in the Swiss population may have reached its peak already or may reach it in the next few years. Compared to our first assessment in 2004, the estimate of the total economic burden for overweight and obesity and associated diseases (comorbidities) has more than doubled over the past five years from CHF 2'648 (cost basis 2001) to CHF 5'755 Mio (cost basis 2006) from the societal point of view. Both, overweight and obesity, contribute equally to these costs. Thus, overweight and obesity continue to represent a considerable financial burden for the Swiss health care system and the Swiss society as a whole and is expected to increase in the years to come due to an increasing prevalence of obesity-linked comorbidities despite the expected stabilization in the prevalence of overweight and obesity.



5. CONCLUSIONS/RECOMMENDATIONS

A clear implication of our findings is that the observed rapid increase in prevalence of overweight and obesity in Switzerland over the past two decades is slowing down at a relatively high level for men and a lower but still substantial level for women. What does such a development mean for the Swiss population in general and for the Swiss health care system in particular? Is it acceptable from a political point of view that a substantial percentage of the Swiss population is and shall remain overweight or obese? Are the high health care costs occurring in the overweight and obese fraction of the population acceptable to the rest of the population? These are questions that will have to be answered in the years to come. Needless to say that in the light of the continuously increasing health care costs the discussion may be vehement and of passionate nature.

In this context it is important to emphasize that there is a wide variety of obesity treatments available, including diet, exercise, behavioral modification, pharmacological treatment and surgery. Among several strategies, we have documented in a previous study that lifestyle intervention leads safely to improvements in metabolic abnormalities such as increased body weight, dyslipidemia, elevated blood pressure and decreased insulin sensitivity that are linked to the development of obesity, diabetes, metabolic syndrome and cardio-vascular disease (115). Furthermore, it was shown that lifestyle intervention is an effective prevention tool with beneficial effects maintained for more than three years (115). Lifestyle programs are multi-factorial interventions that are designed for each individual patient or group of patients according to their risk factor status and specific needs of the subjects. These include promoting habits of a healthy lifestyle, dietary counselling, physical exercise and behavioral modification targets. Especially overweight individuals at risk for obesity, diabetes and cardiovascular disease may be influenced through learning process to allow the lifestyle changes to control risk factors such as body weight, blood pressure, blood cholesterol and blood glucose levels.

In addition, an economic analysis clearly indicated that lifestyle intervention is cost-effective in the long-term prevention and treatment of obesity (116). Thus, lifestyle intervention allows allocation of limited health care resources while ensuring that any additional cost is justified by the additional benefits such as increased survival duration and quality of life over lifetime (116). Improvements in quality of life are of great importance to take into account when deciding on treatment options for subjects suffering from overweight and obesity.

In conclusion, given the high cost attributable to obesity and associated comorbidities, obesity treatments via life style changes proved to be cost-effective interventions. Therefore, we continue to recommend that lifestyle interventions should be considered the first line therapy in prevention and treatment of obesity and that corrective programs/policies are implemented to avoid the inevitable consequences of



accepting a large part of the Swiss population to remain overweight and obese. The present direct costs of close to CHF 4 billion attributable to overweight and obesity still represent too large a portion of the national health care budget to be acceptable as a fixed expenditure for the overweight and obese portion of the Swiss population at the projected level. Considering the epidemiological development over the upcoming two decades in Switzerland, it appears that we need to allocate a significant amount of health care resources for the care of the elderly rather than for the “unnecessary” treatment of obesity-associated comorbidities.

One important aspect that is not accounted for in our previous studies is the association between socio-economic factors and the prevalence of overweight and obesity in Switzerland. Information on the link between socio-economic factors and obesity is of great importance for understanding of the determinant of obesity. The key question is whether socio-economic factors and obesity are interdependent, or does there a one-way causal relationship exist between the two, and if so, in what direction does it run. In this respect we recommend to apply the tool of multivariate analysis to the combined data from the nationally representative survey data collected over the past 15 years, from 1992 to 2007. Multivariate analysis (MVA) is based on the statistical principle of multivariate statistics, which involves observation and analysis of more than one statistical variable per subject/person at a time. With the help of multivariate analysis it is possible to analyse a number of socio-economic parameters for a possible causal relationship with overweight and obesity in the presence of many covariates and to eventually determine which of these factors are most important in the development of obesity.



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