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Abstract

Food high in energy but low in nutritional value is an important contributor to several serious illnesses, and one type of food that is particularly high in energy but low in nutrition is food consumed away from home. In this paper, we examine the demand and willingness to pay for healthy, Keyhole-labelled meals. A Keyhole-labelled meal is particularly low in calories, fat, sugar and salt, but particularly high in fibre. The results suggest that to get the majority of individuals to choose the healthy option regularly it would be necessary to alter the relative price between healthy and less healthy meals. Generally groups of individuals with a poor nutritional intake require a larger compensation (subsidy) before they choose the healthy alternative. About one third of respondents would choose the healthy option regularly if the prices for a healthy and less healthy meal were the same. In particular groups of individuals who already have a relatively good nutritional intake would select the healthy option. Groups with a generally poor nutritional intake (men and individuals with lower education and lower income) would gain health benefits from a subsidy of Keyhole-labelled meals.

Keywords: subsidy, food demand, food away from home, healthy, restaurant

JEL code: D12, H20, H31, I18

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1. Introduction

Modern Western food that is high in energy while low in nutritional value is an important contributor to several serious illnesses, including hypertension, type 2 diabetes, cardiovascular disease, osteoporosis, dental diseases and many common cancers (Mann 2002; Palacios *et al*. 2009; WHO 2003). As an example, poor nutrition is estimated to cause about one third of cancer deaths and one third of deaths from cardiovascular disease (WHO 2004). Poor diet – coupled with physical inactivity – is also a cause of the increase in obesity – itself a major risk factor for many of the diseases mentioned.

One type of food that is particularly nutritionally poor is food consumed away from home; such food is generally higher in calories, fat, saturated fat, salt and cholesterol, and lower in fibre, calcium and iron than food consumed at home (Lin *et al.* 1999 and 2001; Guthrie *et al.* 2002; Callmer & Fridel 2002; Becker 2008). The increased consumption of food away from home is also considered to be an important contributor to the increase in obesity and overweight (Chou *et al*. 2004; MaCrory *et al.* 1999; Pereira *et al.* 2005; Rashad 2006). In Sweden, the budget share of food consumed away from home, as a proportion of total expenditure on food, has increased from 12% in 1985 to 24% in 2007–2009 (Statistics Sweden 1985 and 2009). In the US, where obesity rates are the highest in the world, the budget share for food consumed away from home currently amounts to around 50% of households' total food expenditure (National Restaurant Association 2012). Improving the nutritional content of food consumed away from home may therefore be key to improving public health.

Consumers lack full nutritional information on meals supplied in restaurants, canteens and similar establishments. It may therefore be difficult for them to choose meals that match their nutritional preferences. Further, if consumers cannot assess the nutritional quality of food away from home, there is little incentive for restaurants and other establishments to supply nutritious meals, since such food is generally more costly (see e.g. Monsivais & Drewnowski 2007; Monsivais *et al*. 2011; Rydén & Hagfors 2011). One way of improving nutritional information on food consumed away from home is to introduce point-of-purchase menu labelling, such as the Keyhole label in Sweden or the mandatory menu (calorie) labelling imposed on chain restaurants in many states in the US (first introduced in New York in 2006).

However, if the aim is to promote healthy choices for the majority, other policy instruments may need to be considered in addition to information (Downs *et al.*, 2009), such as a change in the relative price between healthy and less healthy meals. Glanz *et al.* (1998) found for example that in food decisions taste is the most important factor, followed by price. Studies (e.g. Drewnowski, 1997a,b) show that the most palatable food is high in fat and energy. Even with an information system, then, if prices of healthy and unhealthy meals are the same, consumers may in general choose less healthy, but tastier meals.

In this study, we analyse consumers' choice of healthy meals when the price for healthy and less healthy meals is the same, and how subsidies on healthy meals affect their selection. We examine the impact on different consumer groups, especially groups that have previously been found to have a particularly poor nutritional intake, such as men (Becker & Pearson, 2002), younger people (Becker, 2009), and individuals with lower education and lower income (Åkeson & Nilsson, 2011). To the best of our knowledge, this is the first study to examine healthy meal choices away from home with different levels of subsidies and across different socioeconomic groups.

We define a healthy meal as a "Keyhole-labelled" meal. The Keyhole symbol is a trademark, owned by the Swedish National Food Agency (SLV), that indicates healthy food.[1] The Keyhole symbol is widely recognised by Swedish consumers – a recent study showed that as many as 98% of those responsible for household purchases recognize the symbol. Most know that the Keyhole indicates a healthy choice and express confidence in the label (SLV). The Keyhole has been in use nationally since 1989 to help consumers identify healthier food products within a food product group in grocery stores. Since 2009 Swedish restaurants can be granted Keyhole certification and thereby serve meals labelled with the symbol.[2] The Keyhole symbol is then placed on the menu, next to the healthy meal.

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[1] In June 2009, it was introduced in Denmark and Norway.

[2] Between 2009 and 2012 Keyhole certification was granted to restaurants by an association of seven organizations (including the SLV, the Swedish National Institute for Public Health, and the Swedish Hotel and Restaurant Association). A Keyhole-labelled meal is particularly low in calories, fat, sugar and salt, and particularly high in fibre. Restaurants offering Keyhole-labelled meals are also obliged to offer healthy accompaniments (drinks, bread, salad and dressing). An additional aim of the certification process is to raise restaurant professionals' knowledge about how to cook and serve healthy meals successfully. Since the end of 2012 SLV has the main responsibility for the Keyhole certification and is working to create a new certification association.

Previous research on the impact of menu labelling is mixed, with some studies finding that menu labelling may impact healthy choices (e.g. Downs *et al*., 2009, Pulos and Leng 2010, Dumanovsky *et al*. 2011), and others finding no effect of menu labelling (e.g. Harnack *et al*., 2008; Elbel *et al*., 2009 and 2011; Vadiveloo, 2011; Thunström & Nordström, 2011, Dumanovsky *et al*. 2011, Swartz *et al*. 2011). Previous research on price policies on healthy food choices away from home is limited. Horgen & Brownwell (2002) analyse the impact of lowered prices, health messages and a combination of the two on healthy food choices in a restaurant offering sandwiches, salads and soups. The results show that daily average sales of healthy sandwiches and salads increased by 280% and 43%[3] respectively as a result of the health message intervention, and by an additional 5-10% when the health message was combined with a 20-30% price reduction. The same pattern was observed for soup. However, for sandwiches and salads the largest effect on sales was found with price intervention alone, while the combined intervention had the largest effect on sales of soup, compared to baseline.

Jeffery *et al*. (1994) found that purchases of fruit and salads in a cafeteria increased threefold as a result of a 50% reduction in the price of fruit and salads combined with an increase in fruit and salad choices. French *et al.* (2001) found that price reductions of 10%, 25% and 50% on lower-fat vending machine snacks resulted in an increase in sales of 9%, 39% and 93% respectively compared with usual price conditions. Shortcomings of these studies are that they do not analyse the impact on different consumer groups, and that price reductions are generally limited to a single value.

Existing stated preference data does not permit analysis of price differences between healthy and less healthy options, since the Swedish restaurants that have been Keyhole certified generally offer Keyhole-labelled and non-labelled meals at the same price.[4] To perform our analysis and study the substitution between non-labelled and Keyhole-labelled meals due to price changes, we will therefore use stated preference data from a contingent valuation survey. In doing so, we were able both to examine the impact of the subsidy on different consumer groups and to vary the level of the subsidy at a low survey cost.

A drawback with the contingent valuation method and stated choice experiments in general is the hypothetical bias that the experiments may suffer from, i.e. the payment in the experiment is hypothetical and no transfer of money takes place. An alternative method would be to use experimental auctions. Since we are interested in studying the impact of price

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[3] The large percentage change for healthy sandwiches is partly due to low average daily sales in the baseline period: 1.81 and 2.71 for sandwiches and salads respectively.

[4] In 2012 were about 300 restaurants Keyhole certified.

changes across different socioeconomic groups we need a large sample. A drawback with experimental actions is that the cost for recruiting a large number of participants from different socioeconomic groups is high.

The paper is organised as follows. In the section below, we present the data from the survey and the econometric method used for analysis. Section 3 reports the results, and in Section 4 we conclude our findings.

2. Methods

2.1. Data

To elicit the willingness to pay for Keyhole-labelled meals, we used the contingent valuation method (CVM), see e.g. Bateman *et al.* (2002). This means that respondents were given information about a Keyhole-labelled meal and thereafter asked to state their maximum willingness to pay for that meal. The survey was carried out in 2007 as an internet-based questionnaire. The following text was used to describe the healthy meal:

"There is a proposal to reduce the price of Keyhole-labelled (healthy) meals in the future. The proposal applies only to meals served in restaurants/canteens and not to food purchased in shops.

Imagine that your lunch restaurant/canteen serves a selection of dishes and that one choice is Keyhole labelled. Assume that all dishes cost SEK 60 (€6.50) at present, but that the Keyhole-labelled alternative may become cheaper in the future. At which price would you regularly/almost always choose the Keyhole-labelled alternative?"

The respondents where then asked to mark their maximum WTP on a payment card.

Table 1 shows the levels that respondents could mark, ranging from "more than SEK 60" (€6.50) to "less than SEK 39"[5] (€4.22). In addition to these choices, respondents could also mark the alternative "I have no interest in buying Keyhole-labelled meals". To enable

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[5] On the payment card, respondents could mark values for SEK 36, 33 and 30 (€3.90, 3.57 and 3.25). However, in the estimation these alternatives were merged into a single alternative because of the low number of respondents choosing these levels.

analysis of the effects of different levels of subsidies, we used a payment card on which the difference between the price alternatives was small, SEK 3.00 (€0.32). In the survey, respondents were also asked questions about labour supply, the amount of exercise they took and their household, enabling an analysis of the WTP across different groups of individuals.

The questionnaire was sent out to a sample of Synovate's[6] web panel members. Synovate's web panel consists of a nationwide sample of 30,000 individuals; the questionnaire was sent to 1155 individuals aged 20 to 60 years. Of these, 500 answered the questionnaire, giving a response rate of 43%. Table 2 includes summary statistics for the sample. The sample is representative with respect to age and gender, but has a slight overrepresentation of individuals with a higher (university) education (50%) compared to the national level where 38% has a university education and 47% an upper secondary school education.

Twenty-five respondents reported that they had no interest in purchasing Keyhole-labelled meals and did not state any WTP for Keyhole-labelled meals. Comparing the characteristics of individuals interested in purchasing Keyhole-labelled meals with those with no interest in purchasing such meals, we found no significant difference. However, to control for potential selection effects, a sample selection ordered probability model was estimated, see e.g. Greene & Hensher (2010). In the selection equation, which was defined as a univariate probit model, the explanatory variables were age, gender, household income per adult, and a dummy variable representing self-employed respondents[7]. For a more thorough description of these variables, see the Explanatory variables subsection below. The results suggest that there is no selectivity with a *P*-value of 0.88 for the selectivity parameter. Respondents who reported that they had no interest in buying Keyhole-labelled meals (*n* = 25) were therefore removed from the final sample, which thus comprises *n* = 475 individuals.

Table 1 presents summary statistics for the alternatives marked on the payment card. At a price of SEK 60 (€6.50), i.e. with no subsidy of the Keyhole-labelled alternative, about one third (32%) of the respondents would choose the Keyhole-labelled option if it was available on the menu. This finding is also supported by results of Thunström & Nordström (2011), who studied the effects of introducing a Keyhole-labelled alternative on the menu in a natural experiment conducted at a restaurant serving lunches. Table 1 also reveals that about

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[6] For information on Synovate, see e.g. www.synovate.se.

[7] The variable has a value of 1 if the respondent is self-employed and 0 otherwise. Four percent of the respondents are self-employed.

8% of the respondents would be willing to pay more than SEK 60 for a Keyhole-labelled meal.

Table 1. Summary statistics; stated maximal willingness to pay for a Keyhole-labelled lunch

			Frequency	
Outcome			Count	Percent
0	< SEK 39	(<€4.22)	22	4.6
1	SEK 39	(€4.22)	29	6.1
2	SEK 42	(€4.55)	13	2.7
3	SEK 45	(€4.88)	73	15.3
4	SEK 48	(€5.20)	54	11.3
5	SEK 51	(€5.53)	69	14.5
6	SEK 54	(€5.85)	44	9.2
7	SEK 57	(€6.18)	20	4.2
8	SEK 60	(€6.50)	115	24.2
9	> SEK 60	(> €6.50)	36	7.5
Sum			475	100.0

Note: At the stated maximal willingness to pay the individual would regularly/almost always choose the Keyhole-labelled alternative compared to a selection of dishes that cost SEK 60 (€6.50)

Subsidising the Keyhole-labelled alternative by 10% or SEK 6, for example through a VAT reduction, would increase the demand for Keyhole-labelled meals by 13.4%. This suggests a cross-price elasticity of 1.3% between Keyhole-labelled and non-Keyhole-labelled meals in this price interval. At this price level, about 45% of the respondents would choose the Keyhole-labelled alternative regularly. Increasing the subsidy to 20%, to a price of SEK 48, would imply that about 70% of the respondents would regularly choose the Keyhole-labelled alternative. About 85% of the respondents would regularly choose the Keyhole-labelled alternative if it were subsidised by 25%.

2.1.1 Explanatory variables

As we are interested in analysing the preferences for Keyhole-labelled meals among different consumer groups, we estimate below an ordered logit model where we include information on gender, age, education, income and level of physical exercise for each individual in the set of explanatory variables. In the model, the variables gender, age, employment and physical exercise are classified using dummy variables. *Age* is modelled using a dummy variable with a value of 1 if the respondent is under 50 years and 0 otherwise. The reference individual in

the model is 50 years or older. Education was divided into three levels: *lower* (nine years of compulsory school or vocational education), *upper secondary school education* and *higher* (university) *education*. Physical exercise was classified into *a low* and *a higher level*. The variable *low level of physical exercise* has a value of 1 if the respondent does less than one hour of intense physical exercise per week and 0 otherwise. Intense physical exercise includes, for example, running, jogging, skiing, swimming, playing football, badminton, tennis etc. The variable *higher level of physical exercise* has a value of 1 if the respondent does *more* than one hour of intense physical exercise per week and 0 otherwise.

Income is defined as a household's annual income from work before tax divided by the number of adults[8] in the household. This is defined as a categorical variable, where each income interval has a span of SEK 50,000, except for the last interval which covers incomes over SEK 900,000. The income variable has the following values: 1 for household incomes per adult below SEK 50,000 (€5,406); 2 if the household income per adult is between SEK 50,000 and 99,999 (€5,406 - 10,813), and so on up to a value of 20 if the household income per adult is over SEK 900,000 (€97,317).

As household composition may affect dietary intake, we also include information on the number of adults and presence of children in the household as explanatory variables.[9] The effect of the number of adults is modelled using the dummy variable *single*, which has a value of 1 if the household has one adult and 0 otherwise. The effect of children is modelled using the dummy variable *household with children*.

In addition, we have included information on the respondents' labour supply, since this may affect the WTP for healthy meals (lunches). The hypothesis is that individuals with a higher labour supply may find it more difficult to find time to cook at home – meals that are generally considered healthier than those consumed outside the home. Such individuals might therefore have a higher WTP for healthy meals served in restaurants/canteens. In the econometric model, the reference individual is a male with a university education and a high level of physical exercise who lives in a household consisting of two or more adults and no children, and has an age below 50 years.

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[8] That aim to reflect the number of income earners in the household.

[9] Becker & Pearson (2002) report for example that women in households with two adults and children eat significantly more pasta than women in households with two adults and no children; women in cohabiting households without children have the lowest intake of milk; and households with children have a higher intake of pasta, pizza, rice, sausage, soft drinks and sweets than households without children.

Table 2 presents summary statistics for the explanatory variables in the model. The continuous variable *labour supply* has an average value of 7.91 hours per working day (std 1.32); the categorical variable *income* has an average value of 6.35 (std 2.48). The mean *age* of the individuals in the sample is 41.6 years (s.d. 11.28).

2.2. Econometric model

To analyse the willingness-to-pay data using the payment cards, where the alternatives have a natural order, we used an ordered logit model. This model is built around the latent regression:

$$y_i^* = \boldsymbol{\beta}'\mathbf{x}_i + \varepsilon_i, \qquad i = 1, \dots, n, \tag{1}$$

where y_i^* is the underlying maximum WTP for individual i, the vector $\mathbf{x}_i$ is the set of explanatory variables, $\boldsymbol{\beta}$ is a vector of parameters, and ε_i is a residual that is extreme value distributed with $E[\varepsilon_i|\mathbf{x}_i] = 0$ and $\mathrm{Var}[\varepsilon_i|\mathbf{x}_i] = \pi^2/6$. From the survey, we cannot observe y_i^*, but we know which of the J categories y_i^* belongs to. It belongs to the jth category if:

$$
\begin{aligned}
y_i &= 0 \text{ if } y_i^* \leq \mu_0, \\
y_i &= 1 \text{ if } \mu_0 < y_i^* \leq \mu_1, \\
y_i &= 2 \text{ if } \mu_1 < y_i^* \leq \mu_2, \\
&\dots \\
y_i &= J \text{ if } y_i^* > \mu_{J-1}.
\end{aligned}
\tag{2}
$$

where the $\mu's$ are threshold parameters to be estimated together with $\boldsymbol{\beta}$. For inference purposes, we use a sandwich estimator to account for heteroscedasticity. The estimations were carried out using Limdep 9.0.

2.2.1 Marginal effects

As there is no natural mean function for the ordered logit model, the interpretation of the parameters in this model is more complex than in an ordinary regression model, see e.g. Daykin & Moffatt (2002). The marginal effects of a change in an explanatory variable are therefore analysed via the change in the cell probabilities. For continuous variables, the effects of changes in the explanatory variables on the cell probabilities are calculated as:

$$\boldsymbol{\delta}_j(\mathbf{x}_i) = \frac{\partial \text{Prob}[y=j|\mathbf{x}_i]}{\partial \mathbf{x}_i} = [f(\mu_{j-1} - \boldsymbol{\beta}'\mathbf{x}_i) - f(\mu_j - \boldsymbol{\beta}'\mathbf{x}_i)] \times \boldsymbol{\beta}, \tag{3}$$

where $f(.)$ represents the logistic density function.[10] For a dummy variable, we follow Greene & Hensher (2010) and calculate the marginal effect as the difference in probabilities. If we assume that D represents a dummy variable and that λ is the coefficient on D, then the change in probability is calculated by:

$$\Delta Prob_j(D) = \left[F(\mu_j - \boldsymbol{\beta}'\mathbf{x}_i + \lambda) - F(\mu_{j-1} - \boldsymbol{\beta}'\mathbf{x}_i + \lambda) \right]$$
$$- [F(\mu_j - \boldsymbol{\beta}'\mathbf{x}_i) - F(\mu_{j-1} - \boldsymbol{\beta}'\mathbf{x}_i)], \tag{4}$$

where $F(.)$ is the CDF.

3. Results

The result from the ordered logit regression model is presented in Table 2. As can be seen from the table, the variables representing the target groups age, education, income and physical exercise are all statistically significant, whereas there is no significant difference in the WTP between women and men.

The age dummy variable "below 50 years" is significantly negative, suggesting that individuals under 50 years have a significantly lower WTP for Keyhole-labelled meals compared to those over 50 years. The sign of the point estimate must, however, be interpreted with caution, since it does not tell us how all cell probabilities will be affected by a change in the covariate. It is only for the first and last cells that we can be sure about the sign of the change in the cell probability. The marginal effect on the cell probabilities is shown in Table 3. From this table, we can see that a lower age (i.e. below 50 years) will increase the cell probabilities for the six lowest cells, and decrease the cell probabilities for the other (higher) cells. This means that an individual under 50 years has a greater probability of stating a maximum WTP for a healthy meal below SEK 51 (€5.53) than a person aged 50 years or over and a lower probability of stating a maximum WTP above SEK 51.

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[10] For squared variables the marginal effect is $\boldsymbol{\delta}_j(x_1) = \frac{\partial \text{Prob}[y=j|x_1]}{\partial x_1} = [f(\mu_{j-1} - \beta_1 x_1 - \beta_2 x_1^2) - f(\mu_j - \beta_1 x_1 - \beta_2 x_1^2)] \times (\beta_1 + 2\beta_2 x_1).$

Table 2. Results from the ordered logit model, and descriptive statistics (mean values) for the variables in the model.

Variable		Coefficient	s.e.	P-value	Mean of variable
Constant		6.931	1.192	0.000	
Gender	Female	0.064	0.170	0.7041	0.516
	Male	0			
Number of adults	Single	-0.205	0.204	0.314	0.263
	Two or more adults	0			
Children	Household with children	0.033	0.189	0.859	0.429
	Household without children	0			
Age	Below 50 years	-0.561	0.227	0.013	0.693
	50 years or older	0			
Education	Lower	0.291	0.419	0.487	0.067
	Upper secondary school	-0.428	0.172	0.012	0.375
	Higher	0			
Labour supply	Hours per day	-1.135	0.280	0.000	7.909
	Hours per day squared	0.078	0.018	0.000	64.275
Income		0.079	0.036	0.028	6.349
Physical exercise	Low level of physical exercise [a]	-0.581	0.174	0.001	0.429
	Higher level of physical exercise [b]	0			
Dummy	High labour supply [c]	-4.141	1.013	0.000	0.006
Interaction var.	Income*Dummy_high_income [d]	0.037	0.065	0.571	0.173
Threshold parameter	One	0.923	0.406	0.023	
	Two	1.191	0.423	0.005	
	Three	2.200	0.414	0.000	
	Four	2.741	0.437	0.000	
	Five	3.372	0.501	0.000	
	Six	3.790	0.552	0.000	
	Seven	3.995	0.551	0.000	
	Eight	5.857	0.404	0.000	

Number of observations	475	Chi squared	52.20
Log likelihood function	-980.6	Degrees of freedom	12
Restricted log likelihood f.	-1006.7	Prob [ChiSqd > value]	<0.01

Note: The variables gender, children, age, employment and physical exercise are classified by a set of dummy variables. In the table, the reference dummy variable is indicated by a 0 in the coefficient column. [a] The variable has a value of 1 if the respondent does *less* than one hour of intense physical exercise per week and 0 otherwise. Intense physical exercise include, for example, running, jogging, skiing, swimming, playing football, badminton, tennis etc. [b] The variable 'Higher level of physical exercise' constitutes the reference level in the model. The variable has a value of 1 if the respondent does *more* than one hour of intense physical exercise per week and 0 otherwise. [c] More than 12 hours per day (two individuals fulfil the criteria). [d] Dummy variable that has a value of 1 if the household income per adult is higher than SEK 700,000 (five individuals fulfil the criteria) and 0 otherwise.

For individuals under 50 years, the probability of having a maximum WTP in the highest cell, i.e. above SEK 60 (€6.50), is 3.8 percentage points lower than for an individual aged 50 years or over. The cell probability for the next lowest cell (i.e. SEK 60, the same

price for Keyhole-labelled and non-Keyhole-labelled meals) is 8.6 percentage points lower for an individual under 50 years than for an individual aged 50 years or over.

Table 3 reveals that the sign change in cell probabilities will occur between cells 5 and 6 (at a price of SEK 51 (€5.53)) for all covariates in our model. Thus, a negative point estimate increases the probability of having a maximum WTP in the six lowest cells, while a positive one decreases the probability. The greatest differences in cell probabilities between different groups of individuals is found for cell 8 at a price of SEK 60 (€6.50), i.e. when Keyhole-labelled and non-labelled meals are the same price, and for cell 4 at a price of SEK 45 (€4.88), i.e. with a 25 percent subsidy of the Keyhole-labelled meal.

Table 3. Marginal effects (in percentage units) on the cell probabilities[a] in the payment card. The marginal effect on the cell probabilities is the change in the probability that one will choose a specific alternative (cell) in the payment card due to a change in the explanatory variable by one unit.

	Cell									
	0	1	2	3	4	5	6	7	8	9
Variable	< SEK 39	SEK 39	SEK 42	SEK 45	SEK 48	SEK 51	SEK 54	SEK 57	SEK 60	> SEK 60
Gender (female)	-0.24	-0.30	-0.13	-0.60	-0.26	-0.07	0.12	0.10	0.99	0.40
Single	0.81	0.99	0.42	1.90	0.80	0.15	-0.42	-0.32	-3.11	-1.21
Household with children	-0.13	-0.16	-0.07	-0.31	-0.14	-0.04	0.06	0.05	0.51	0.21
Age (< 50 years)*	1.93	2.43	1.05	5.04	2.44	1.03	-0.75	-0.73	-8.63	-3.80
Lower education Upper secondary school*	-0.98	-1.24	-0.54	-2.62	-1.30	-0.58	0.37	0.38	4.52	1.99
	1.70	2.08	0.87	3.95	1.63	0.29	-0.88	-0.67	-6.45	-2.52
Labour supply*	-0.02	-0.26	-0.22	-1.76	-1.10	-0.32	0.54	0.41	2.61	0.11
Low level of physical exercise*	2.29	2.80	1.18	5.32	2.23	0.45	-1.16	-0.89	-8.75	-3.47
Income*[b]	-0.30	-0.37	-0.16	-0.73	-0.32	-0.09	0.15	0.12	1.21	0.49

Note: [a]1.0 denotes a change in the probability of one percentage point. [b] The marginal effects for the income variable represent a one unit change in the income variable, which can be interpreted as a move from one income interval to another, i.e. from the mean value 6.35 to 6.85. * denotes that the point estimate in the estimated logit model was significant at a five percent significance level.

Analysing the estimation results for the other covariates in Table 2, we see that individuals with upper secondary school education have a significantly lower WTP for Keyhole-labelled meals than those with higher (university) education. This implies that individuals with upper secondary school education have a lower probability mass for the four highest cell probabilities compared to individuals with higher education, and that they require a higher subsidy of the Keyhole-labelled meal before they would choose that alternative

regularly. From Table 3, we see that cell probabilities for the two highest cells (cells 8 and 9) decrease by 6.4 and 2.5 percentage points respectively for individuals with upper secondary school education compared with those with higher (university) education.

The largest marginal effects on cell probabilities are found for individuals with a low level of physical exercise compared with those with a higher level of physical exercise. This means that individuals with a low level of physical exercise require a significantly greater subsidy to choose the Keyhole-labelled alternative than those with a higher level of physical exercise. If the Keyhole-labelled and non-Keyhole-labelled meals are the same price, the probability that an individual will choose the Keyhole-labelled alternative is 8.8 percentage points lower for someone with a low level of physical exercise than for someone with a higher level of physical exercise.

The point estimate for the income variable is significantly positive. Thus, individuals with a lower income generally require a greater subsidy of the Keyhole-labelled alternative before they choose it on a regular basis. The marginal effects is, however, relatively small. In Table 3, the marginal effects for the income variable represent a one-unit change in the categorical income variable, e.g. a change from the mean value of 6.35 to 6.85, which corresponds to an increase in annual income per adult in the household of SEK 50,000 (€5,406).

In addition, the results suggest a significantly greater WTP for Keyhole-labelled meals by individuals with a higher labour supply (i.e. for individuals with more employment hours). This supports our initial hypothesis. The marginal effects reported in Table 3 correspond to an increase in labour supply of one hour. Household composition, on the other hand, has no significant effect on the WTP for Keyhole-labelled meals consumed outside the home. Both the variable *single* and the variable *household with children* are strongly insignificant.

To analyse the robustness of the result and whether the model specification was too restrictive, we also estimated a "hierarchical" model where the threshold parameters were parameterised, as well as an ordered logit model with a more compressed distribution of the outcome variable, i.e. where some of the choice alternatives were added together. The results from these models suggest that the model presented in Table 2 represents the data well. The results from the "hierarchical" model revealed that the variables in the threshold parameter function were insignificant and that the ordered logit model with fewer choice alternatives gave the same results as the model in Table 2.

3.1 Health effects of a Keyhole-labelled diet

To be able to analyse the distributional health effects from a subsidy of Keyhole-labelled meals we need to know the expected health benefits from a Keyhole-labelled diet. In this section we will therefore summarise the findings within this area. The Keyhole criteria for a main course meal stipulate that the energy content should be 400-750 kcal/portion and that the maximum percentage of energy (E%) from fat should be 30%. Further, Keyhole-labelled meals should have a maximum sugar and salt content of 3g/100g and 1g/100g respectively and should include at least 100g of fruit and vegetables (excluding potato).

In a study by Callmer & Fridel (2002), $n = 66$ lunch meals from a representative sample of Swedish municipalities were collected and analysed. The results showed that main courses on average contained 645 kcal/portion, with 44E% as fat, 36E% as carbohydrates and 20E% as protein.[11] To reduce the percentage of energy from fat from 44% to 30%, for an average 650kcal/portion meal, the amount of fat would have to be decreased by 10g/portion (or fully 30%).[12] However, diets intended to lower fat and total cholesterol should not reduce the level of high-density lipoprotein cholesterol (HDL-C), since HDL-C may protect against coronary heart disease (Mensik & Katan, 1987).

Ginsberg *et al*. (1990) compared the health effects of an American Heart Association Step 1 diet[13] with those of the average American diet[14]. Compared to the group that followed the average American diet, the group on the Step 1 diet showed a statistically significant reduction in plasma total cholesterol level and reductions in plasma low-density lipoprotein cholesterol (LDL-C) levels, at the same time neither the plasma triglyceride levels nor the HDL-C concentrations changed significantly. A Step 1 type diet may thus reduce the risk of coronary heart disease.

A Keyhole-labelled meal corresponds fairly well to the Step 1 diet in Ginsberg *et al*., though it lacks specific criteria for the types of fatty acids. However, Swedish nutrition

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[11] Approximately the same result was obtained by calculating the nutritional content of recipes for a sample ($n = 31$) of the most common meals in Swedish restaurants serving lunches at the beginning of 2012. These calculations suggest that the calories amount to 585 kcal/portion (s.d. 115), 43E% as fat (28g/portion, s.d. 10.75), 34E% as carbohydrates (49g/portion, s.d. 7.24) and 22E% as protein (31g/portion, s.d. 7.24). We would like to thank Ingela Jonsson for carrying out the calculations.

[12] A portion containing 650 kcal and a fat content of 44E% has about 32g fat/portion.

[13] 30E% as fat, 10% saturated, 10% monounsaturated, and 10% polyunsaturated, 250 mg of cholesterol per day and 55E% carbohydrate.

[14] 38E% as fat, 18% saturated, 10% monounsaturated and 10% polyunsaturated, 500 mg of cholesterol per day and 47E% as carbohydrate.

recommendations do stipulate that people should limit their intake of saturated plus trans fatty acids to about 10E%. If this recommendation were included as part of the criteria for Keyhole-labelled meals, it would become quite similar to the Step 1 diet. A meta-analysis by Hu & Willet (2002) also suggests that it is the mix of fatty acids that is important in reducing the risk of coronary heart disease.

High intakes of fat and specific fatty acids (e.g. saturated fat) have been found to increase the risk of breast cancer Boyd *et al.* (2003). However, compared to case-control studies, cohort studies generally find a lower association between the intake of fat and breast cancer. Holmes *et al.* (1999) and Hunter *et al.* (1996) found for example no evidence of a positive association between total dietary fat intake and the risk of breast cancer.

A Keyhole-certified restaurant should ensure a minimum of 100g/portion of fruit and vegetables in Keyhole-labelled meals and also provide an abundant supply of whole grain products on the salad bar. A high intake of fruit and vegetables is associated with a reduction in blood pressure and a lower risk of cardiovascular disease (Willet 2005), whereas a high intake of *whole grain* is associated with a reduced risk of colorectal cancer (Schatzkin *et al.* 2007, Park *et al.* 2005), with a stronger association between whole grain and rectal cancer than colon cancer (Schatzkin *et al.* 2007).

Switching to Keyhole-labelled meals (following SLV recommendations on fatty acids) may thus reduce the risk of many common illnesses. Cardiovascular diseases are the largest cause of death in Sweden. And among cardiovascular diseases, coronary heart disease is the most common cause of death. In Sweden in 2005, cardiovascular diseases were twice as common in individuals with a low level of education than in those with a high level, and about 1.7 times more common in men than in women. Among people aged 60 years or younger, the incidence of coronary heart disease was fully three times higher for men than women.

Breast cancer is the most common form of cancer among Swedish women, followed by colorectal cancer. After prostate cancer, colorectal cancer is also the most common form of cancer among men. For both men and women, the prevalence of rectal cancer is higher than that of colon cancer.

However, the expected health benefits also depend on how frequently people eat in restaurants or canteens. We address this issue below.

3.2 Distributional effects across different consumer groups

In the sample, about 27% of respondents ate their lunch in a restaurant/canteen between three to five days per week and 20% one or two days per week. Just over half of the respondents ate lunch in a restaurant/canteen less than one day per week. Especially women, individuals on lower incomes and those with lower education (upper secondary school) ate significantly less frequently in restaurants/canteens.

To examine whether there were significant socioeconomic differences between those who ate lunch in a restaurant/canteen less than one day per week and those who ate lunch in a restaurant/canteen one to five times per week, we estimated a binary logit model. In the model, the dependent variable took the value 1 if the respondent ate lunch in a restaurant/canteen less than one day per week and 0 otherwise. We used the same set of explanatory variables as in the ordered logit model. The estimation result indicates that the variables female, upper secondary school education and income are significantly different from zero at a one percent significance level. None of the other variables was significant at a ten percent significance level. For individuals that ate lunch in a restaurant/canteen less than one day per week, fully 60 percent were female, 47% had upper secondary school education, 45% had higher (university) education and the mean of the categorical income variable was 6.06 (s.d. 2.28). For individuals that ate lunch in a restaurant/canteen between one to five times per week, about 40 percent were female, 26% had upper secondary school education, 67% had higher (university) education and the mean of the categorical income variable was 6.67 (s.d. 2.63).

If the frequencies of eating in restaurants/canteens remain unchanged, an *introduction* of healthy Keyhole-labelled meals will thus generate greater health benefits for men than for women. Men more frequently eat lunch in restaurants, and there is no significant difference in the WTP between genders. In addition, men have a higher risk of coronary heart disease. If Keyhole-labelled meals followed SLV recommendations on fatty acids, introduction of Keyhole-labelled meals would likely lower the risk of coronary heart disease to a larger extent for men than for women.

Introduction of Keyhole-labelled meals would also improve the dietary intake of those with higher education and higher incomes, since these groups eat relatively frequently in restaurants/canteens and have a high WTP for healthy meals. However, comparison of health benefits is less clear cut than between men and women, as groups with lower education and on lower incomes have a poorer dietary intake and health status than those with higher education and on higher incomes. Thus even if a relatively small proportion of individuals

with low education and on lower incomes consumed Keyhole-labelled meals in restaurants/canteens, the health benefits for them could be large.

With a subsidy on Keyhole-labelled meals, the health benefits are likely to be greater for groups with low education (upper secondary school) and on lower incomes compared to those with higher education and on higher incomes, since the former have a lower WTP for healthy meals and poorer health status, e.g. a greater risk of coronary heart disease. Individuals with a low level of physical exercise are also likely to experience a relatively large health benefit from a subsidy as a result of their low WTP for healthy meals and high risk profile (individuals with a sedentary lifestyle tend to have a poorer diet).

From a monetary distributional point of view, men, individuals with higher education and those on higher incomes will benefit most, since these groups eat in restaurants more frequently.[15]

4. Discussion

Modern Western food that is high in energy and low in nutritional value is a significant contributor to many chronic diseases. A type of food that has been found to be particularly poor is food consumed away from home. In this paper, we have examined the effects on demand of changes in relative prices between healthy Keyhole-labelled and non-Keyhole-labelled meals consumed in restaurants/canteens.

The results suggest not only that the availability of healthy meals is an important factor in improving dietary intake, but also that it is necessary to change the relative price between healthy Keyhole-labelled and non-Keyhole-labelled meals in order to get the majority and specific target groups (groups with particularly poor health – men and individuals on low incomes and with a low level of education) to choose the healthy alternative.

Our results suggest that about one third of respondents would choose the Keyhole-labelled alternative if introduced on menus. This result is supported by the findings of a natural experiment in which a Keyhole-labelled alternative was introduced on the menu at a restaurant serving lunches (Thunström & Nordström, 2011). The results also show that a

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[15] A subsidy on healthy Keyhole-labelled restaurant meals may also increase the demand for restaurant services from individuals that without subsidy show a relatively low demand for such services. However, it is not possible to examine this substitution pattern based on the data from the contingent valuation survey.

subsidy of 10% (corresponding to removing VAT) would increase the demand for Keyhole-labelled meals by a further 13 percent. To get the majority to choose the Keyhole-labelled alternative on a regular basis, further price reductions would be necessary. However, since the demand and choice probability for Keyhole-labelled meals reveals strong non-linearities – i.e. greater changes in demand with greater price reductions, especially for price reductions above 10% – a subsidy of 25% would imply that 85% of respondents would choose the healthy Keyhole-labelled alternative on a regular basis.

In addition, the results reveal that target groups that generally have a poorer diet have a lower WTP for Keyhole-labelled meals; they would thus require a larger subsidy before they would choose the healthy meal on a regular basis compared with groups with more healthy diets. One potential explanation is that individuals with a poor diet may have a stronger taste for unhealthy ingredients. Sensory studies (e.g. Bartoshuk *et al*., 2006 and Drewnowski, 2002) have found for example that the liking for fat varies with body mass index, and that obese individuals have a stronger preference for fat than those that are not obese.

A subsidy of healthy Keyhole-labelled meals in restaurants/canteens will have a positive welfare effect on individuals that eat in such establishments, taking into account both economic and health benefits. According to our results, men, individuals with higher education (university education) and those with higher incomes eat in restaurants/canteens more frequently. This implies that men in particular will benefit from an introduction and subsidy of Keyhole-labelled meals. Groups with a lower education (upper secondary school) and lower income, both men and women, will also benefit from a reform, but to a lesser extent than men alone, since they eat less frequently in restaurants/canteens and have a lower WTP for Keyhole-labelled meals. However, a larger subsidy of healthy meals in canteens/restaurants serving lunches could change this behavioural pattern, increasing the probability that these groups would eat lunch in restaurants/canteens.

Keyhole certification of restaurants, which among other things includes training for restaurant staff, may also result in a generally healthier menu. For example, the findings of Lassen *et al*. (2004) suggest that better-trained restaurant/canteen staff can increase the intake of fruit and vegetables by customers. Investment in better training of restaurant/canteen staff may thus have a positive health effect on all consumers, not just those that choose the healthy alternative.

In addition, a better-trained labour force may lower the production cost of healthy meals. Wagner *et al*. (2007) show for example that more nutritious school meals do not

necessarily cost more to produce, but that it may be necessary to adjust the production process to attain this result. The more nutritious meals in their study have higher labour costs but lower costs for processed food. According to interviews with food service managers, producing healthier meals requires greater managerial skill, better-equipped kitchens[16] and more skilled labour for on-site food preparation (Wagner *et al.* 2007). From this perspective, it seems important to encourage the restaurant sector to train their employees to cook more nutritious meals efficiently. One incentive that could encourage the restaurant sector to undertake this investment would be to introduce a subsidy on Keyhole-labelled meals.

A shortcoming of this study and the contingent valuation method is that the results may suffer from a hypothetical bias due to the hypothetical nature of the payment commitment. In a pure WTP study, this implies that the stated WTP may be biased upwards, resulting in an underestimate of the required subsidy. On the other hand, previous studies have shown that individuals tend to require a higher compensation to give up a good that they own compared to what they are willing to pay to acquire the good, i.e. willingness to accept (WTA) is higher than WTP in this situation. To reduce the risk of an upward/downward bias, we designed a question, in which respondents were asked to state their WTP in relation to the prevailing market alternative. Although, we have tried to reduce the bias due to the hypothetical nature of the payment commitment, the results should still be interpreted with caution. One can for example not rule out the possibility that individuals on low incomes act strategically and "vote" for a larger subsidy.

Another potential bias is that the respondents find it difficult to evaluate the described scenario. We believe that this type of bias is of minor importance in our experiment since the respondents are asked to evaluate a product that most people are familiar with (lunch meals) and we use a well-known label. However, respondents with a lower knowledge about the Keyhole-label may requite a larger subsidy before they chose that alternative on a regular basis. This may also be an additional explanation for the lower WTP for Keyhole-labelled meals that we observe for some of the socioeconomic groups.

Although we find support in other studies for the fraction that chooses the Keyhole-labelled alternative when the price of the labelled and non-labelled meal is the same, one should interpret the level of the estimated substitution towards Keyhole-labelled meals at different subsidy levels with caution. To gain additional insight about this pattern it would be

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[16] Although the long-term cost of producing nutritious meals was not higher, food service managers reported that significant short-term capital investments were necessary to switch to production of more nutritious meals.

of interest to carry out a price experiment in a lunch restaurant/canteen. Our experience from the Scandinavian countries is however that managers are unwilling to undertake price experiments in their canteens. One reason is that a subsidy on healthy meals during a period could affect the employees' price expectations and that they expect/require that the company should continue to subsidize the healthy meals after the experiment (financed by the researchers). Another reason is that a price increase on food products in the canteen could have a negative impact on the employees' perception of the canteen/company.

Finally, from a public health perspective it would be of interest to develop the criteria for Keyhole-label meals at restaurants further, and also add criteria for the mix of fatty acids.

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