Changes in the consumption of fruits and vegetables among university students during master courses: an analysis of data automatically collected from cashier transactions

Cambiamenti del consumo di frutta e verdura tra gli studenti universitari nei tre anni succesivi l'immatricolazione sulla base dei dati raccolti dalle transazioni effettuate per l'accesso alle mense universitarie

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Abstract

Previous evidence showed a degradation of eating habits among university students with high prevalence of unhealthy eating behaviours among freshmen that may change in further years when students acquire consciousness about their behaviours. As the frequency of consumption of both fruits and vegetables are well recognised indicators of healthy habits, the present study assessed changes in the consumption of both fruits and vegetables among university students during master courses using data automatically recorded by cashier' transactions and related to meals consumed at the canteens of a large University in central Italy. Results highlighted that the frequency of choice of both fruits and vegetables was low in the first year of enrolment and significantly increased in subsequent years.

Abstract

Le evidenze disponibili sottolineano un peggioramento delle abitudini alimentari tra gli studenti universitari con un'alta prevalenza di comportamenti non salutari tra le matricole, che possono cambiare negli anni successivi con l' acquisizione di consapevolezza verso il cibo. Poiché la frequenza di consumo di frutta e verdura sono considerati indicatori di abitudini salutari, il presente studio ha valutato i cambiamenti nel consumo di frutta e

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verdura tra gli studenti universitari durante il corso di laurea utilizzando dati acquisiti automaticamente dalle transazioni di cassa e relativi ai pasti consumati presso le mense di un' università del centro Italia. I risultati evidenziano un aumento significativo della frequenza di scelta di frutta e verdura negli anni successivi al primo.

Key words: Diet, Fruit, Vegetables, University Students, Beta Regression

1 Introduction

Despite literature about eating habits among university students is limited, particularly in Europe, available evidence tend to equal student food with 'bad' food (Kapinos et al., (2014); Nelson et al., (2008)). Reasons for poor eating habits in this population have been mainly ascribed to the transition period university students have to face, the reduced influence of parents as compared to the greater importance of peers' effect and the high degree of duties and responsibilities they are required to absolve (Doherty et al., (2011); Sharma et al., (2009)).

In details, while the frequent consumption of vegetables and fruits are among well recognized indicators for healthy eating, with potential beneficial effect on both acute and chronic diseases (Slavin and Lloyd, (2012)), several studies suggested that the assumption of both fruits and vegetable is limited among university students and particularly among freshmen (García-Meseguer et al., (2014); Huang et al., (1994); Small et al., (2013); Teleman et al., (2015)) with potential effect not only on their present and future health status but also on their overall well-being and academic achievement.

Using data automatically recorded by cashier' transactions and related to meals consumed at the canteens of a large University in central Italy,, the present study aims at evaluating changes in the frequency of selection of both fruits and vegetables among students during their master courses.

2 Methods

2.1 Study population and data

The population under study was composed of students enrolled in courses in a large University in central Italy who accessed the canteens in the academic years from 2010-11 to 2013-14. In order to observe the behaviour over a sufficient period of time, only students enrolled in first-degree courses and accessing the canteen at least 40 times all over the three years of analysis were considered.

Analyses were performed merging two different sources of data: the administrative archive of the University and the database of Azienda Regionale per il Diritto allo Studio Universitario (DSU). The first source contained demographic characteristics of students and data about their career progression, while the second one contained all the records of consumed meals.

The two source of data were merged by the anonymous student ID and analysis about food choices was allowed by the fact that one of the canteens serving the University is

equipped with an automatic system that allow for the recording of all consumed meals. In detail, for each meal consumed, in addition to the student ID a set of variables were available, such as date and time, number and type of courses chosen, dishes selected and the price charged. On the basis of these data, the frequency of fruits and vegetables selected was measured in terms of the number of times these items were selected over the total number of accesses. Calculating this measure for each student generates a continuous doubly bounded random variable defined in the unit interval (0,1). In details two responses variables were used in the present study: a) the proportion of vegetables choice over the total of meals consumed; b) the proportion of fruits choice over the total of meals consumed. For both variables a multiple model considering also age, gender, scholarship and geographical origin was adapted.

2.2 Statistical analysis

To model the proportion of meals including vegetables and fruits all over the period of observation, we used a beta regression model with robust standard errors. The class of beta regression models (Ferrari and Cribari-Neto, (2004)), are well-suited to model continuous variables constrained in the unit interval (0,1) and assumes that the response variable (y) is beta distributed. Following the parameterization proposed by Ferrari and Cribari-Neto, the beta density function can be written as follows:

$$f(y;\mu,\phi)=\frac{\Gamma(\phi)}{\Gamma(\mu\phi)\Gamma((1-\mu)\phi)}y^{\mu\phi-1}(1-y)^{(1-\mu)\phi-1}$$

where $0 < \mu < 1$, $\phi > 0$ and $\Gamma(\cdot)$ denotes the gamma function. Moreover, $E(Y) = \mu$ and $Var(Y) = \mu(1-\mu)/(\phi+1)$. The parameter ϕ is known as a "precision" parameter since, for fixed μ, the larger ϕ, the smaller the variance of the response variable y. Since the beta regression is heteroscedastic, both location and precision are modelled by specifying the following two submodels, one for the location parameter μ and another for the precision parameter ϕ. Given $\mathbf{x}_i$ and $\mathbf{w}_i$ the vector of fixed and known covariates, and let $\boldsymbol{\beta}$ and $\boldsymbol{\delta}$ be the vector of regression coefficients, the location submodel is:

$$g(\mu_i)=\mathbf{x}_i\boldsymbol{\beta},$$

where $g(\cdot)$ is the logit function and the precision submodel is:

$$h(\phi_i)=\mathbf{w}_i\boldsymbol{\delta},$$

where $h(\cdot)$ is the log function. Finally, parameter estimation is performed by maximum likelihood (ML).

3 Results

A total of 2,825 students enrolled in master courses at University of Pisa and having observations over a 3-year period (starting from matriculation) were included in the analysis. The main characteristics of the study population at enrolment are shown in Table 1.

Table 1: Main Characteristics of the study population

Age	20.5±1.8
Gender	
Female	1,177 (41.7%)
Male	1,648 (58.34)
Scholarship older	
No	1,536 (54.4%)
Yes	1,289 (45.6%)
Geographical Origin	
North Italy	233 (8.3%)
Central Italy	1,024 (36.3%)
South Italy	730 (25.8%)
Italian islands	567 (20.1%)
Foreign	271 (9.6%)

The selection of both vegetables and fruits during meals consumed at the university canteen significantly increased over years ($p<0.001$). In details, while freshmen included vegetables in their meals about 65% of times, values increased to 72% and 76% in the second and third year respectively; for fruits values increased from about 61% in the first year to 75% in the third year, see Figure 1.

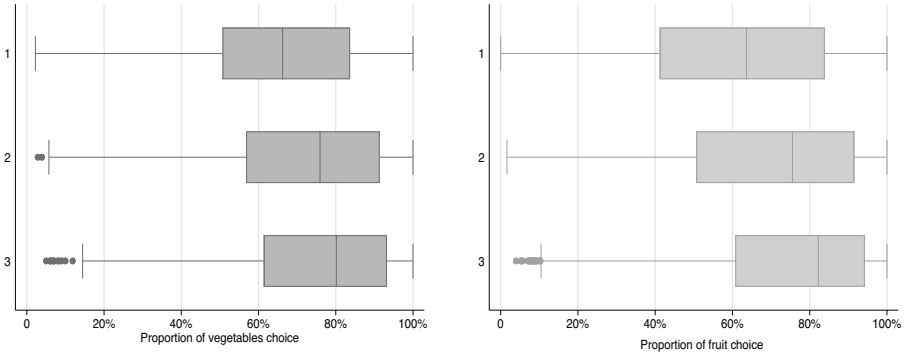

Figure 1: Box-plot showing the proportion of vegetables and fruit (choice) over years.

Results from the beta regression model suggested that in the second and third year of registration the frequency of selection of vegetables significantly increased by 0.29 (SE 0.02) and 0.44 (SE 0.02) respectively (Table 2).

Table 2: Results from the multiple beta regression models for the response variable "Proportion of vegetables choice"

	Coef.	***SE***	***95%CI***	***P-value***
Response variable: Proportion of vegetables choice				
Registration year 1	*(ref)*			
Registration year 2	0.290	0.016	0.258-0.322	<0.001
Registration year 3	0.445	0.024	0.399-0.491	<0.001
Age	0.032	0.009	0.015-0.050	<0.001
Male gender	-0.038	0.032	-0.101-0.024	0.227
Scholarship holders	0.227	0.030	0.168-0.286	<0.001
Geographical Origin				
North Italy	*(ref)*			
Central Italy	0.211	0.062	0.089-0.332	0.001
South Italy	-0.039	0.062	-0.161-0.084	0.536
Italian islands	0.062	0.064	-0.062-0.187	0.325
Foreign	0.569	0.072	0.429-0.710	<0.001
Pseudo R^2	0.11			

Similarly results emerged when modelling the proportion of fruits choice, with coefficients being 0.32 (SE 0.02) and 0.57 (SE 0.03) for the second and first year compared with the enrolment year (Table 3).

Table 3: Results from the multiple beta regression models for the response variable "Proportion of fruits choice"

	Coef.	***SE***	***95%CI***	***P-value***
Response variable: Proportion of fruits choice				
Registration year 1	*(ref)*			
Registration year 2	0.318	0.018	0.282-0.352	<0.001
Registration year 3	0.566	0.025	0.517-0.615	<0.001
Age	0.027	0.010	0.008-0.046	0.005
Male gender	-0.052	0.033	-0.117-0.013	0.118
Scholarship holders	0.292	0.032	0.229-0.355	<0.001
Geographical Origin				
North Italy	*(ref)*			
Central Italy	0.227	0.069	0.092-0.362	0.001
South Italy	0.041	0.069	-0.094-0.175	0.553
Italian islands	0.155	0.070	0.018-0.291	0.026
Foreign	0.618	0.075	0.470-0.765	<0.001
Pseudo R^2	0.12			

Moreover these models also suggested that the proportion of both fruits and vegetables selection were positively related with age, scholarship and being from central Italy or being foreign instead of being from the North of Italy.

4 Conclusions

Results from the present study confirm that unhealthy eating habits (in this case represented by a low proportion of meals that include fruits and vegetables) occur more frequently in freshmen thus potentially increasing their risk of developing overweigh and obesity as well as impacting on both physical and mental health (Blichfeldt and Gram, (2013); Vella-Zarb and Elgar, (2010)).

With the increasing availability of data routinely collected even for purpose other than research there is nowadays the possibility to directly monitor behaviour, such as eating habits, with the opportunity to timely encourage the development of policies and new strategies to promoting healthy habits among university students, with the possibility of also targeting interventions to specific subgroups.

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