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# The use of household budget surveys to estimate the availability of fruits and vegetables for consumption in Swiss households after deduction of food waste

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## ABSTRACT

### Background

**The consumption of 400-600 grams per day of fruits and vegetables has been linked to reduced risk of cardiovascular disease, and lower incidence of cancers and chronic diseases. This study explores the alignment of household purchases of fruits and vegetables with nutritional recommendations in Switzerland.**

### Methods

**The Swiss Household Budget Surveys for 2006-2008 are analyzed to estimate the availability of fruits and vegetables at household level after accounting for food waste. A household is defined as meeting the recommendation when the monthly purchases by weight are equal or superior to the amount required to provide three servings of vegetables and two servings of fruits per person per day.**

### Results

**The descriptive statistics demonstrate that close to 90% of households fail to meet the vegetable recommendation, and 76% fail to meet the fruit recommendation when unavoidable waste is deducted. These percentages increase further when total waste (unavoidable, possibly avoidable, and avoidable waste) is deducted from household purchases. Moreover, a significant association is observed between the structure of the households and the availability of fruits and vegetables. Families with children are less likely to meet the recommendations than other types of households.**

### Conclusions

**This paper reveals a need to improve the availability and accessibility to fruits and vegetables, particularly in households with children. It also highlights the importance of limiting avoidable food waste at household level. Interventions such as introducing price subsidies on fruits and vegetables, and educating the public on the importance of limiting household food waste, are recommended.**


**Keywords:** Fruits and Vegetables, Household Budget Survey, Food Waste, Public Health, Nutrition, Switzerland

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## INTRODUCTION

The consumption of 400-600 grams per day of fruits and vegetables is reported to reduce the risk of cardiovascular disease, and to lower the incidence of certain cancers and chronic diseases of ageing. [1, 2, 3] This is because fruits and vegetables are a rich source

of vitamins, minerals, dietary fiber and antioxidants. [4]

A variety of professional bodies in Switzerland, drawing on the association between fruit and vegetable consumption and reduced risk of ill-health, have recommended the intake of at least three servings of vegetables and two servings of fruits daily with the possibility of exchanging one of the servings with unsweetened juice.[5,6,7] A '5 a Day'[1] national campaign was launched in 2001 to raise the level of intake of fruits and vegetables. Between 2001 and 2008, more than 3.3 million Swiss francs were spent on the campaign.

This paper focuses on the fruit and vegetable availability in households to explore the alignment of household purchases with nutritional recommendations, using the Household Budget Surveys (HBS) for 2006-2008. The quantities of fruits and vegetables purchased were first adjusted for unavoidable waste, and later for total waste, at household level in order to have an estimation of the amount of fruits and vegetables available for consumption. The first section of the paper describes the methodology. The second section presents and discusses the results of the analysis.

## METHODS

### Household Budget Surveys (HBS)

HBSs are national quantitative surveys that focus on household expenditures on goods and services, thus shedding light on a given population's living conditions. Since 1998, the yearly survey in Switzerland allows the regular update of the basket of commodities listed in the Consumer Price Index, and the monitoring of consumer behavior and income of private households. The HBS are used to identify the sources of household income and how much of the household budget goes to food purchases in comparison to total expenditure or to non-food expenditure stratified by geographic area or by income group.[8,9] The HBS are seldom used in Switzerland for nutrition surveillance although the survey has a built-in mechanism of continuity and a representative coverage of the population. They seem to be an untapped source for dietary information.

HBS comprises permanent residents in Switzerland. Tourists, seasonal visitors and commuters do not participate in the sampling. The sampling unit is the private household. Since 2000, the sample size is around 3,700 households per year. The random list of households is produced by the Federal Statistical Office (FSO) and given to institutes commissioned to perform the work. Participation is not mandatory. The response rate is estimated at 30%.

In order to compensate for possible biases, the data undergoes three levels of weighting. The first accounts for the household's probability of inclusion in the survey. The second considers various factors that prevent the household from participating, such as individual characteristics, regional and temporal variables. The data is further weighted according to population distribution.

The participants are asked to describe each expense or revenue over a month. The accuracy and the completeness of the information provided by the respondents determine the reliability of the final data.

### Our Descriptive Statistics

As per contract #12474, the authors obtained, from the FSO, the HBS data for 2006-2008; the files contain individual household data without identification of respondents.

Our data analysis is conducted using IBM SPSS 20. The following variables are used in our assessment: g*eneral information (*household identification number, year of participation), s*ocioeconomic information* (size and composition of the household, household expenditure on consumption, expenditure on food and non-alcoholic beverages, expenditure per food item, expenditure on catering services), and nutritional information (food code, quantity of fruits and vegetables expressed in kilograms). There are no missing values.

[1] As per the annual reports of the 'Five a Day' campaign, webpage http://www.5amtag.ch


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Our analysis identifies the proportion of households meeting the nutritional recommendations. A household is defined as meeting the recommendation, when its monthly purchases, by weight, are equal or superior to the amount required to provide three servings of vegetables per person per day or two servings of fruits per person per day. The serving size does not include unavoidable waste such as stalk, pit, skin and seeds. A vegetable serving equals 120 grams for adults or 70 grams for children. A fruit serving equals 120 grams of fresh fruit for adults and 100 grams for children. The households that fall below a daily serving per person are also determined in order to identify those consuming an alarmingly low quantity. Chi-square tests are used to identify significant differences between the groups of households.

The availability of fruits and vegetables is checked twice: once after unavoidable waste is deducted from the quantities of fruits and vegetables acquired and, a second time, after total waste is subtracted from household acquisitions.

Given the absence of data on food losses in Swiss households, Foodwaste.ch[2] suggests adopting the figures from the United Kingdom[10,11] and assuming that Swiss households produce similar proportions of waste by food category. Using these figures, it is estimated that 23% of the calories purchased in Swiss households end as waste, with 16% as avoidable waste, 5% as possibly avoidable, and 2% as unavoidable waste.[12] In accordance with Quested and Johnson[11], we deduct 4.4% of the net weight of vegetables and 19.2% of the net weight of fruits to account for unavoidable losses in the households. A second analysis is run after subtraction of total waste (unavoidable, possibly avoidable, and avoidable) which represents 21.5% of the net weight of fruit purchases and 34.7% of the net weight of vegetable purchases.

For the total expenditure on consumption, the following expenses are added: food and non-alcoholic beverages; alcoholic beverages and tobacco; catering and hosting services; clothes and shoes; housing and energy; furniture, household equipment and maintenance; health expenditure; transportation; communication; leisure and culture; other goods and services.

For the expenditure on catering services, the following codes are added: meals in restaurants, cafes and bars; non-alcoholic beverages in restaurants, cafes and bars; meals and snacks in take-away, self-service and small restaurants; non-alcoholic beverages in take-away, self-service and small restaurants; meals in canteens; non-alcoholic beverages in canteens; meals at private invitations; and non-alcoholic beverages at private invitations. Alcoholic beverages are excluded.

In order to determine the availability of fruits, we add the codes for this category. Both fresh fruit and processed fruit such as dried, frozen or canned fruit figure as fruits. Nuts, hazelnuts and oleaginous fruits are excluded. Prior to its addition, the weight of dried fruits is adjusted. The Swiss Society for Nutrition defines an average serving of 25 grams of dried fruit as equivalent to a serving of 120 grams of fresh fruit. We, therefore, multiply the quantities of dried fruit by (120/25) prior to adding them to the total quantity of fruit.

As a measure of the availability of vegetables, we add the codes of the vegetable category. It contains fresh and processed vegetables such as frozen, canned, pickled or lyophilized vegetables. In accordance with the recommendations of the Swiss Society for Nutrition, potatoes and products based on potatoes and other tubers are excluded. The quantities of dried or lyophilized mushrooms and vegetables are adjusted[3] prior to their addition to the rest of the vegetables.

[2] Foodwaste.ch, Swiss organization working to reduce food waste and achieve a more sustainable food system, available at www.foodwaste.ch

[3]The Swiss Food Composition Database was used (http://naehrwertdaten.ch/request?xml=MessageData&xml=MetaData&xsl=Start&lan=en&pageKey=Start.


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**Rationale for using the Household Budget Surveys**

A national nutrition survey, menuCH, is being conducted on a representative sample of 2000 individuals across Switzerland. Until the data from this first individual dietary survey (IDS) are released, Swiss Nutrition Reports have been using for years the food supply and utilization data to estimate food consumption in the population. This method of estimation of dietary intake, like other methods, is not without its weaknesses. For one, it is based on the collection of data at the agricultural production level or, at the very least, the initial stages of the food chain, and it does not account for the losses incurred before the products reach the consumers.[13] The overlooked losses could occur during transportation, food industry, retail, catering, or household levels due to food being unsold, expired, and discarded. The data are therefore highly aggregated.[14] They do, however, account for the inedible parts of food such as the shells of nuts and the fruit pits.[15] Since the food supply does not account for the variable losses that occur along the food chain, it is higher than the food available at household level and also at individual level.[16] The Swiss Farmers' Union estimates that the actual consumption of food by the population is around 30% below the numbers generated by the food supply and utilization data. [15] In addition, the data on imports do not take into account the purchases of food across the border and their import by individuals for private use, nor do they consider the actual consumption of food during a stay abroad. Estimates in Switzerland show that around 4.7% of food and non-alcoholic beverages, up to 10.6% of alcoholic beverages, 23% of spirits, 11% of beef and close to 4% of vegetables and fruits are purchased abroad. [17]

The food supply data reveal trends within a given country, but tend to miss the differences in nutritional intake between population subgroups. [18] A more concise tool would be the household and the individual surveys because they allow disaggregation by socio-demographic characteristics, and an appreciation of food choices. [19]

The use of HBS for nutritional epidemiological purposes is practiced internationally.[18,20-26] From HBS, it is possible to establish dietary patterns and socio-demographic determinants as well as trends in food habits.[27,28] HBS can be used for monitoring nutritional intake and for obtaining detailed information for epidemiological analyses at low cost in comparison to other methods of data collection.

Studies have compared the data from HBS with other sources in order to establish their validity, and to explore the nature of the errors that occur from using them.[26,27,29] They concluded that estimates of population nutritional habits may be reached using HBS provided that biases are kept in mind. In comparison to HBS, IDS based on 24-hour dietary recall is more prone to survey bias from social desirability leading to over-reporting of desirable behavior or underreporting of undesirable behavior. A source of bias could come from seasonal variation when a product could be more readily purchased during its harvest season. Moreover, the higher levels of acquisition in HBS as compared to IDS may be a reflection of wastage at the household level.

## RESULTS

**Characteristics of the Household**

The FSO does not allow the publication of results when a sub-category falls below 100 households. In order to bypass this limitation, we pooled the datasets for 2006, 2007 and 2008 since there are no duplicates. Table I gives the characteristics of the households in our analysis, and their expenditure on fruits and vegetables. The 2006-2008 HBS consist of 9,919 households representing 27 sub-categories of households. The subgroups with less than 100 households were excluded; they represent 7.16% (n=711) of the households. Among the excluded households are, for instance, households composed of 5 adults, or 3 adults with 4 children.

**Table 1 Characteristics of the households and expenditure on vegetables and fruits, 2006 – 2008**

| Household composition 2006-2008 | n | Expenditure on food & non-alcoholic beverages in total expenditure on consumption Mean (± SD) | Expenditure on fruits & vegetables in total expenditure on food Mean (± SD) | Expenditure on food & non-alcoholic beverages outside the home in total expenditure on consumption Mean (± SD) |
|---|---|---|---|---|
| Adult | 2671 | 0.11 (± 0.07)$^{abcdef}$ | 0.20 (±0.12)$^{abcde}$ | 0.07 (±0.06)$^{a}$ |
| Couple | 3592 | 0.14 (± 0.08)$^{agh}$ | 0.20 (±0.10)$^{fghij}$ | 0.07 (± 0.05) |
| 3 Adults | 586 | 0.15 (± 0.08)$^{bijkn}$ | 0.18 (±0.09)$^{af}$ | 0.07 (± 0.05) |
| 4 Adults | 310 | 0.15 (± 0.07)$^{clmo}$ | 0.17 (±0.09)$^{bg}$ | 0.08 (± 0.05)$^{bcd}$ |
| Adult & a child | 133 | 0.12 (± 0.05)$^{ilnopq}$ | 0.19 (±0.09) | 0.06 (± 0.04)$^{ab}$ |
| Couple & a child | 690 | 0.13 (± 0.06)$^{djmrs}$ | 0.18 (±0.09)$^{ch}$ | 0.07 (± 0.04) |
| Couple & 2 children | 978 | 0.15 (± 0.07)$^{egprt}$ | 0.16 (± 0.08)$^{di}$ | 0.07 (± 0.04)$^{c}$ |
| Couple & 3 children | 248 | 0.17 (± 0.08)$^{fhkqst}$ | 0.16 (±0.08)$^{ej}$ | 0.07 (± 0.04)$^{d}$ |
| **Total** | **9,208** | **0.13 (± 0.07)** | **0.19 (±0.10 )** | **0.07 (± 0.05)** |

*(Values with the same superscript under the same column are different at p<0.05)*

**Fruit and vegetable availability in the household**

The analysis reveals that only 10.2% of the households meet the monthly recommendation for vegetables, and 24% meet the monthly recommendation for fruits (Figure 1).

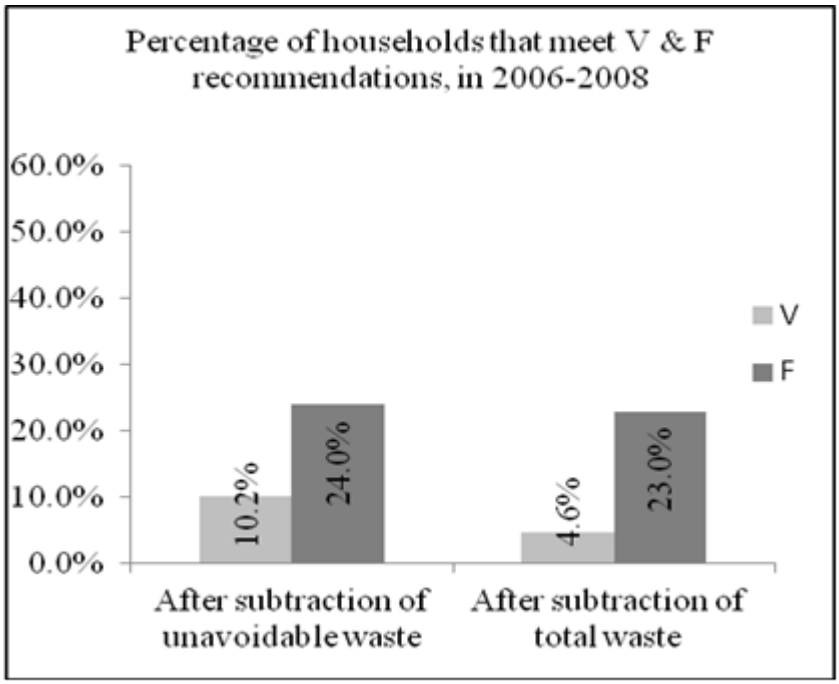


**Figure 1 Proportion of households that meet the Vegetables (V) and Fruits (F) recommendations after deduction of food waste**


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As expected, fewer households meet the recommendations when total waste is deducted. Moreover, the availability of fruits is much higher than the availability of vegetables in the households. After the estimated total waste for fruits and vegetables is removed from the purchases, the gap between the households that meet the recommendation for fruit and those that meet the recommendation for vegetable increases further.
Moreover, close to 50% of households have less than one daily serving of fruit or vegetable per person when unavoidable waste is deducted; and more households fall below a serving per person a day when the total waste is subtracted from the net weight of produce (Figure 2).

Five percent of the households have zero values for the acquisition of fruits and vegetables. This may indicate that fruits and vegetables are not consumed by those households, or that they are bought in bulk at an interval of time which extends beyond the survey period, and stored for later use.

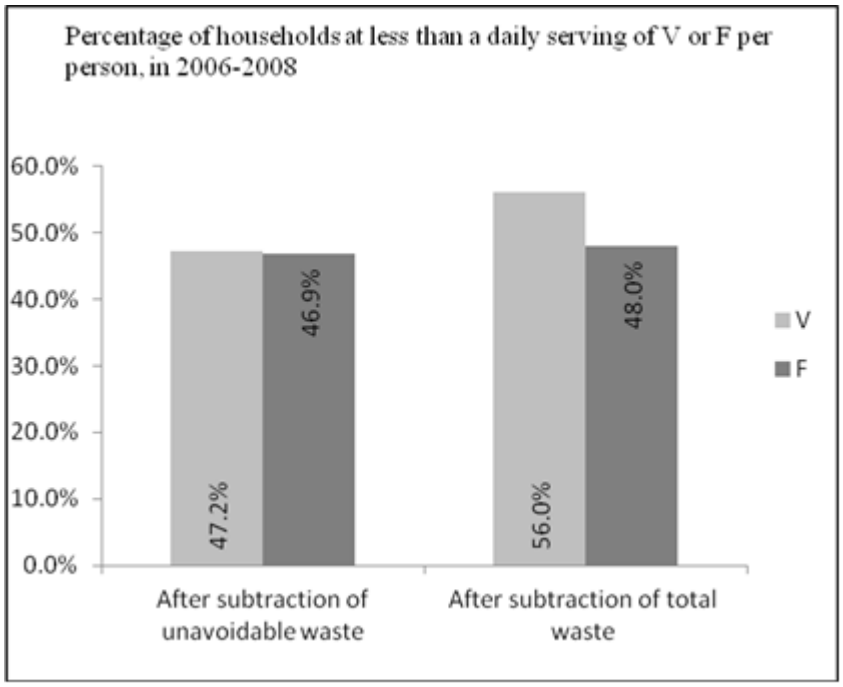


**Figure 2 Proportion of households at less than a daily serving of Vegetables (V) or Fruits (F) per person after deduction of food waste**

Figure 3 shows the percentage of households, by household composition, that meets the monthly vegetable and fruit recommendations. The use of a chi square goodness of fit test shows a significant association between the household composition and the availability of vegetables [$\chi^2$ (7) = 158.845, p≤0.05] and fruits [$\chi^2$ (7) = 414.712, p≤0.05] in the households.

The percentage of households meeting the requirement drops as the number of persons in the household increases. There is also a significant association between the composition of the households and their falling beneath one daily serving of vegetable [$\chi^2$ (7) =158.845, p≤0.05] or fruit [$\chi^2$(7) = 262.032, p≤0.05] per person.


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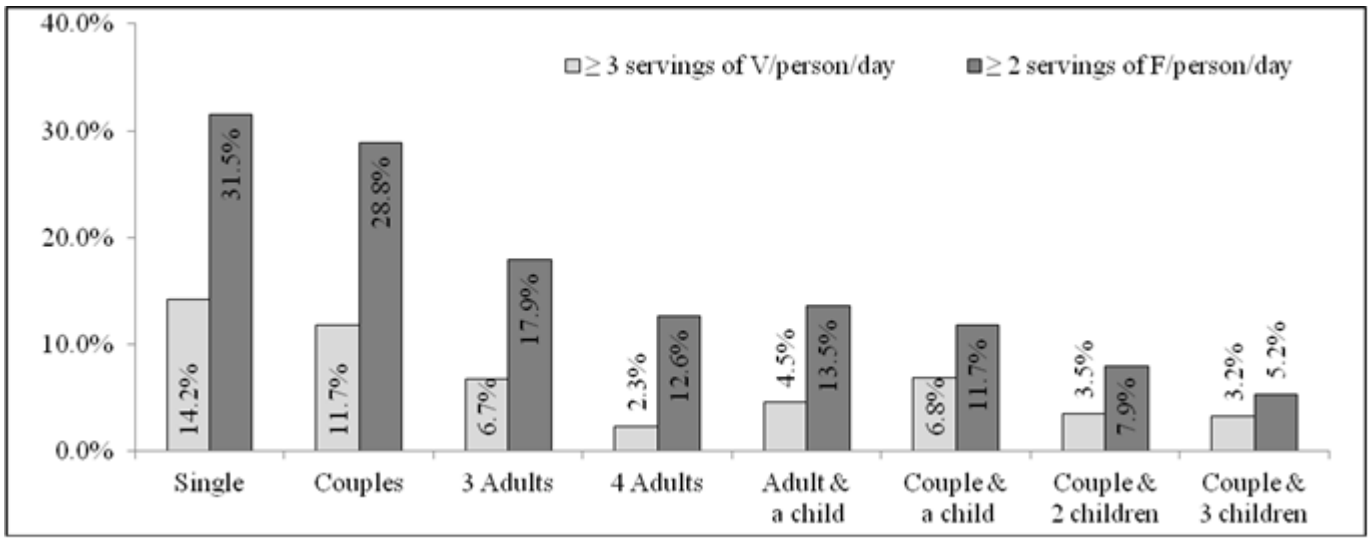


**Figure 3 Percentage of households that meet the Vegetables (V) and Fruits (F) recommendations by household composition after deduction of unavoidable food waste, 2006-2008**

When total waste is deducted, the proportion of households that meet the recommendation for vegetables shrinks [$\chi^2$ (7) = 95.097, p≤0.05]. As shown in Figure 4, not more than 2% of the households with children meet the recommendation. A significant association is also found between the household composition and the availability of the recommended amount of fruit after deduction of total waste [$\chi^2$ (7) = 402.317, p≤0.05]. With the increasing number of persons within the household, the percentage of households that provide two or more daily servings of fruit drops.

An association is evident between the rising number of persons within the household and the percentage of households falling below one serving of fruit [$\chi^2$(7) = 262.032, p≤0.05] or vegetable [$\chi^2$ (7) = 112.059, p≤0.05] per person each day after subtraction of total waste. The share of households falling below a daily serving is also high among households with children- reaching more than 60% of the households composed of a couple with two children.

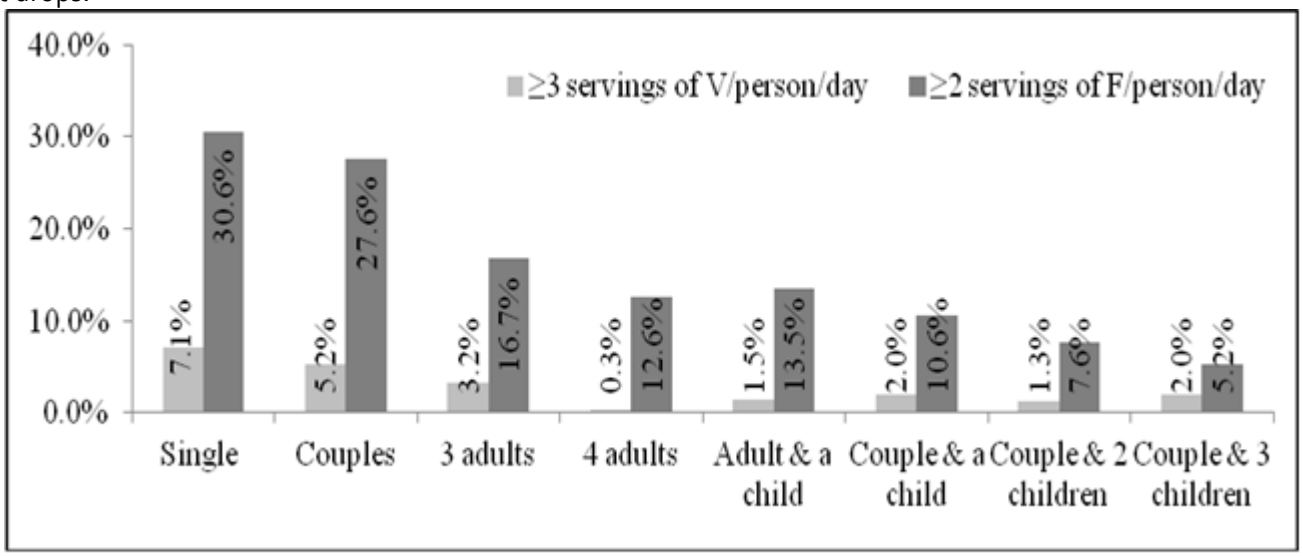


**Figure 4 Percentage of households that meet the Vegetables (V) and Fruits (F) recommendations by household composition after deduction of total food waste, 2006-2008**


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## DISCUSSION

With the exception that our analysis is based on measured household data, our results are consistent with previous studies in Switzerland. The 2007 Swiss Health Survey revealed that only a third of the population (29%) follow the '5 a Day' recommendation, with men (20%) less likely than women (38%) to do so.[30] Similarly, a survey conducted by the Institute of Social and Preventive Medicine at the University of Bern[4] reports that 15% of people consume five daily servings or more, close to 20% are at two servings or less, around 40% are between two and four servings, and close to 25% are at four to five servings.

Earlier figures showed a steep drop, between 1960 and 2004, in the share of expenditure on food out of total expenditure on consumption, but this drop did not apply to the expenditure on food away from home.[31] In our analysis, out of total household expenditure on consumption, around 13% goes to food and non-alcoholic beverages. On average, 19% of total food expenditure goes on fruit and vegetable purchases. However, the spending on fruits and vegetables is significantly lower in households with children although total spending on food is higher than in other household structures.

A majority of the households in Switzerland do not meet the recommendations for fruits and vegetables. This result is comparable to other European countries. Half the countries within the WHO European region fail to meet the recommendation for fruits and vegetables, and a third are actually below 300 grams per person per day.[32] These regional variations have been linked to structural characteristics such as availability and accessibility of fresh produce. [33, 34]

This study also reveals that the availability of fruits in Swiss households is greater than that of vegetables. In most countries across Europe, a different availability pattern has been observed for fruits and vegetables. [35] The sweet taste of fruit and the minor preparation time may explain why more households meet the recommendation for fruits than that for vegetables, and why fruits are more included in household purchases.

To our knowledge, this study is first to report that the availability of fruits and vegetables is lower in larger households in Switzerland, particularly in households with children. Since 1997, the high cost of healthy food has been mentioned in the Swiss Health Surveys as the main barrier to healthy eating. [36-39] Unlike the fixed costs of housing, health insurance, and transportation, households could cut back on food expenditure when necessary. [13] This may explain why larger families seem to be falling short on their purchases of fruits and vegetables.

Our paper also draws attention to the effect of food waste in households. If, in fact, 21.5% of the net weight of fruits and 34.7% of the net weight of vegetables end up as waste, then very few households reach the nutritional recommendations. Consumers should be sensitized to ways to limit avoidable waste. Since 2011, a researchers' dialogue on food waste is conducted yearly at the Federal Office of Agriculture. The participants present their on-going work, and try to identify best-practices and solutions to this issue. Our findings will be shared with them in order to stimulate discussion.

This research has three main limitations: 1- The HBS provide aggregated data on the availability of food in households. The produce consumed by guests cannot be distinguished from what is available to the residents of the household. This may lead to an overestimation of the food available to members of the households. 2- Moreover, the HBS do not provide information on the composition and the quantity of food and drinks consumed outside of the households. The expense on food away from home is broken down in terms of place where the food is bought, and the expense incurred. It is impossible to estimate the consumption of food outside the home. Our analysis shows that, on average, 7% of household expenditure goes to food away from home. For households whose members eat out frequently, the overlooked amount could be substantial. 3-Our results are based on the HBS of 2006, 2007, and 2008. Changes may have occurred, since then, in the general conditions of the

[4] As per the 2005-2006 annual report of the 'Five a Day' campaign, webpage http://www.5amtag.ch


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Swiss population. The level of information on the importance of fruits and vegetables in household purchases, and consequently in the diet, may have increased. The growing availability of alternative food networks may have affected the affordability of fruits and vegetables in larger families with children, or in less fortunate households. The importance of limiting household food waste may have become more prevalent than it was eight years ago. There might have been changes in the prices of fruits and vegetables, in household income, an increase or a decrease in the disparities between households, which may have had an effect on household expenditure and the amount of household food waste.

In summary, the analysis of the 2006-2008 Swiss HBS reveals that close to 90% of households fail to meet the vegetable recommendation and 76% do not meet the fruit recommendation. The study also reports lower availability of fruits and vegetables in households with children. A more pessimistic picture appears after subtraction of total waste. Interventions, such as price subsidies, to improve the situation in larger families need to be devised. Moreover, the knowledge, in the population, of what constitutes a healthy diet needs to be assessed and built upon. There is also a pressing need to understand the challenges to healthy nutrition, and to recognize effective ways to prevent food waste in households.

## KEYPOINTS

1) The availability of fruits and vegetables in Swiss households is very low. The situation is most alarming when estimated total waste at household level is taken into account.
2) The availability of fruits is higher than the availability of vegetables in Swiss households.
3) The expenditure on fruits and vegetables, and consequently their availability in households is lower in larger households than in smaller households, with the most vulnerable being families with children.
4) Close to 5% of households do not consume fruits and vegetables.
5) Barriers to the availability of fruits and vegetables in households need to be tackled.
6) Effective ways to prevent food waste at household level need to be identified and promoted.

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