Excess mortality in Switzerland from 2020 to 2022 (week 42)

report for
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summary

Excess mortality calculations can answer several questions. On the one hand, there is the question of whether deaths are reaching an unprecedented level. A positive answer to the question posed is a sufficient condition to consider unprecedented pandemic measures, provided they are effective.

On the other hand, excess mortality can also be used to determine whether the death rate during a pandemic is higher than would be expected without a pandemic. In this view, the aspect of the historically exceptional is missing. Temporary excess mortality in this sense is merely a necessary but not a sufficient condition for pandemic measures

Hagemann's calculations answer the first question about what is historically exceptional, and negatively so. If the years 2020 to 2022 are viewed as a whole, none of them reach a historic peak.

This means that there were outbreaks of the pandemic, but after taking into account the size and age structure of the population, they were never greater than what had already occurred in terms of excess mortality in previous years. This result is supported by the Nobel Prize winner Michael Levitt and John Ioannidis, the internationally most cited health statistician, who cannot prove positive excess mortality for Switzerland in around 66% of all the variants they have calculated.

The excess mortality calculation of the Federal Statistical Office (BfS) answers the second type of question. This shows that there have been at least three major spikes in mortality among seniors aged 65 and over since 2020. However, the aspect of the historically exceptional is not the subject of these analyses.

The BfS also shows that in 2022 there will be persistent excess mortality in this largely vaccinated age group. Up to week 42, there are currently 3,900 excess deaths, which is already higher than the total excess mortality in 2021 (3,600 cases).

The BfS does not show any significant excess mortality for residents under the age of 65. However, it is sufficient to cumulate the figures from the BfS, so that an almost monotonous increase in mortality is also revealed in this age group (0-64).

Although the cumulative values will drop again from January 1, 2022, this is solely due to the fact that the BfS has a massive and also extraordinary

Increase in deaths expected in 2022. This means that the BfS data also show increased mortality for those aged 0 to 64, either because the BfS tacitly included this assumption in its calculation model at the beginning of the year, or because excess mortality also results for 2022 as soon as the assumption of a sharp increase in the fatalities among younger people is reversed.

In addition, there is a 10% drop in the number of births in 2022, which is unique in the last 100 years and started exactly nine months after the vaccination peak in this age group. The hypothesis put forward by Swissmedic as justification, that this is simply a change in behavior and therefore a voluntary renunciation of children and not a possible side effect of the vaccination, is not convincing. A (probably) voluntary decline in births in those cantons that later have a high vaccination rate can already be demonstrated in 2020. However, this change in behavior is ten times smaller than the decline in 2022. That a ten times stronger change in behavior should now follow the vaccination, especially in those cantons in which the voluntary decline in the birth rate for 2020 could not be proven at all seems rather implausible. Even if this is not yet hard evidence, there is increasing evidence that the vaccination has a fertility-reducing effect.

In principle, it should be noted that additional knowledge can be expected at any time. Nevertheless, the still upheld, explicit vaccination recommendation from Swissmedic and BAG, among others, seems rather adventurous to us, of all things, for pregnant women.

Table of Contents

1 Excess mortality – meaning, methodology and focus

This paper analyzes excess mortality in Switzerland from 2020 to week 42 in 2022.

1.1 Importance

The topic of "excess mortality" is of central importance and has rightly received particular attention in the media in recent years. The lethal risk of a pandemic can only be estimated on the basis of excess mortality. Because not everyone who dies from the pandemic would necessarily have survived the pandemic year. Some would have died from other causes in the same period even without the pandemic. Only the "excess mortality" shows whether the pandemic killed more people than would have been expected without the pandemic.

This effect can also be seen in the BfS statistics on the causes of death in 2020. Although 35% died from Covid-19, other causes of death also recorded a corresponding decrease in frequency (cf. Hagemann 2022a).

In addition, as a more technical advantage, the deaths are routinely and almost completely recorded, while diagnoses are always accompanied by data collection errors.

The pandemic only has a lethal effect on the population if excess mortality occurs, i.e. if more people die than expected. That is the central meaning of this size.

1.2 Methodological problems

Excess mortality is the difference between the expected and actual number of deaths (TdF). This required a good forecast of the expected TdF. If expectations are too high, excess mortality will be too low and vice versa.

This already reveals a fundamental problem. The quality of a forecast is usually measured by its agreement with the values that actually occur later. This type of quality control is not so easy to do when calculating excess mortality because the

«False prognosis» (or the deviation from what is expected) is the target value of the study. In this respect, there is always uncertainty as to whether the statistically reported excess mortality actually reflects real excess mortality or merely represents an underestimation of natural mortality.

It is striking that there is neither a uniform understanding nor a universally uniform definition of the term for this important parameter. Depending on the context and objective, different methods are used side by side (method pluralism). In addition, the parameters used also vary greatly and the choice of parameters cannot be justified objectively. However, this is not unusual in statistical evaluations and there are methodological principles to at least limit this problem:

1. Simpler models are preferable to mathematically complicated ones.
2. Variables that change over time and have a strong influence on deaths are to be standardized in the calculation.
3. The chosen model should deliver robust results, i.e. those that do not react significantly to small changes in the choice of parameters.
4. The model should be transparent insofar as it is reasonably clear which variables are responsible for changes in the result.

Simplicity: «But why are simple methods so important from our point of view? (...) In a crisis like this, trust in statistical evaluations is an important asset. This asset is better preserved if the calculations presented are intuitively comprehensible. Even if very few go and check the numbers themselves, the fact that they can check them with a pocket calculator is enough to increase confidence in the statistical statements.

This transparency argument is accompanied by a methodological principle: A proven statistical procedure consists in allowing the data as much original freedom of expression as possible and not subjecting them to indiscriminate mathematical transformations (ranking, smoothing, taking logarithms, etc.). Because each transformation falsifies the original statement of the data a little (in individual cases even very strongly), and when complicated transformations are connected in series, it is no longer clear whether the final result actually still reflects the structure of the data or only the structure of the mathematical ones Transformation reflects." (Beck/Widmer, 2021, chap. 11.3).

Standardization:More deaths are to be expected in large collectives than in smaller ones; the same applies to collectives with a high proportion of seniors. The standardization of these influencing variables is part of the standard in health statistics itself and part of day-to-day business in practical statistics (e.g. in an insurance company's actuary's office) (cf. the description of the "practitioner method" in Beck, 2013, Chapter 3.3).

Robustness:A method is robust if variations in the calculation method cause only small variations in the result. The Nobel Prize winner Michael Levitt and the most cited health statistician John PA Ioannidis examined the robustness of the calculation by calculating the excess mortality in Switzerland with 66 differently parameterized models (Levitt et al. 2022). The results for the years 2020 and 2021 ranged from 5.7% excess mortality to -8.2% mortalitydecline.The average of all 66 calculations was one mortalitydeclineof -1.3%. These results show that the evidence of excess mortality in Switzerland depends very much on the selected parameters and in this respect does not represent a robust result, not even the one to be expected. We will be able to illustrate this result in Figure 2 below.

Transparency:Transparency arises not only through the use of simple models (cf. simplicity) but also through the fact that all the assumptions that determine the results are disclosed to the statistics consumers.

1.3 Method dispute or differences in the question?

Technical aside, the importance of an excess mortality calculation also depends on the sender. The most important official calculation in this regard comes from the Federal Statistical Office (BfS), which is the basis of many arguments in politics and the media.

In short, the BfS postulates no significant excess mortality among residents under the age of 65, but large and persistent excess mortality up to 2022 among senior citizens.

In contrast, Hagemann's calculations have established themselves as a frequently cited alternative over the past two years. At first glance, the two approaches differ: Hagemann tends to question excess mortality (thus confirming the results of Levitt et al. cited above) or restricts excess mortality to the highest age groups. He uses a relatively simple, age-standardized approach, weighting the death rates of each age group with an identical standard population for all reference years, resulting in an annual death rate per 100,000 population, making mortality comparable across years. This procedure basically follows the recommendation of the WHO from 2001 and the European joint project of the Eurostat task force for the comparison of different years and ensures that the demographic change does not distort the result.

The BfS model, on the other hand, is more complicated. For each week, it “uses the mortality rate of the same calendar week of typically five previous years, takes additional changes in age structure and life expectancy into account and derives an expected value for the current death figures from this. To estimate (..) for 2022, the statisticians also factor out the pandemic-related excess mortality from 2020 and 2021” (Schöchli, 2022).

The comparison of the Hagemann and BfS methods shows that there are two different questions behind them. Hagemann asks whether there is currently a death rate that exceeds previous pandemics (usually influenza waves), while the method of the BfS is much more finely calibrated because it wants to recognize and trace every single pandemic with fatal consequences, regardless of whether the pandemic is small or large. The reference of the BfS is therefore not simply the deaths of the past years, but the death history of the past when all excess mortality has been filtered out. It is therefore not surprising that the BfS method indicates excess mortality earlier than Hagemann's.

An important difference in these models arises from the treatment of life expectancy. Based on their own calculations, Beck and Widmer (2021, Chapter 11.2) come to the conclusion that excess mortality in Switzerland only results if a continuous increase in life expectancy is assumed. This parameter is crucial. To this end, Levitt et al. (p. 11), the choice of certain anticipated temporal trends in mortality can significantly determine the outcome without the choice of trend being tested to determine whether it is appropriate. Anyone who assumes decreasing mortality is already provoking excess mortality in the event that the mortality of a population remains constant. There would be no guarantee that mortality rates would have to decrease continuously.

Hagemann is thus looking for an unprecedented level of excess mortality, while the Federal Statistical Office reports any short-term presence of excess mortality, regardless of historical classification. Hagemann's approach is therefore better suited to justifying "unprecedented" pandemic measures.

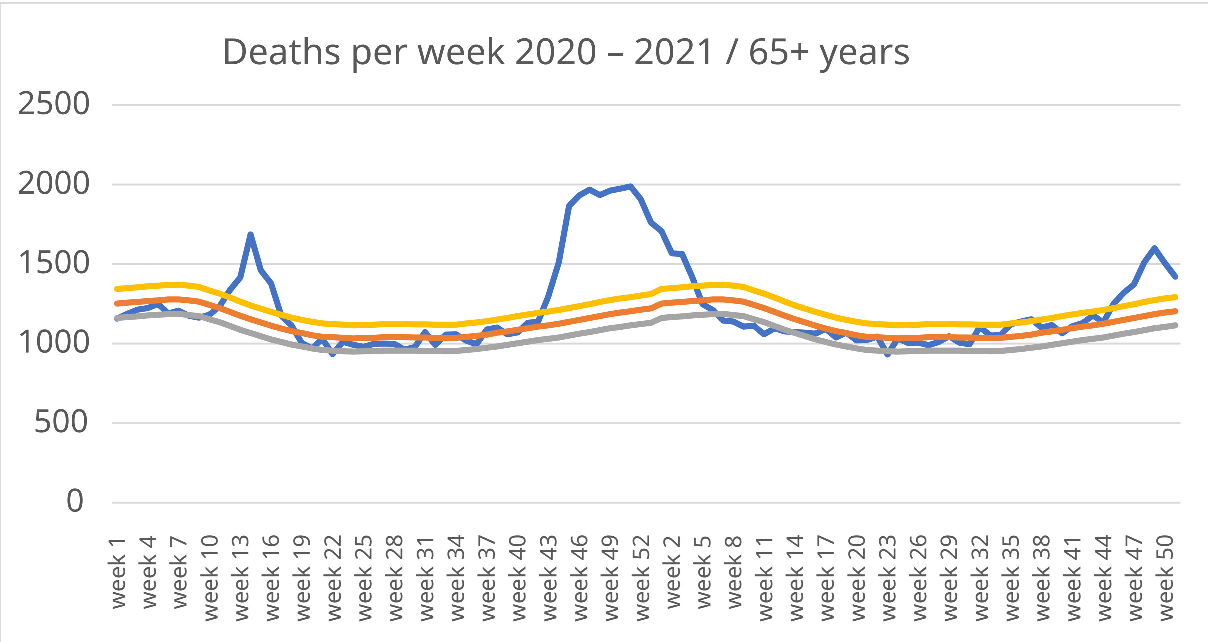
1.4 Analysis of excess mortality according to the Federal Statistical Office

Nevertheless, we will continue to examine the BfS model below. On the one hand because of its dominant position in the public discussion, on the other hand because we have shown that the BfS model is better able to depict short-term and not necessarily historically unique pandemic swings.

It is also about checking whether the BfS model is "simple, standardized, robust and transparent". Much more important, however, are the additional conclusions that can be drawn from the BfS model but are not drawn by the office.

How does the BfS present its results? In figure 1 we see the actual deaths per week (blue zigzag line), the expected deaths (brown). Deflections that move within the yellow and gray boundary lines are considered random deviations. Rashes exceeding the yellow border are considered excess mortality.

illustration 1



In the period shown (2020 to 2021), three excess mortality rates can be identified, the so-called first, second and third corona wave. Although there is no objective definition of

Limiting lines, however, the deflections are so marked that smaller shifts of the limit inwards or outwards hardly affect the excess mortality measured. The excess mortality according to the BfS of over 65-year-olds is thereforerobust,not for 0 to 64-year-olds (cf. discussion of Fig. 2). Oneage standardizationis available. aseasythe model cannot be described on the basis of the description in Section 1.2, not even efficiently, especially since the practically identical excess mortality in Fig. 4 can be derived based on a much simpler regression. It is also deficientTransparency,because, among other things, the decisive assumption on mortality was changed significantly but tacitly during the course of the pandemic, which has a significant impact on excess mortality, without this change or its consequences having been openly discussed. The public today is neither aware of this change nor of its consequences for excess mortality among the under-65s (cf. discussion of Figures 7 and 8).

2 Excess mortality over 65 years (2010-2022)

Let's look at seniors first, 65+. Here we follow the calculations of the BfS one to one and the following is shown:

The situation for the largely vaccinated older population is devastating after three vaccination campaigns and numerous corona measures.

Table 1: Excess mortality per year, 65+

Year	number weeks	Of that weeks with survivor honesty	number of survivors fatalities
2022	42	25	3885
2021	52	15	3570
2020	53	16	8739
2019	52	3	297
2018	52	5	615
2017	52	6	1468
2016	52	1	205
2015	53	15	2770
2014	52	0	0
2013	52	5	566
2012	52	5	480
2011	52	1	99
2010	52	3	288

- From 2010 to 2019, on the one hand, there were short, severe excess mortality periods of around 5 weeks with 0 to 1500 unexpected deaths, and on the other hand the year 2015, which was unusual, with 15 weeks of excess mortality and 2770 unexpected deaths.

- The years 2020 and 2021 show the same length but more severe rashes (16 and 15 weeks, but 8,740 and 3,750 excess deaths).
- The year 2022, with its largely vaccinated population, comes as a great surprise. Excess mortality occurred for 25 weeks through week 42. This is a unique record compared to previous years. In addition, there are already more excess deaths (3,900) than in the whole of 2021 (3,600).

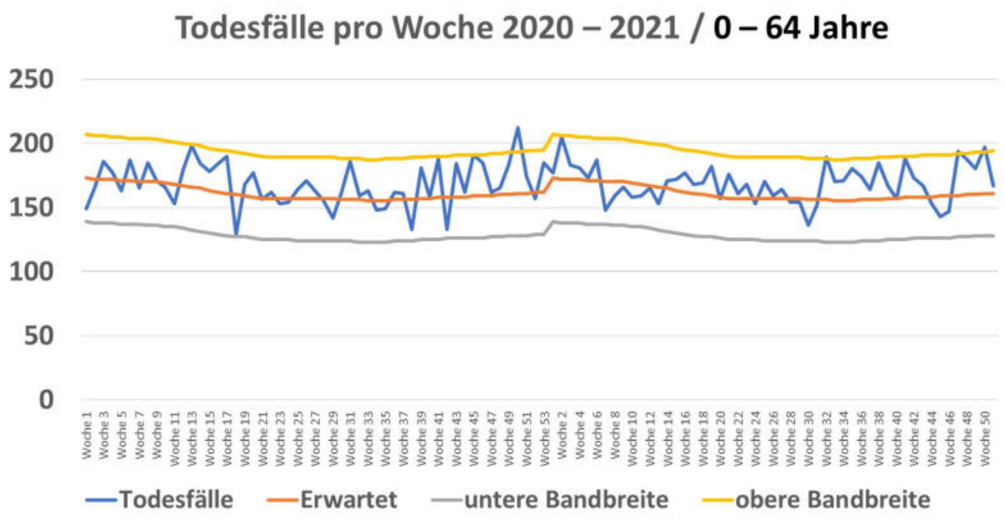
A long-term positive effect of measures and Covid-19 vaccination cannot be read from this table. The table follows the original data of the BfS.

3 Excess mortality up to the age of 64 (until 2021)

3.1 Insufficiently robust measurement of excess mortality

Let us now turn to young adults and children. Basically, the methodology of the BfS is the same here. In contrast to Figure 1, Figure 2 shows only very small deflections. In the period shown, weekly deaths exceed the upper range in only four places and only very slightly. So excess mortality is rare.

Figure 2



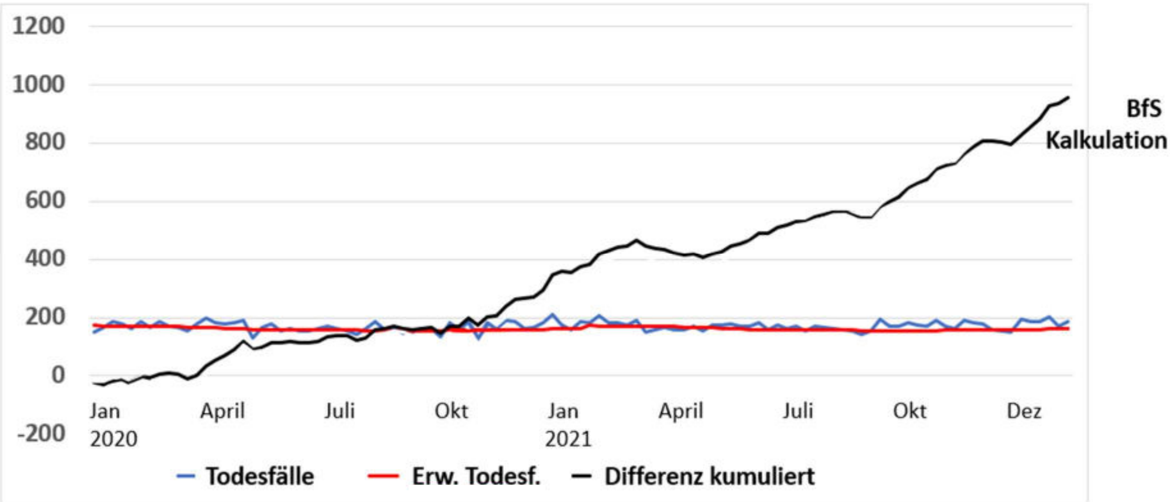
Because there is no "objectively correct" range - there are only commonly used interval widths - is the measured excess mortality among the over 65-year-oldsno longer robust.In Figure 2, if the range is defined a little wider, there is no excess mortality at all, if it is defined narrower, there is much more excess mortality.

3.2 Cumulative excess mortality (0-64)

We therefore move to a more robust definition of excess mortality by cumulating the weekly positive and negative deviations. This means that in 2020, week 30, we do not show the number of deaths for this week, but the sum of the deviations from the expected value from weeks 1 to 30. This results in the curve of the cumulative excess and under-mortality (see Fig. 3). Others use the same method (e.g. «our world in data» or «US Mortality»).[1]

If there is no excess mortality, then the positive and negative deviations roughly cancel each other out. The curve of the cumulative values meanders slightly around the curve of the expected deaths (see Fig. 5, the years 2015 to 2019). If, on the other hand, there is excess mortality, the cumulative curve rises continuously, which is surprisingly shown in Figure 3 for the 0-64 year olds:

Figure 3: Cumulative excess mortality 0-64 years



The curve of the cumulative deaths (black) increases almost continuously. There is neither a substantial decline nor a prolonged flattening.

Conclusion:If the deviations of the 0-64 year olds are cumulated, the younger adults also show persistent excess mortality.[2]

[1] See.https://ourworldindata.org/grapher/cumulative-excess-deaths-covid?country=USA~RUS~MEX~BRA~IRN~PER

[2] The curve in Fig. 3 can be justified. Fig. 2 shows that the major part of the blue curve is above the brown line (of expected deaths). However, because these values are within the «random»

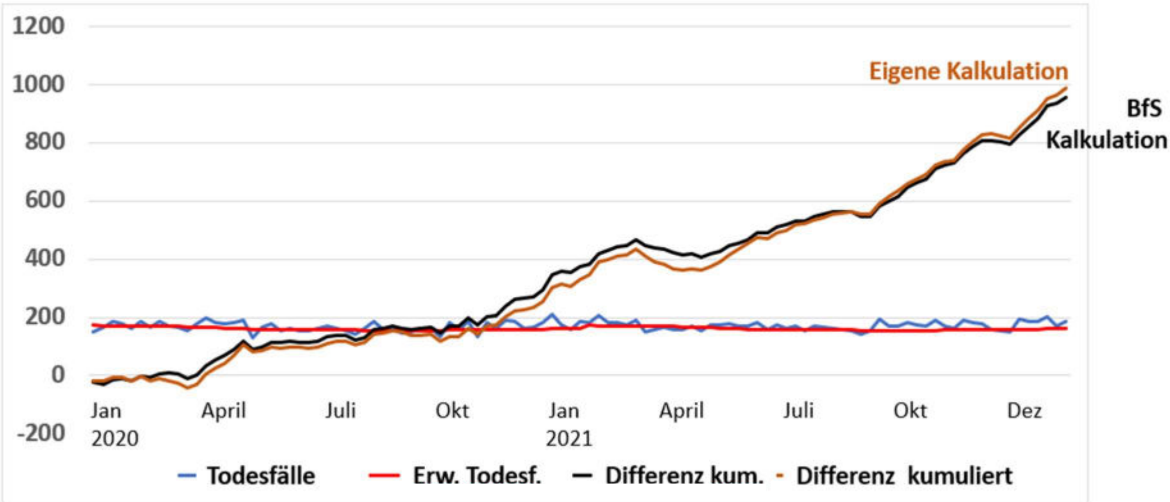
3.3 Age group subdivision – recalculation of expected deaths

Because the years 0-64 summarize completely different age groups, we divided the data into the groups 0-19, 20-39 and 40-65 years.

The BfS does not publish "expected deaths" for children and young adults. We were therefore forced to calculate these ourselves. To do this, we constructed a regression that is intended to reproduce the data published by the BfS (for 0-64 year olds) as precisely as possible.

For an explanation of the content of the regression, see 6.1. We can show the agreement in Figure 4. The brown curve we calculated for the expected deaths is quite close to the expected TdF according to the BfS (black curve).

Figure 4: Cumulative excess mortality 0-64 years, BfS method and Beck method



We then apply the same regression formula that we used to generate the brown curve in Fig. 4 to the death rates for children (0-19), young adults (20-39) and older adults (40-64). One way to think of it is that we use the same formula but calibrate it with the deaths by age group (again details in Appendix 6).

The results for the 40-64 year olds are not discussed further here because they show a very similar trend as for the 65 year olds.

fluctuation range (i.e. below the yellow curve), they are not included in the calculation of excess mortality by the BfS. Because the blue values do not fluctuate randomly and correspondingly evenly within the random interval, but mostly lie above the brown line, the cumulative value in Fig. 3 does not fluctuate but increases.

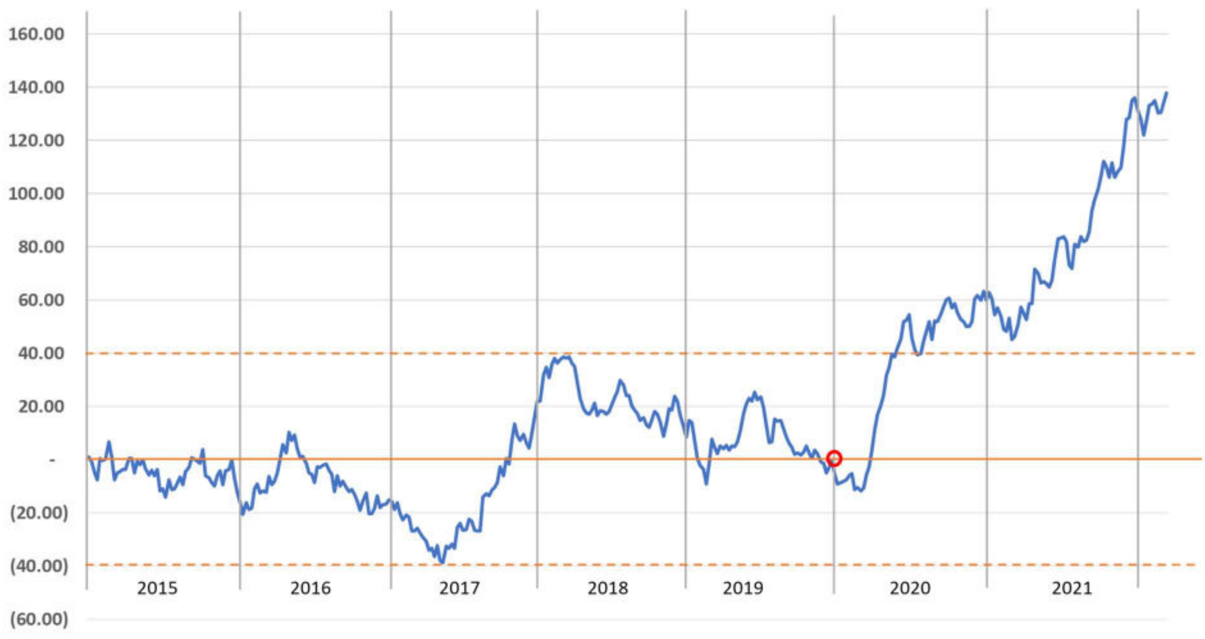
3.4 Young adults 20-39

The situation is different for young adults (Fig. 5). From 2015 to 2019, the cumulative values fluctuate within plus/minus 40 TdF, as expected. With the first wave (March/April 2020), the cumulative values   increase slightly beyond this range (of 40 TdF).

It is striking that the big second wave (end of 2022/beginning of 2021, see Fig. 1) is not visible in this curve. The corona infection but also the measures had hardly any lethal impact on this age group. Excess mortality only starts when the vaccination should bring relief, namely from around February 2021. Only then does the cumulative excess mortality climb to an additional 140 TdF and thus well above the usual range of +/- 40 TdF. All statements are based on the BfS death data and the methodology, which was developed in close accordance with the BfS method (cf. section 3.3).

Conclusion:While the violent second wave of Covid-19 had little or no effect on the boys in terms of lethality, an exceptional lethality did not set in until February 2021 and thus from the time of vaccination.

Figure 5: Cumulative excess mortality 20-39 years



3.5 Children 0-19

Even with the death data from the BfS for children (0-19), the cumulative curve before the pandemic regularly fluctuates between a little more than plus/minus 20 TdF. An increase in excess mortality can only be seen here in the period of the second wave. This is likely to be related to the measures and cannot be a side effect of vaccination because at that time (end of 2020/beginning of 2021) no vaccination was approved for children. Here, too, there is an extraordinary excess mortality compared to previous years.

Conclusion:The most vulnerable among the children certainly paid a price for the Corona measures.

Figure 6: Cumulative excess mortality 0-19 years

The statement is in turn based on the BfS death data and the methodology, which was developed in close accordance with the BfS method (cf. Section 3.3).

4 Excess mortality from 0 to 64 years in 2022

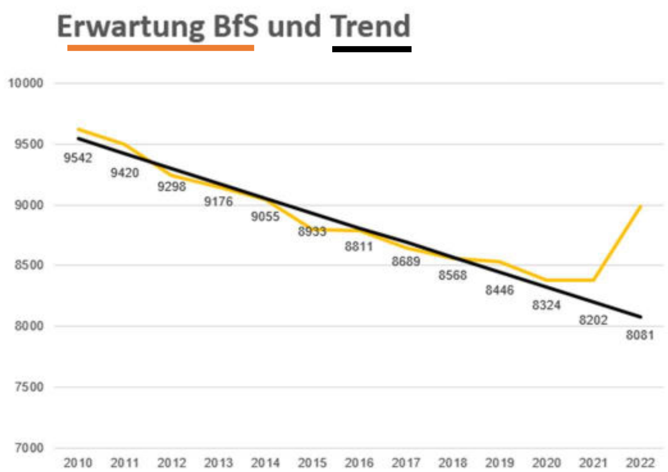
So far, the year 2022 has been excluded from the analysis of deaths between the ages of 0 and 64. In 2022, according to the BfS data, excess mortality will decrease, as can be seen in Fig. 8 (yellow curve).

A drop in excess mortality can have two causes: Either excess mortality actually decreases and under-mortality increases, or the BfS assumes a marked increase in the expected deaths in this age group.

Fig. 7 shows the number of TdF per year expected by the BfS for the age group 0-64. There is a steadily decreasing trend over 11 years, starting at 9623 TdF down to 8380 (in 2020), the difference is 15%. In 2021, the BfS left mortality constant and in 2022 it assumes that mortality will be 11% higher than the trend.[3]

Figure 7: BfS expected deaths for the age group 0-64

	Erwartung BfS	Trend
2010	9623	9542
2011	9501	9420
2012	9242	9298
2013	9144	9176
2014	9047	9055
2015	8800	8933
2016	8785	8811
2017	8648	8689
2018	8562	8568
2019	8530	8446
2020	8380	8324
2021	8380	8202
2022	8985	8081



The BfS data say that mortality in the age group 0-64 should deteriorate by 11% within one year. The mortality expected by the BfS for 2022 roughly corresponds to the situation in 2014. This means that within one year the health improvement of eight years would be destroyed. However, the BfS neither comments nor justifies this very pessimistic view. At the same time, we know from Section 1.3 that the

[3] The BfS value 8985 is 11% above the trend value for 2022, 8081. All information from Fig. 7. The Trend regression also has a very high R^2 from 96% up.

Taking life expectancy into account is crucial for proving excess mortality. The BfS assumes that life expectancy will increase or remain the same (and thus the number of TdF will decrease) until 2021. From 2022 onwards, the opposite is suddenly the case, which means that an almost inevitable decline in excess mortality is predictable. And that is exactly what the yellow curve in Figure 8 shows (from January 2022).

If one calculates excess mortality with 8081 deaths in 2022 (the long-term expectation according to the long-term trend), this leads to a further increase in excess mortality in Fig. 8 (red curve). This means that the easing in excess mortality is solely a consequence of the BfS's sudden change in expectations regarding deaths in 2022.

Whatever the calculation, the data from the BfS definitely support the finding that mortality among 0-64 year olds has deteriorated massively in 2022. Either one assumes a massive increase in mortality by 11%, as the BfS does, and then no longer reports excess mortality for 2022, or one uses the optimistic expectation of only 8,081 deaths (as we did) and then reports constant excess mortality from according to the red curve in Fig. 8.[4]

Conclusion:Irrespective of the type of calculation, the mortality of 0-64 year olds has deteriorated massively in 2022 according to BfS data.

Figure 8: Cumulative excess mortality 0-64 years, 2020 to mid-2022

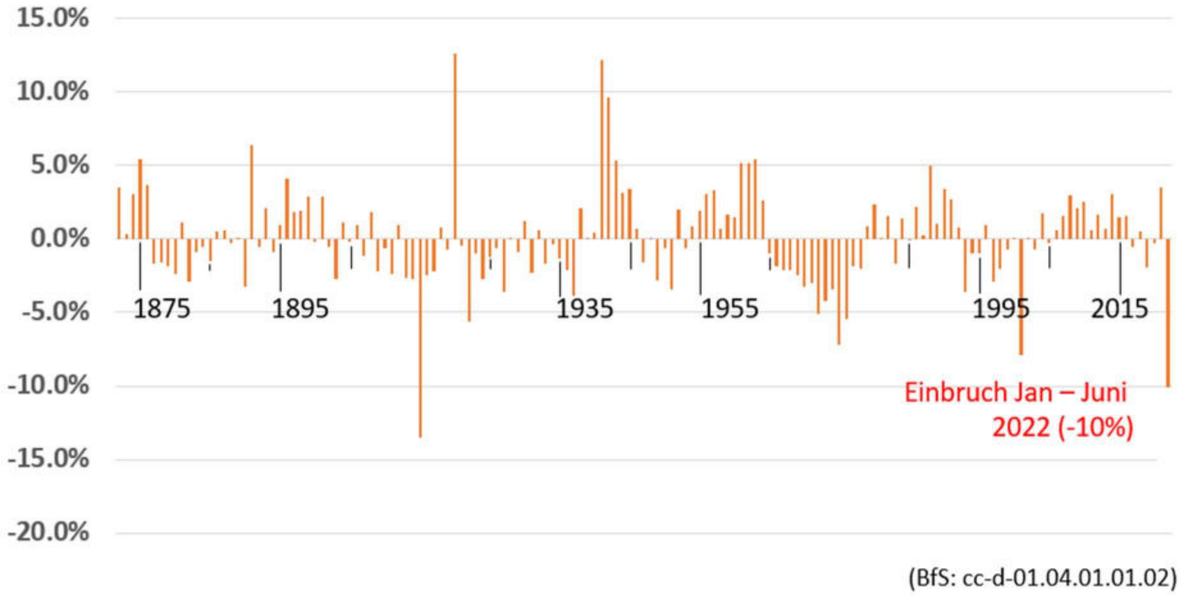
[4]The BfS proves to be quite accurate with 7242 expected and 7007 actual Tdf by week 42.

5 Historical decline in births

Live births show a historical decline in the first half of 2022, which has the following characteristics.[5]

Point 1:The decline across Switzerland is minus 10% and is therefore historic. A Since the beginning of the recording (i.e. since 1870) there has only been a larger decline, namely in 1915, as a result of the general mobilization.

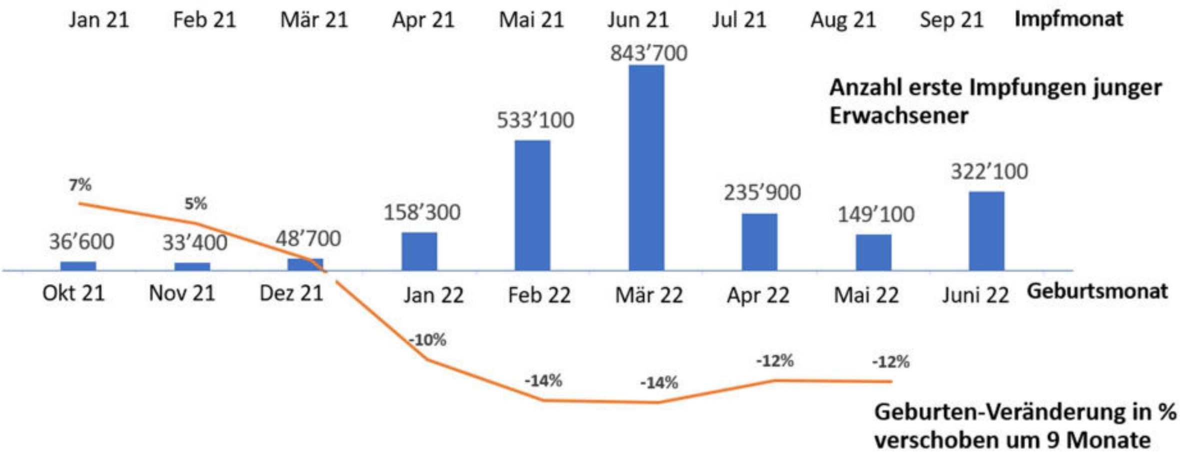
Figure 9: Historic slump in births in 2022



Point 2:The decline reaches its preliminary maximum exactly nine months after Maximum number of vaccinations among those able to bear children (Hagemann et al. 2022). This means that a general fertility-reducing effect of the corona virus can also be ruled out, because the decline would then have to correlate with the Covid-19 infection waves.

[5] Data status BfS from 28.9.2022.

Figure 10: Number of first vaccinations (blue) and change in the number of births (on the 5-year average; brown)



The following hypotheses must be excluded as explanations for logically compelling reasons:

- The decline cannot be explained as a reaction to the omicron wave or the invasion of Ukraine because the children then conceived were not born until July 2022 (but the statistics under discussion end in June 2022).
- The 2022 decline also cannot be explained by increasing abortion rates, because abortion rates declined from 2020 to 2021 (while rising to a record high in 2020).

- The explanation that it was a reaction to the baby boom of 2021 is also not convincing because this baby boom was only weak (+3%). In addition, it has never happened in the past that a baby boom was followed by a corresponding decline in the birth rate.

Based on updated data, a new, more precise, empirical analysis of the number of births from 2015 to 2022 (limited to the first half of the year in each case) was carried out. The analysis also attempted to capture behavioral changes in cautious parents. For this purpose, the cantons were divided into two groups, those with a high vaccination rate among young adults in August 2021 and those with a low rate at the same time in the same age group (details in Appendix 6.4).

The vaccination rate was also taken as an indicator of caution. Cantons with a high vaccination rate have populations that are more cautious and are therefore more inclined to postpone their desire to have children (even before the vaccination) for reasons of uncertainty.

Table 2 shows for the cantons with low vaccination rates that the pandemic years 2020-2022 generally have 2% more children than the average of the years before, which corresponds to an increase of 148 additional births. The generally expected voluntary restriction of reproduction cannot be proven for these cantons.[6]

In addition to the 2% growth, there will also be a baby boom effect of 3% in 2021. In 2022, the number of births will fall by 10% after a significant proportion of this age group has been vaccinated.

Table 2: Number of births in cantons with a low vaccination rate

	modification	in %	number births
Mean number of births before the pandemic (2015 – 2019)			8'359
Change in behavior from 2020-2022	148	2%	8'507
Baby boom 2021	236	3%	8'743
Vaccination effect 2022	- 862	- 10%	7,881

In these cantons, where it can be assumed that the population is more anxious on average due to the higher vaccination rate, the change in behavior is also more pronounced (see Table 3). Here the number of children will drop by 1% from 2020. However, there is also a 3% baby boom and a 10% drop in births nine months after vaccination.

The often-heard objection that Corona fundamentally leads to a postponement of the desire to have children can be proven in this calculation. The cantons with a tendentially more anxious population already show a negative development in the number of live births in 2020. However, the change in behavior is ten times smaller than the decrease in 2022 with the vaccinated parents.

[6] See Appendix 6.4 for a discussion of other possible reasons.

Table 3: Number of births in cantons with a high vaccination rate

	modification	in %	number births
Mean number of births before the pandemic (2015 – 2019)			17,721
Change in behavior from 2020-2022	- 265	- 1%	17,457
Baby boom 2021	484	3%	17,941
Vaccination effect 2022	- 1'769	- 10%	16'172

In this respect, Swissmedic's argument must be questionedthe sharp drop of 10% in 2022 is solely due to a change in behavior among cautious young couples.Since a change in behavior began as early as 2020, it is plausible to assume that the significantly greater decline in 2022 may have additional reasons, such as an undesirable effect of the vaccination.

In addition, it is ultimately irrelevant whether Switzerland misses births because the Covid-19 policy has led to unnecessary scaring of young people or because there are side effects from the vaccination. The fact is and remains that in the year following the vaccination, births plummeted on an historic scale.[7]

In principle, however, it should be noted that these results on the baby gap are preliminary evidence and additional findings can be expected at any time. Nevertheless, the still upheld, explicit vaccination recommendation from Swissmedic and FOPH seems rather adventurous to us, of all things, for pregnant women.

[7]See:https://corona-elefant.ch/swissmedic-takes-a-position-on-the-baby-gap-no-effect-of-vaccination/

6 Technical Appendix

6.1 Method description for non-mathematicians

The method tries to trace the expected deaths of the BfS as well as possible.[8th]
To do this, she uses the number of deaths of 0-64 year olds per week.

The average number of deaths at 26 points in time is calculated:

- Long-term average in weeks 1 and 2 Long-term average in weeks
- 3 and 4 Long-term average in weeks 5 and 6...
-

-Up to the long-term average at weeks 51 and 52

Simultaneously, a linear trend in the death data is calculated. It shows that deaths have been falling continuously over the years (both from 2010 to 2019 and from 2015 to 2019), even though the number of people has increased due to immigration. The decline is an expression of technical progress.

For example, the number of deaths per week among 0-64 year olds decreases by 0.04 deaths each week (significant at the 99% level). This means that after 100 weeks (or almost 2 years) an average of 4 fewer people die than 100 weeks ago (= 100 x 0.04).

The decline is much weaker for younger people (0-19 and 20-39 years). Here it is 0.005, so that only after 200 weeks (or almost 4 years) one less person dies. The trends among the very young are also not significant.

Based on this calculation, an expected number of deaths per week can now be determined for each individual week. This consists of the long-term average of deaths in the respective week minus the decrease in the number of deaths due to the long-term trend.

(Refer to the following two sections for more precise details.)

6.2 Method description for mathematicians

This appendix describes data and method applied to calculate cumulated deviations from expected mortality. Input are fatalities per week and age group for all Swiss inhabitants. We define weeks as follows: 2015.14 for the 14th week in year 2015. Our database ranges from 2010.01 to 2022.12.

We used three different data sources:

FOS mortality statistic, number of fatalities per age groups 0-19, 20-39, 40-64, 65-79 and 80+, and weeks from 2015.01 to 2022.12, data all over Switzerland; Code: cc-d-01.04.02.01.32; prompted 4/7/2022.

FOS excess mortality statistic, containing number of fatalities, expected number of fatalities, upper and lower range of expectation, for two age groups 0-64, 65+, ranging from 2010.01 to 2022.12, data all over Switzerland; Code: ts-d-14-03-04-03-wr; prompted 4/21/2020, more recent data prompted 4/7/2022.

[8th] The entire appendix is based on: Beck, 2022a, Working Paper.

FOH (BAG) Statistics on Covid-19-labeled fatalities per day published on their homepage https://www.covid19.admin.ch/de/overview .

From this database we derive the following set of variables: ,

=number of fatalities per week and age group with ∈

{2010.01, … ,2022.12}other

∈ {(00 − 19), (20 − 39), (40 − 64), (65 − 79), (80+)}

=a linear trend per week, ranging from 1 (in 2010.01) to 678 (in 2022.12)

, =a dummy variable indicating 26 neighboring pairs of weeks:

Week	,	,	,	,		,	,	,
1	1	0	0	0	…	0	0	0
2	1	0	0	0	…	0	0	0
3	0	1	0	0	…	0	0	0
4	0	1	0	0	…	0	0	0
5	0	0	1	0	…	0	0	0
…	…	…	…	…	…	…	…	…
48	0	0	0	0	…	1	0	0
49	0	0	0	0	…	0	1	0
50	0	0	0	0	…	0	1	0
51	0	0	0	0	…	0	0	1
52	0	0	0	0	…	0	0	1
53	0	0	0	0	…	0	0	1

We use an OLS regression that reads:

(1) ,= ,+ , + ∑ , ,+ ,

The regression is applied on data from a set of weeks ranging from to . From OLS we can derive an estimated error per week, ̂,with ≤ ≤ . within to .

Given ,, ,, ,, … , , we can predict deviations ̂,for < ≤ ≤ .

Our estimates are true in expectation, since (by definition of OLS),∑ Our ̂, = 0

focus is on accumulated errors, such as that

(2) ,∗= ̂,∗= ∑ ∗ ̂,,

6.3 Presentation of the regressions

Regression 1:
periods:2010.01 to 2019.52
Age:00 - 64

```
Call:
lm(formula = y ~ x)

Residuals:
    Min      1Q  Median      3Q     Max 
-41.072  -8.424  -0.024   8.834  44.975 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept) 188.911588   3.204085  58.960  < 2e-16 ***
xTrend_lin   -0.043288   0.004008 -10.799  < 2e-16 ***
xZW2         10.286576   4.329450   2.376  0.01788 *  
xZW3          5.973151   4.329472   1.380  0.16832    
xZW4         14.009727   4.329509   3.236  0.00129 ** 
xZW5         10.346302   4.329561   2.390  0.01724 *  
xZW6          1.232878   4.329628   0.285  0.77595    
xZW7         -1.480547   4.329710  -0.342  0.73253    
xZW8         -7.193971   4.329806  -1.661  0.09725 .  
xZW9        -12.807395   4.329917  -2.958  0.00325 ** 
xZW10        -0.270820   4.330044  -0.063  0.95015    
xZW11        -7.684244   4.330185  -1.775  0.07658 .  
xZW12        -9.547669   4.330340  -2.205  0.02793 *  
xZW13        -4.961093   4.330511  -1.146  0.25251    
xZW14        -9.674518   4.330697  -2.234  0.02593 *  
xZW15       -11.837942   4.330897  -2.733  0.00649 ** 
xZW16        -8.051367   4.331112  -1.859  0.06363 .  
xZW17       -11.164791   4.331342  -2.578  0.01024 *  
xZW18        -5.178215   4.331587  -1.195  0.23248    
xZW19        -6.191640   4.331847  -1.429  0.15354    
xZW20        -2.855064   4.332121  -0.659  0.51017    
xZW21        -8.368489   4.332410  -1.932  0.05398 .  
xZW22        -8.031913   4.332714  -1.854  0.06437 .  
xZW23        -0.745338   4.333033  -0.172  0.86350    
xZW24        -6.858762   4.333367  -1.583  0.11411    
xZW25        -1.522186   4.333716  -0.351  0.72556    
xZW26        -0.574987   4.282529  -0.134  0.89325    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 13.69 on 494 degrees of freedom
Multiple R-squared:  0.3482,	Adjusted R-squared:  0.3138 
F-statistic: 10.15 on 26 and 494 DF,  p-value: < 2.2e-16
```

Regression 2:
periods:2015.01 to 2019.52
Age:00 - 19

```
Call:
lm(formula = y ~ x)

Residuals:
    Min      1Q  Median      3Q     Max 
-7.2713 -2.4463 -0.0963  2.3484  9.4431 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) 10.437193   1.468957   7.105 1.44e-11 ***
xTrend_lin  -0.005289   0.002792  -1.894   0.0594 .  
xZW2        -0.089423   1.491334  -0.060   0.9522    
xZW3         0.421154   1.491365   0.282   0.7779    
xZW4         2.331731   1.491418   1.563   0.1193    
xZW5        -0.057692   1.491491  -0.039   0.9692    
xZW6         1.352885   1.491585   0.907   0.3653    
xZW7         1.263463   1.491700   0.847   0.3979    
xZW8        -0.325960   1.491836  -0.218   0.8272    
xZW9        -0.015383   1.491992  -0.010   0.9918    
xZW10        0.895194   1.492170   0.600   0.5491    
xZW11        0.905771   1.492368   0.607   0.5445    
xZW12        0.816348   1.492588   0.547   0.5849    
xZW13        3.026925   1.492828   2.028   0.0437 *  
xZW14       -0.262498   1.493089  -0.176   0.8606    
xZW15        1.148079   1.493371   0.769   0.4428    
xZW16        1.858656   1.493673   1.244   0.2146    
xZW17        0.869233   1.493997   0.582   0.5612    
xZW18       -0.820190   1.494341  -0.549   0.5836    
xZW19        2.090388   1.494706   1.399   0.1633    
xZW20        2.200965   1.495092   1.472   0.1423    
xZW21        1.711542   1.495499   1.144   0.2536    
xZW22        0.222119   1.495926   0.148   0.8821    
xZW23        0.632696   1.496374   0.423   0.6728    
xZW24        1.743273   1.496843   1.165   0.2454    
xZW25        3.753850   1.497332   2.507   0.0129 *  
xZW26        2.532945   1.461440   1.733   0.0844 .  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.335 on 234 degrees of freedom
Multiple R-squared:  0.1182,	Adjusted R-squared:  0.02019 
F-statistic: 1.206 on 26 and 234 DF,  p-value: 0.2318
```

Regression 3:
periods:2015.01 to 2019.52
Age:20 - 39

```
Call:
lm(formula = y ~ x)

Residuals:
    Min      1Q  Median      3Q     Max 
-9.9546 -2.7433 -0.3963  2.2401 12.8037 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) 20.347766   1.742577  11.677  < 2e-16 ***
xTrend_lin  -0.005317   0.003312  -1.606  0.10972    
xZW2        -1.089365   1.769122  -0.616  0.53865    
xZW3        -3.078730   1.769159  -1.740  0.08313 .  
xZW4        -0.368096   1.769221  -0.208  0.83537    
xZW5        -4.257461   1.769308  -2.406  0.01689 *  
xZW6        -3.546826   1.769419  -2.005  0.04617 *  
xZW7        -3.736191   1.769556  -2.111  0.03580 *  
xZW8        -3.025556   1.769717  -1.710  0.08866 .  
xZW9        -3.314921   1.769903  -1.873  0.06232 .  
xZW10       -3.604287   1.770114  -2.036  0.04286 *  
xZW11       -2.493652   1.770349  -1.409  0.16029    
xZW12       -2.783017   1.770609  -1.572  0.11735    
xZW13       -4.972382   1.770894  -2.808  0.00541 ** 
xZW14       -1.561747   1.771204  -0.882  0.37882    
xZW15       -0.251113   1.771538  -0.142  0.88740    
xZW16       -0.040478   1.771897  -0.023  0.98179    
xZW17       -3.029843   1.772281  -1.710  0.08867 .  
xZW18       -0.519208   1.772689  -0.293  0.76986    
xZW19       -2.208573   1.773123  -1.246  0.21416    
xZW20       -2.097939   1.773580  -1.183  0.23806    
xZW21       -1.787304   1.774063  -1.007  0.31475    
xZW22       -2.976669   1.774569  -1.677  0.09480 .  
xZW23       -2.566034   1.775101  -1.446  0.14964    
xZW24       -3.455399   1.775657  -1.946  0.05285 .  
xZW25       -3.044764   1.776238  -1.714  0.08782 .  
xZW26       -1.547701   1.733659  -0.893  0.37292    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.956 on 234 degrees of freedom
Multiple R-squared:  0.1208,	Adjusted R-squared:  0.02312 
F-statistic: 1.237 on 26 and 234 DF,  p-value: 0.2052
```

Regression 4:
periods:2015.01 to 2019.52
Age:40 - 64

```
Call:
lm(formula = y ~ x)

Residuals:
    Min      1Q  Median      3Q     Max 
-31.039  -7.704   0.082   7.382  33.026 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept) 153.28229    5.41575  28.303  < 2e-16 ***
xTrend_lin   -0.03708    0.01029  -3.602 0.000385 ***
xZW2          8.87416    5.49824   1.614 0.107875    
xZW3          6.34832    5.49836   1.155 0.249438    
xZW4          9.02248    5.49855   1.641 0.102165    
xZW5         17.29664    5.49882   3.146 0.001873 ** 
xZW6          1.37080    5.49917   0.249 0.803368    
xZW7          1.24496    5.49959   0.226 0.821109    
xZW8         -1.38088    5.50009  -0.251 0.801984    
xZW9        -10.00672    5.50067  -1.819 0.070162 .  
xZW10         4.56743    5.50133   0.830 0.407248    
xZW11        -5.85841    5.50206  -1.065 0.288079    
xZW12        -2.98425    5.50287  -0.542 0.588123    
xZW13         2.98991    5.50375   0.543 0.587475    
xZW14        -1.73593    5.50471  -0.315 0.752775    
xZW15        -0.16177    5.50575  -0.029 0.976585    
xZW16         2.81239    5.50687   0.511 0.610038    
xZW17        -2.51345    5.50806  -0.456 0.648582    
xZW18         2.66071    5.50933   0.483 0.629586    
xZW19         7.03487    5.51068   1.277 0.203013    
xZW20         6.90903    5.51210   1.253 0.211300    
xZW21         5.68319    5.51360   1.031 0.303718    
xZW22         1.75735    5.51517   0.319 0.750285    
xZW23        11.03151    5.51683   2.000 0.046699 *  
xZW24         7.10567    5.51855   1.288 0.199159    
xZW25         6.67983    5.52036   1.210 0.227486    
xZW26         8.07850    5.38803   1.499 0.135133    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 12.29 on 234 degrees of freedom
Multiple R-squared:  0.223,	Adjusted R-squared:  0.1366 
F-statistic: 2.582 on 26 and 234 DF,  p-value: 9.084e-05
```

6.4 Baby Gap Calculations

The study of the decline in the birth rate is based on the number of births from January to June for the years 2015 to 2022. The cantons are divided into two groups: those with a high vaccination rate (HIQ), ZH, GE, BS, VD, NE and ZG (gl. Tab. A.1), and those with less Vaccination rate, AI, AR, GL, GR, JU, OW, NW, UR, SG, SO, SZ and TG. Those in between Cantons are omitted to emphasize the difference between high and low IQ. The selection criterion was the cantonal vaccination rate for people of childbearing age in August 2021.[9]

Table A.1

classification		Group 1	group 2
grouping High versus low vaccination rate	cantons	ZH GE BS VD NE ZG	AI AR GL GR JU OW NW UR SG SO SZ TG
	vaccination rates	from 65% to 60%	55% to 42%

The average number of births before the pandemic was 17,700 in group 1 and 8,400 in group 2. With the linear regression, we reached our limits because a large drop in births in the cantons with HIQ could also simply be due to the larger number of births. We need a model that interprets baby boom and fertility decline as proportional phenomena. The influencing variables thus become factors that are multiplicatively linked. The linear regression equation therefore had to be logarithmized. From the original regression equation:

(1) = ( )

Then the linear regression becomes:

(2)ln ( ) = + + + + + +

The indices are there {1,2}for the canton group and {2015, 2016, ... 2022}for years. until are the coefficients to be estimated and is the error term.

The number of births ( ) based on four dummy variables.

- is one if the data set belongs to group 1 (the cantons with a high vaccination rate),
- equals one in the baby boom year 2021, identifies the
- three pandemic years (2020 to 2022)
- and identifies the semester nine months and more after vaccination, so 2022.

---

[9]See an earlier version of this work, Beck/Vernazza, 2022.

The hypotheses are:

> 0,because it corresponds to the average number of births in group 2, without pandemic, baby boom and vaccination.

> 0,because it corresponds to the additional number of births in the baby boom group 1.

> 0,because it corresponds to the additional births triggered by the 2021 baby boom.

< 0,because it is the mean change in behavior over the three years of the pandemic is equivalent to. A decline in births due to stress and risk aversion is expected.

< 0,because of the change in behavior during the three years of the pandemic of the population in corresponds to the cantons that will later be vaccinated more frequently.
Behavior change means a voluntary renunciation of children. It is assumed that risk-averse people voluntarily postpone their desire to have children. This is a thesis that is regularly heard in the media.
The vaccination rate is understood here as an indicator of risk aversion. Cantons with risk-averse populations will be vaccinated more frequently than cantons with risk-taking populations. Therefore will < 0assumed because the population in the Cantons identified with a high vaccination rate during the three years of the pandemic.

< 0,because nine months (and more) after vaccination a drop in live births present.

Table A.2 Regression Statistics

Regression Statistics	
multiples correlation coefficient	0.9997
coefficient of determination	0.9995
Adjusted coefficient of determination	0.9992
standard error	0.01061199
number of observations	16

Source: Own calculations according to the text

The regression gives very good test statistics (Table A.2) and the estimated coefficients are given in Table A.3.

Except for the pandemic behavior, which is also not significant at the 90% level, all coefficients have the expected sign. Either the pandemic fundamentally led to more children, or the pandemic behavior variable reflects a long-term trend in the number of live births (e.g. due to the growing population). This aspect needs further investigation. But because the R^2 is 99%, the model should depict the other relationships sufficiently well.

Table A.2 Regression Statistics

coefficients		coefficients		
constant	b_0	9.03	1'902.9	* * *
HIQ cantons	b_1	0.75	112.0	* * *
baby boom	b_2	0.03	2.6	*
pandemic behavior	b_3	0.02	1.8	
Behavior of HIQ cantons	b_4	- 0.03	- 3.0	*
vaccination	b_5	- 0.08	- 7.2	* *

Source: Own calculations according to the text

The decrease in the number of children in cantons with a high vaccination rate in 2020 is also irritating at first glance. If the lockdown begins in mid-March, only the second half of December 2020 could be affected by a decrease in procreation. However, it should not be overlooked that in 2020 abortions also skyrocketed to a record level, so that the change in behavior in 2020 could not have been a postponement of the desire to have children, but an increased number of pregnancy terminations.

In principle, however, it should be noted that these results are preliminary evidence and additional findings can be expected at any time. Nevertheless, the still upheld, explicit vaccination recommendation from Swissmedic and FOPH seems rather adventurous to us, of all things, for pregnant women.

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