



Vrije Universiteit Brussel

Faculteit Lichamelijke Opvoeding en Kinesitherapie

Determinants of fruit & vegetable and fat intake in university students: a cross-sectional explanatory study

Hannah Verhoeven

Masterproef aangeboden tot het behalen van de graad van Master of Science in de Lichamelijke Opvoeding en Bewegingswetenschappen

Promotor : Prof. Dr. P. Clarys
Co-promotor: Prof. Dr. B. Deforche
Begeleider : Drs. T. Deliens

Academiejaar 2012-2013





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GEZIEN en GOEDGEKEURD

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(Promotor(en) van de masterproef,

.....)

Foreword

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PART 1: Literature review

1. Overweight and obesity among university students

The prevalence of overweight and obesity has increased worldwide over the past 30 years among both adults and adolescents (West et al., 2006; Yang et al., 2010). Initially, obesity was most prevalent in developed countries, but meanwhile also developing countries experience the effects of increasing rates of this disease (Ford et al., 2008). The World Health Organization (WHO) stated that, in 2008, more than 1.4 billion adults, 20 years and older, were overweight (BMI ≥ 25 kg/m²). In fact, over 200 million men and nearly 300 million women were classified as obese (BMI ≥ 30 kg/m²) (WHO, 2012b). Since 1997 the obesity epidemic was formally recognized by the WHO (Caballero et al., 2007).

Overweight and obesity can be the cause of serious epidemic health problems (Al-Rethaiaa et al., 2010). Obesity contributes to an increased risk of morbidity and mortality (Wengreen et al., 2009). It is the fifth leading cause of deaths at global level, with no less than 2.8 million adult deaths each year (WHO, 2012b). Obesity is related with diseases such as diabetes type 2, hypertension, high cholesterol, stroke, coronary heart disease and certain cancers (Al-Rethaiaa et al., 2010; Shuger et al., 2011).

The National Health and Nutrition Examination Survey (NHANES) from 2009-2010 reported a prevalence of overweight and obesity (combined) of 68.8% among US adults (≥ 20 years), with 35.7% being obese (Flegal et al., 2012). Furthermore, similar epidemic tendencies can be observed in Europe. The rate of obesity in Europe has increased with approximately 30% over the past 10 to 15 years (Berghöfer et al., 2008). According to Duvigneaud et al. (2006), the prevalence of overweight and obesity in the Flemish part of Belgium had increased in both men and women between 1997 and 2004. In 2004, the rates of overweight seemed to be higher in men than in women, 41.4% and 29.8% respectively (Duvigneaud et al., 2006).

Furthermore, the prevalence of obesity was found to be 10.7% in men and 10.2% in women (Duvigneaud et al., 2006). The obesity epidemic can be seen as a serious worldwide problem. Hence, there is a need for drastic behavioural changes among the global population.

To develop effective and tailored intervention programs it is important to identify critical periods of weight gain. Mokdad et al. (1999) indicated that the greatest increases in obesity rates in the US were found among 18-29 year olds. Additionally, data from the Coronary Artery Risk Development in Young Adults (CARDIA) study showed significantly greater weight gains in 18-24 year olds versus 25-30 year olds (Burke et al., 1996). Moreover, especially young-adults with college experience showed the greatest increases in obesity rates (Mokdad et al., 1999). Mokdad et al. (1999) reported an increase of 10.6% to 17.8% in college students versus 7.1% to 12.1% in 18-29 year olds overall. In addition, the review studies of Vella-Zarb et al. (2009) and Crombie et al. (2009) showed a significant weight gain in students during their first year of university. Therefore, the transition from high school to university is a critical period for weight gain among young-adults (Crombie et al., 2009; Vella-Zarb et al., 2009; Wengreen et al., 2009). This weight gain may be due to lifestyle changes, caused by changes in social and physical environment, which may affect eating and exercise behaviours (Crombie et al., 2009; Wengreen et al., 2009). Weight problems in late adolescence were found to be highly predictive for the presence of adult overweight or obesity (Guo et al., 2002). Additionally, according to Morrow et al. (2006), it is possible that bad health habits will be carried on throughout the college years into adulthood.

In the US there is a common belief that students gain 15 pounds (6.8 kg) during their first year of college or university (Gropper et al., 2012b). Recent studies on the “freshman 15” showed that most students really do gain weight during their freshman year, although the average weight gain is smaller than suggested. According to the meta-analysis of Vella-Zarb et al. (2009), mean weight gain was 1.75 kg and ranged from 0.7 to 4.0 kg. In addition,

Crombie's review (2009) suggested a mean weight gain of 3.0 kg in those who actually gained weight.

Only a few studies have followed students longitudinally through senior year of university (4th year). Gropper et al. (2012a) mentioned that mean weight gained by the end of senior year was 3.0 kg. According to Racette et al. (2008), students gained a mean of 2.5 kg between freshman year (fall semester) and senior year (spring semester). Between the start of college and the end of junior year (3rd year), Gropper et al. (2012b) found a decreased percentage of students classified as normal weight (from 79% to 70%) and an increased percentage classified as overweight/obese (from 15% to 24%). Participants in this study gained 1.2 kg during freshman year, 0.5 kg during sophomore year (2nd year) and 0.6 kg during junior year.

These observed weight gains could be partially explained by unhealthy eating behaviours (Nelson et al., 2008). Young adults often establish unfavourable dietary habits when leaving the parental home and entering university (Hoefkens et al., 2012). Therefore, it is important to pay attention to this critical period of weight gain. On university campuses, large numbers of young adults can be reached by obesity prevention strategies that promote a healthy lifestyle. These prevention programs should inform students about proper dietary behaviour, including healthy food choices.

2. Dietary habits in university students

Good eating habits are an essential part of a healthy lifestyle (Neslisah et al., 2011). The main cause of obesity is a positive energy balance, which is established when energy intake exceeds energy expenditure (Caballero et al., 2007; Ford et al., 2008). According to Levitsky et al. (2004), eating an excess of 32 kJ (7.7 kcal) corresponding to energy expenditure results in 1 g of gained body weight. Diets including regular consumption of energy-dense foods that are high in fat, sugars and salt but low in vitamins, minerals and other micronutrients have been related to obesity (WHO, 2012b). Poor nutritional habits are established risk factors for chronic diseases, including cardiovascular disease (Irazusta et al., 2007).

The transition from adolescence to (young) adulthood is a period often characterized by an unhealthy lifestyle in which younglings become independent and adopt lasting health behaviour patterns (Nelson et al., 2008). These young adults enter college with established eating behaviours and have to cope with increasing autonomy (Nelson et al., 2008). Hence, this transition period can have many consequences on young adults' dietary habits (Nelson et al., 2008; Cluskey et al., 2009). Some of their nutritional habits are associated with health risks, not only during early adulthood itself but also during later life (Irazusta et al., 2007). Lifestyle habits (including dietary habits) adopted during adolescence may last into adulthood (Pearson et al., 2009). Furthermore, in young people, healthy diets have important short- and long-term health protective effects (Pearson et al., 2009).

According to Nelson et al. (2008), college students often established poor dietary practices playing an important role in unhealthy weight change. Weight gains seen in the freshman year may be the result of negative health behaviours, contributing significantly to energy intake (Crombie et al., 2009). Besides, a small increase in energy intake over the university years could lead to students being overweight by the time they complete university (Morrow et al., 2006). Most university students exceed recommended intake of fat, sugar and salt and

fail to meet recommendations for fruits, vegetables and fibers (Anding et al., 2001; Huang et al., 2003; Racette et al., 2008). Although these poor nutritional habits are considered as part of university life, so-called temporary, they generally persist in older adult life (Silliman et al., 2004). This period of increasing responsibility may be important for establishing long-term health behaviour patterns (Nelson et al., 2008).

Changes in living arrangements are considered as one of the main factors influencing dietary habits in university students (Brevard et al., 1996). Brevard et al. (1996) suggest that students living on campus consume different types of foods compared to student colleagues living at their parents' home. Mainly those students living away from the parental home develop more undesirable nutritional habits (El Ansari et al., 2012). According to Pliner et al. (2008), university students living on campus typically combine cooking for themselves, ordering takeaway foods and eating in one of several university canteens. In a study of Cluskey et al. (2009), freshman students mentioned campus canteens, including fast food courts, all-you-can-eat cafeterias or snack stores, did not offer many opportunities to practice a healthy diet.

According to El Ansari et al. (2012), living away from the parental home did not have a significant influence on the consumption of sweets, snacks, fast food or fish, yet students living away from their family home did show a lower consumption of fruits, cooked/raw vegetables and meat. In addition, Brevard et al. (1996) stated that students living on campus have access to many fried and fast foods. Papadaki et al. (2007) indicated that Greek university students living away from the family home adopted unhealthy eating habits but at the same time they also adopted some positive nutritional habits. On the one hand, these students lowered the consumption of white bread, feta cheese, whole-fat yoghurt and margarine, but on the other hand their consumption of fresh fruit, cooked and raw vegetables, oily fish and seafood decreased whereas the intake of sugar, wine and alcoholic

beverages increased. In general, students living on campus adopted more undesirable eating habits compared to students living at home (Papadaki et al., 2007).

These poor eating habits observed among university students include skipping breakfast, snacking, fast food consumption and much more as discussed below (Silliman et al., 2004; Driskell et al., 2006).

2.1. Skipping breakfast

Breakfast is a regularly missed meal among university students (Silliman et al., 2004). Silliman et al. (2004) mentioned that 8% of participating students of a US university never ate breakfast and only 23% of them had breakfast on a daily basis. In contrast, a study on Chinese university students reported that 75.9% of these highly disciplined students ate breakfast every morning, 11% of them took breakfast only 3 or 4 times per week (Sakamaki et al., 2005b). According to Ganasegeran et al. (2012), only 43.9% of medical students at a Malaysian university had breakfast daily. Kilinc et al. (2012) mentioned that breakfast skipping is positively related with increasing age and education level. Therefore, university students should be informed about the importance of consuming a healthy breakfast on a daily basis. They need to become aware of the negative health outcomes of breakfast skipping.

Regular breakfast consumption is of primary importance for sufficient nutrient intake (Kleinman et al., 2002). Skipping breakfast is associated with the prevalence of fatigue in university students (Tanaka et al., 2008). Additionally, young people who eat breakfast frequently have a lower Body Mass Index (BMI) compared to those who skip breakfast (Delva et al., 2007). Frequently consuming a proper breakfast might prevent them from experiencing hunger leading to overeating at meals and snacking (Delva et al., 2007). Nevertheless, young people are more likely to skip this most important meal of the day than

any other meal (Silliman et al., 2004). Besides, skipping breakfast is a frequently occurring phenomenon among female students trying to lose weight (Malinauskas et al., 2006).

2.2. Snacking

In literature, different definitions of snacking are brought forward. Snacking can be defined as 'any food taken outwith a regular mealtime (namely breakfast, lunch or dinner) or snack item taken in place of such meal' (Drummond et al., 1996). Savige et al. (2007) defined snacking as 'the consumption of foods and drinks between meals including milk drinks, regular soft drinks, sports drinks and energy drinks'. Despite frequent attempts to define 'snacking', the difference between a meal and a snack still remains unclear.

According to Neslisah et al. (2011), snacks provide an intake of approximately 443.2 kcal/day and approximately 334 kcal/day in male and female students respectively. The participants in this study consumed fruits as a snack more often than in other meals, but also more sweets than in other meals. Sakamaki et al. (2005a) investigated the food habits of university students in Japan and Korea, reporting that 34.7% of them consumed snacks daily apart from regular meals and 24.2% only took a snack once or twice per week. The majority of students (63%) of a US college reported snacking one to two times per day, mostly consuming chips, crackers or nuts. Male students consume fast foods more frequently as a snack than female students, who eat more ice cream, cookies and candy (Silliman et al., 2004).

The contribution to daily energy intake provided by snacking is increasing in most countries (Chapelot et al., 2011). According to Levitsky et al. (2004) and Serlachius et al. (2007), snacking is associated with weight gain. However, according to Chapelot et al. (2011) and Swinburn et al. (2004), scientific literature could not supply adequate evidence to support the impact of a higher frequency of eating (e.g. snacking) on obesity or weight gain. The composition of snack foods is a key factor to judge its health impact. It is commonly stated

that snacks provide our daily diet of 'empty calories' (Gatenby et al., 1997). The high energy density of common snack foods may initiate weight gain (Swinburn et al., 2004).

2.3. Fast food consumption

The United States Department of Agriculture (USDA) defines fast food as 'food purchased in self-service or carry-out eating places without wait service' (Isganaitis et al., 2005). Fast food consumption appears to be common among university students; in general, it is part of their lifestyle (Driskell et al., 2006). Eighty-two % of students of a US university reported eating dinner at fast food restaurants at least once a week and 29% of subjects weekly ate a snack at fast food restaurants (Driskell et al., 2006). According to Nelson et al. (2009b), male US college students consumed 1.9 fast food meals per week, while their female counterparts consumed 1.4 fast food meals per week. In accordance, Driskell et al. (2006) stated that college students in their study visited a fast food restaurant at least 1 to 2 times a week. El Ansari et al. (2012) assessed fast food consumption among university students in four European countries. According to this study 33% of German students reported fast food consumption at least several times per week, among Danish, Polish and Bulgarian students it was 19.6%, 10.6% and even 77.1% respectively.

According to Isganaitis et al. (2005), fast food tends to be energy dense and high in fat but poor in micronutrients and low in fiber. A typical fast food meal contains 1400 kcal, 85% of recommended daily fat intake, 73% of recommended saturated fat, but only 40% of recommended fiber (Isganaitis et al., 2005). In accordance, Bowman et al. (2004) mentioned that fast food provides 158 to 163 kcal/100 grams of food consumed. People who eat fast food have higher intakes of energy, total fat, saturated fat and added sugars compared to people who do not eat fast food. Additionally, Bowman et al. (2004) stated that fast food eaters have lower intakes of nutritious foods such as fruits, fluid milk and non-starchy vegetables than those who do not eat fast food. The intake of these nutritious foods decreases as the number of fast food days increases (Bowman et al., 2004). Generally, fast

food is characterized by large portion sizes and frequently it is associated with large portions of sugar-sweetened beverages contributing to excessive energy intake (Isganaitis et al., 2005). According to Bowman et al. (2004), fast food eaters consume twice the amount of sugar-sweetened beverages than their counterparts who do not eat fast food. Eating fast food is associated with having a higher BMI (Bowman et al., 2004). Therefore, fast food consumption can be related to increased caloric intake and it is considered as one of the main causes of overweight and obesity (Isganaitis et al., 2005; Rosenheck, 2008).

2.4. Low consumption of vegetables and fruits

The WHO recommends intake of a minimum of 400 g of fruits and vegetables per day (WHO, 2012a). According to Racette et al. (2008), less than 30% of freshman students consumed the recommended amount of fruits and vegetables. The same pattern was observed in senior students (Racette et al., 2008). Silliman et al. (2004) asked US college students about their consumption of vegetables and fruits, 58% of these students ate vegetables less than once per day and 64% of them ate fruit less than once per day. Only 14% of the participants in this study ate vegetables 2 to 3 times per day, 25% of female and 11% of male students ate fruit 2 to 3 times per day. According to El Ansari et al. (2012), less than 50% of university students in 4 European countries reported frequent (= several times a day/daily) consumption of fruits. As in the study of Silliman et al. (2004), students reported eating vegetables even less, with only 15 to 32% of students eating vegetables frequently (El Ansari et al., 2012).

It is well documented that vegetables and fruits are usually low in fat content and energy density (kcal/g), and high in water and dietary fiber (Rolls et al., 2004). Several studies suggest that sufficient water and fiber intake, as in vegetables and fruits, increases satiety and decreases feelings of hunger after a meal (Howarth et al., 2001; Rolls et al., 2004). Therefore, adding them to a diet can reduce a person's energy intake, and thus, help in weight management (Rolls et al., 2004). According to Howarth et al. (2001), the intake of an

additional 14 g of fiber per day (> 2 days) can decrease energy intake by 10%, initiating a loss of 1.9 kg of body weight over approximately 4 months. Economos et al. (2008) asked US freshman students about their consumption of fruits and vegetables. Female students reporting a consumption of 5 fruits or vegetables per day at baseline lost 2.1 pounds (0.95 kg) over a period of 8 months. Nevertheless, the use of fruit juices should be restricted because they add extra energy while contributing little to satiety (Rolls et al., 2004). Despite such health benefits, most students fail to meet proposed recommendations (Crombie et al., 2009).

2.5. Excessive alcohol consumption

Excessive alcohol consumption among university students is a widely spread problem on many university campuses. According to Economos et al. (2008), alcohol consumption increased in nearly 50% of the students during freshman year. For male students, this increase in alcohol consumption was related with a weight gain of 4.2 lbs (1.90 kg) (Economos et al., 2008). However, Economos et al. (2008) revealed that weight gains seen in female students were not associated with increased alcohol consumption during freshman year. According to Silliman et al. (2004), 74% of female college students consumed 0 to 7 alcoholic drinks in a week; only half of male students reported these quantities. In male students, 24% drank 8 to 14 units per week and 15% even drank 22 units or more per week (Silliman et al., 2004). In 2005, 44.7% of US college students reported drinking 5 or more drinks on a single occasion in the past month (Hingson et al., 2009).

Alcohol has a harmful impact on the burden of diseases and, additionally, it contributes to more than 60 types of diseases and injuries (WHO, 2009). The use of alcohol is responsible for approximately 30% of deaths due to cancers and epilepsy and 50% due to liver cirrhosis (WHO, 2009). Worldwide, more men than women are affected by the consequences of alcohol (ab)use because of differences in drinking habits, as well as in quantity and pattern of drinking (WHO, 2009).

2.6. Sugar-sweetened beverages

Currently, sugar-sweetened beverages' (SSB) consumption is substantial among university students (West et al., 2006). According to West et al. (2006), 65% of students of a US university reported that they consumed SSB on daily basis. These students consumed an average of 4 to 5 servings per day, corresponding with a caloric intake of approximately 543 kcal/day (West et al., 2006).

The consumption of SSB has been linked to an increased risk of overweight and obesity (Malik et al., 2006; West et al., 2006). According to Malik et al. (2006), SSB provide little nutritional benefit and have a low satiety of liquid carbohydrates. Therefore, people will not lower energy intake in subsequent meals, leading to a positive energy balance (Malik et al., 2006). Americans obtain 9.2% of total energy from SSB; this percentage corresponds to 190 kcal (Nielsen et al., 2004). According to Nielsen et al. (2004), the percentage of total daily caloric intake obtained from SSB more than doubled between 1977 and 2001. Between 1977 and 1996 servings increased from 1.96 to 2.39 per day and SSB portion sizes increased significantly from 13.6 fl. oz. (0.40 l) to 21 fl. oz. (0.60 l) (Nielsen et al., 2004).

3. Determinants of dietary habits in university students

The overweight and obesity problem among university students can only be treated and prevented by interventions on several levels of influence on dietary habits. The effect of individually based approaches is not radical enough to change a person's health behaviour, because they do not focus on the environmental factors influencing health habits (Sallis et al., 2002).

Hence, in this literature review, an ecological perspective will be used to describe the determinants that influence eating behaviours and food choices in university students. Sallis et al. (2002) defined ecological models of health behaviour as models proposing that behaviours are influenced by intrapersonal, socio-cultural, policy and physical-environmental factors. These variables are likely to interact and, additionally, multiple levels of environmental variables are described that are relevant for understanding and changing health behaviours. From this conviction, ecological models regard the relation between people and their environments on a multilevel base (Sallis et al., 2002; Story et al., 2002). This multilevel approach may be essential to intervene on each of those levels of influence and improve the population's health (Sallis et al., 2002).

Several researchers already represented their point of view on factors influencing dietary habits. Therefore, it is necessary to take a closer look at these different points of view and statements. Story et al. (2002) combined the ecological perspective with a social cognitive theory. In a social cognitive theory it is important to consider socio-environmental, personal and behavioural factors (Neumark-Sztainer et al., 1999). Story et al. (2002) noted that adolescent eating behaviour could be seen as the result of both individual and environmental influences. Four levels of influence on eating behaviour were described: individual (intrapersonal), social environmental (interpersonal), physical environmental (community setting) and macrosystem (societal) influences. Story et al. (2002) considered food preferences, taste, self-efficacy, knowledge, hunger, time, convenience and cost as

individual influences, whereas the social environmental influences included family, demographic characteristics, food availability and peers. In addition, schools, fast food restaurants, vending machines and convenience stores were considered as physical environmental influences whereas media and advertising were considered as macrosystem influences. According to Neumark-Sztainer et al. (1999), food choices among adolescents are related to three unmistakable factors. Given the fact that Neumark-Sztainer et al. (1999) based their study on a social cognitive theory, they stated that socio-environmental factors (e.g. parental influence and food availability), personal factors (e.g. taste, food preferences and body image) and behavioural factors (e.g. meal patterns and vegetarian lifestyle) interplay to influence dietary habits.

The determinants described as influencing dietary habits in adolescents are also listed in studies among university students. LaCaille et al. (2011) distinguished psychosocial and environmental factors affecting eating behaviour. These psychosocial factors included personal motivation and self-control whereas lack of healthy options on campus, lack of time, cost and all-you-can-eat cafeterias were considered as environmental determinants. Greaney et al. (2009) also listed lack of time, lack of access to healthy food and lack of money and additionally ready access to fast food restaurants as environmental factors. Besides, they differentiated intrapersonal and interpersonal determinants. Limited time, reliance on precooked meals, limited knowledge, stress, temptation and lack of discipline were considered as intrapersonal factors, whereas behaviour of others, social situations (e.g. going out to dinner) and external social pressure were classified as interpersonal factors. Greaney et al. (2009) analysed data from an ecological point of view.

During the transition from adolescence to (young) adulthood a variety of factors may play an important role in nutritional behaviour (Nelson et al., 2009a). Below, the determinants of dietary habits in university students will be discussed, based on the subdivisions recognised by Story et al. (2002) and Sallis et al. (2002).

3.1. Intrapersonal determinants

Intrapersonal determinants are the characteristics of individuals that have an effect on their dietary habits (Story et al., 2002). A wide variety of characteristics were described in the study of Story et al. (2002), subdivided in psychosocial, biological and lifestyle factors.

Psychosocial factors

Psychosocial factors include food preferences, taste preferences, health concerns, self-efficacy, meanings attached to food (symbolic and functional meanings, e.g. pleasure) and knowledge (Story et al., 2002). Sallis et al. (2002) mentioned several factors listed above as well as mood and perceived ability to change. Knowledge to shop and/or prepare healthy food was also found by Greaney et al. (2009) to be a factor affecting dietary behaviour in university students, but also lack of discipline, being bored and stress. Eating out of boredom and stress were also mentioned by Nelson et al. (2009a). According to LaCaille et al. (2011), university students recognised personal motivation and self-control as important psychosocial factors.

Biological factors

Biological factors include hunger and gender (Story et al., 2002). Multiple researchers mentioned gender differences as a factor affecting food choices in university students (Story et al., 2002; LaCaille et al., 2011; Greaney et al., 2009; Neumark-Sztainer et al., 1999). Neumark-Sztainer et al. (1999) mentioned hunger and food cravings as factors influencing adolescents' dietary behaviour.

Lifestyle factors

Lifestyle factors include cost, meal patterns (such as skipping meals), dieting, and time and convenience (Story et al., 2002). In accordance, LaCaille et al. (2011) and Greaney et al. (2009) also mentioned a perceived lack of time as a factor influencing dietary habits in

university students. Furthermore, vegetarian beliefs seemed to be a factor influencing dietary habits as well (Neumark-Sztainer et al., 1999).

3.2. Social environmental (interpersonal) determinants

Dietary habits among adolescents are strongly influenced by their social environments (Story et al., 2002). These young adults' food choices are affected by the interpersonal relationships between themselves and their families, friends and peer networks (Story et al., 2002). Social environmental influences include family and family meals, demographic characteristics and peers (Story et al., 2002). According to Story et al. (2002), factors such as social role models, social support and perceived norms have a substantial impact on the nutritional behaviours of adolescents. In university students, factors such as social norms, social support, social situations (e.g. going out to dinner) and external social pressure seem to influence dietary behaviour (LaCaille et al., 2011; Greaney et al., 2009).

Story et al. (2002) considered food availability as a social environmental determinant among adolescents because parents can influence the foods that are available at home. In university students, especially those leaving the parental home, the familial influence on availability is not as strong as before because of their increased autonomy. Therefore, in this population, availability can be considered as a physical environmental determinant. On the other hand, the family influences on food attitudes, preferences and values affect lifetime eating habits (Story et al., 2002). LaCaille et al. (2011) also noted that friends, family and parental values were contributing to food choices at university.

3.3. Physical environmental determinants

Multiple aspects of the physical environment can have an influence on students' dietary habits. The physical environment within the community influences access to and availability of foods, affecting students' eating habits (Story et al., 2002). Health behaviour can be

influenced directly and also indirectly, through individual perceptions, by environmental determinants (Sallis et al., 2002).

According to Story et al. (2002), schools, fast food restaurants, vending machines and convenience stores can be considered as physical environmental determinants. A perceived lack of healthy options on campus, characteristics of meal plans, all-you-can-eat cafeterias, the way food is prepared on campus and a lack of places to cook in student residences were listed by LaCaille et al. (2011) as physical environmental determinants. In accordance, Greaney et al. (2009) listed food served at university cafeterias, ready access to unhealthy food (including fast food restaurants) and lack of access to healthy food as physical environmental determinants. Nelson et al. (2009a) mentioned similar factors, like all-you-can-eat cafeterias, the high number of unhealthy choices and convenience stores located within campus, affecting dietary habits in university students.

Sallis et al. (2002) considered the price of foods as a powerful environmental influence, although Story et al. (2002) included cost in intrapersonal determinants. In accordance, LaCaille et al. (2011) considered cost, availability and even convenience as physical environmental factors impacting eating behaviour. Greaney et al. (2009) also included cost in physical environmental factors influencing dietary habits in university students.

3.4. Macrosystem determinants

Macrosystem determinants listed by Story et al. (2002) were mass media and advertising, social and cultural norms with regard to eating habits, and food production. Sallis et al. (2002) stated that culture is often expressed through food. In addition, Story et al. (2002) considered distribution systems as macrosystem influences because they affect food accessibility and availability. Furthermore, food-related issues (e.g. availability and pricing) are regulated by local and federal policies and laws, which can also be seen as macrosystem determinants (Story et al., 2002). These policy factors were also mentioned by Sallis et al.

(2002). Political decisions, such as unfavourable laws, negative corporate behaviours and inability to put a given health behaviour on the political agenda, have an important impact on a population's health behaviour (Sallis et al., 2002). Subsidies for unhealthy food products are one of the main examples of political processes with a negative impact on people's health behaviour (Sallis et al., 2002). All of those macrosystem factors play a more distal and indirect role in determining food behaviours (Story et al., 2002).

All these levels of determinants interact and affect university students' eating behaviours, mostly simultaneously (Story et al., 2002; Sallis et al., 2002). Some determinants have a direct and others have an indirect influence on dietary habits in university students (Story et al., 2002). Sallis et al. (2002) stated that inclusion of all these types of influence distinguishes the potential contributions of ecological models from those of theories that primarily focus on intrapersonal and interpersonal influences. To develop effective intervention programs it is crucial to identify this large number of determinants of eating behaviour in university students at multiple levels of influence. Maybe then, it is possible to initiate changes in health behaviour in this population.

4. Problem statement and research questions

The prevalence of overweight and obesity has increased worldwide over the past 30 years among both adults and adolescents (West et al., 2006; Yang et al., 2010). According to US literature, the transition from secondary school to university is such a critical period for weight gain among young-adults (Wengreen et al., 2009). It is a period characterized by an unhealthy lifestyle in which younglings become independent and adopt lasting health behaviour patterns (Nelson et al., 2008). Young adults often establish unfavourable dietary habits when leaving the parental home and entering university (Hoefkens et al., 2012).

During the transition from adolescence to young adulthood a variety of factors may play an important role in nutritional behaviour (Nelson et al., 2009a). To initiate changes in health behaviour patterns, effective intervention programs should be developed. Therefore, it is important to determine these factors affecting dietary habits in university students.

Previous, mostly qualitative, studies investigated determinants of dietary habits mainly in US university students. To the best of our knowledge, no quantitative explanatory studies on determinants of dietary habits, and more specifically fruit & vegetable and fat intake, in European university students have been published yet. However, a student's lifestyle on a US university campus may differ strongly from a European student's lifestyle. For example, in Europe, the phenomenon of all-you-can-eat cafeterias and fast food restaurants on every corner does not exist. Hence, not all data from US research concerning determinants of dietary habits in university students can be extrapolated to European students. Therefore, the purpose of this study is to assess which factors influence European (Flemish) university students' fruit & vegetable and fat intake. Furthermore, we want to explain to what extent these dietary behaviours are being influenced by these determinants.

This implies the following two research questions:

- Which factors determine European (Flemish) university students' fruit & vegetable and fat intake?
- To what extent can European (Flemish) university students' fruit & vegetable and fat intake be explained through these determinants?

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PART 2: Scientific paper

Determinants of fruit & vegetable and fat intake in university students: a cross-sectional explanatory study

Hannah Verhoeven, Tom Deliens, Benedicte Deforche, Peter Clarys

Abstract

Objective The purpose of this study was to assess which factors influence European (Flemish) university students' fruit & vegetable and fat intake. Furthermore, we wanted to explain to what extent fruit & vegetable and fat intake were being influenced by these determinants.

Methods A self-reported on-line questionnaire assessing socio-demographic variables, health status, dietary habits, factors influencing fruit & vegetable consumption and factors influencing fat intake was completed by 211 university students of the Vrije Universiteit Brussel. A Food Frequency Questionnaire (FFQ) was used to calculate daily fruit & vegetable and fat intake.

Results With regard to fruit & vegetable consumption, being female, being older, living in a student residence, being currently on a diet, more vegetarian dietary preferences, higher subjective norm, higher perceived control, higher perceived threat, more social norms, more social support, more social models, higher perceived advantages, higher self-efficacy and less perceived barriers result in higher fruit & vegetable intake. 41.8% of total variance in fruit & vegetable consumption was explained by the regression model. Whereas concerning fat intake, being female, being currently on a diet, lower body image, higher subjective norm, higher perceived threat, more social norms, more social models and higher perceived

advantages were significant correlates of lower fat intake. 16.1% of total variance in fat intake was explained by the regression model.

Conclusions We can conclude that fruit & vegetable and fat intake can be explained through several intrapersonal, social environmental and physical environmental factors. Future interventions to promote healthier dietary habits among university students should focus on male students and students not currently dieting.

Key Words University students, fruit & vegetable intake, fat intake, determinants.

Introduction

The prevalence of overweight and obesity has increased worldwide over the past 30 years among both adults and adolescents (West et al., 2006; Yang et al., 2010). To develop effective and tailored intervention programs it is important to identify critical periods of weight gain. According to US literature, the transition from high school to university is such a critical period for weight gain among young-adults (Crombie et al., 2009; Vella-Zarb et al., 2009; Wengreen et al., 2009). Especially young-adults (18-24 year olds) with college experience showed the greatest increases in obesity rates (Burke et al., 1996; Mokdad et al., 1999). The transition from adolescence to (young) adulthood is a period often characterized by an unhealthy lifestyle in which younglings become independent and adopt lasting health behaviour patterns (Nelson et al., 2008). Moreover, the observed weight gains during university could partially be explained by unhealthy eating behaviours (Nelson et al., 2008). A small increase in energy intake over the university years could lead to students being overweight by the time they complete university (Morrow et al., 2006).

Diets including regular consumption of energy-dense foods that are high in fat but low in vitamins, minerals and other micronutrients have been related to obesity (WHO, 2012b). Most university students exceed recommended intake of fat and fail to meet recommendations for fruits and vegetables (Anding et al., 2001; Huang et al., 2003; Racette

et al., 2008). The development of overweight and obesity is strongly determined by fat intake and the consumption of high-fat foods (Bray et al., 1998). Only 31% of students of a US college reported eating 30% or less of energy from fat (Schuette et al., 1996). Fast food for example tends to be energy dense and high in fat but poor in micronutrients and low in fiber (Isganaitis et al., 2005). In a study by Driskell et al. (2006), university students reported at least 1 to 2 fast food restaurant visits a week. Additionally, Bowman et al. (2004) stated that fast food eaters have lower intakes of nutritious foods such as fruits and non-starchy vegetables than those who do not eat fast food. The intake of these nutritious foods decreases as the number of fast food days increases (Bowman et al., 2004). Concerning fruit and vegetable intake, the World Health Organization (WHO) recommends intake of a minimum of 400 g of fruits and vegetables per day (WHO, 2012a). However, less than 30% of first year university students (= freshmen) consumed the recommended amount of fruits and vegetables (Racette et al., 2008). The same pattern was observed in senior students (4th year students) (Racette et al., 2008). According to El Ansari et al. (2012) less than 50% of university students in 4 European countries reported frequent (= several times a day/daily) consumption of fruits, whereas only 15 to 32% of students reported eating vegetables frequently (El Ansari et al., 2012).

During university a variety of factors may play an important role in students' nutritional behaviour (Nelson et al., 2009). The ecological model of Sallis et al. (2002) proposes a subdivision of four determinant categories, i.e. intrapersonal, social environmental, physical environmental and macro system determinants (Story et al., 2002; Sallis et al., 2002). The intrapersonal determinants consist of psychological factors such as food preferences, health concerns, self-efficacy, mood, knowledge and lack of discipline (Story et al., 2002; Sallis et al., 2002; Greaney et al., 2009). Biological factors such as hunger and gender can also be considered as intrapersonal determinants (Story et al., 2002; LaCaille et al., 2011; Greaney et al., 2009; Neumark-Sztainer et al., 1999). Furthermore, lifestyle factors including dieting, meal patterns and time are important intrapersonal determinants as well (Story et al., 2002;

LaCaille et al., 2011; Greaney et al., 2009). Social environmental determinants, also called interpersonal determinants (Story et al., 2002), include family and family meals, friends, social role models, social support and perceived norms (Story et al., 2002; LaCaille et al., 2011; Greaney et al., 2009). The physical environment (within the community) on the other hand, influences access to and availability of foods, affecting students' eating habits (Story et al., 2002). According to Story et al. (2002), schools, fast food restaurants, vending machines and convenience stores can be considered as physical environmental determinants. A perceived lack of healthy options on campus, all-you-can-eat cafeterias, the way food is prepared on campus and a lack of places to cook in student residences were listed by LaCaille et al. (2011) as physical environmental determinants of students' eating behaviour. Finally, macro system determinants such as mass media and advertising, social and cultural norms with regard to eating habits, and food production are essential factors influencing students' dietary habits. In addition, distribution systems and local and federal policies and laws are considered as macrosystem determinants as well (Story et al., 2002; Sallis et al., 2002).

All these levels of determinants interact and affect university students' eating behaviours, mostly simultaneously (= ecological theory) (Story et al., 2002; Sallis et al., 2002). Sallis et al. (2002) stated that inclusion of all these types of influence distinguishes the potential contributions of ecological models from those of theories that primarily focus on intrapersonal and interpersonal influences. To develop effective intervention programs it is crucial to identify this large number of determinants of eating behaviour in university students, taking the interaction between all levels of influence into account.

Few, mostly qualitative, studies investigated determinants of dietary habits in US university students. However, due to socio-cultural differences, US research concerning determinants of dietary habits in university students cannot be extrapolated to European students. To the best of our knowledge, no quantitative explanatory studies on determinants of dietary habits,

and more specifically fruit & vegetable and fat intake, in European university students have been conducted so far. Therefore, the purpose of this study was to assess which factors influence European (Flemish) university students' fruit & vegetable and fat intake. Furthermore, we wanted to explain to what extent fruit & vegetable and fat intake were being influenced by these determinants.

Methods

Participants

Using convenience sampling 429 university students, both Bachelor and Master students, were recruited face-to-face on the campus of the Vrije Universiteit Brussel. All recruited students received an on-line questionnaire invitation by e-mail. One reminder e-mail was sent to every student. Two hundred seventy two (63%) students of those who volunteered to take part in the study filled out the questionnaire, with 211 of them (66.8% female) completing the questionnaire entirely. Participants were on average 20.8 ± 1.6 yrs old and showed a mean BMI of 22.0 ± 3.6 kg/m².

Procedure and questionnaire

In this cross-sectional study, students were asked to complete a self-reported on-line questionnaire assessing socio-demographic variables, health status, dietary habits, factors influencing fruit & vegetable consumption and factors influencing fat intake. The questionnaire was filled out in March 2013 and consisted of questions derived from existing questionnaires. A Food Frequency Questionnaire (FFQ) (Bolca et al., 2009) was used to calculate daily fruit & vegetable and fat intake. Fat values per nutrient were estimated using 'Nubel Voedingsplanner' (Nubel Voedingsplanner, 2013). For fruit & vegetable intake, frequency was multiplied with portion size. For fat intake on the other hand, frequency was

multiplied with portion size and fat values per 100 g of the fat containing nutrient. The study was approved by the medical ethical committee of the Vrije Universiteit Brussel.

Statistical analysis

Data were analysed using IBM SPSS Statistics 20. A multiple linear regression analysis was conducted to determine the factors influencing fruit & vegetable and fat intake. Before performing the multivariate regression analysis, we regressed fruit & vegetable and fat intake onto all possible determinants presented in table 2, by using univariate regression analyses. After checking for multicollinearity ($r > 0.6$) only significant correlates for fruit & vegetable and fat intake were included into the multivariate regression model. p -Values < 0.05 were considered as statistically significant, whereas p -values < 0.1 were considered as trends towards significance.

Results

Table 1 shows descriptive statistics of 211 university students who completed the questionnaire entirely. The sample had a mean age of 20.8 ± 1.6 yrs and consisted of 66.8% female students. Mean BMI was 22.0 ± 3.6 kg/m². Based on the FFQ, their mean fruit & vegetable consumption was 178.8 ± 146.0 g/day, while their mean fat intake was 56.2 ± 26.6 g/day.

Table 1: Descriptive statistics (% , Mean \pm SD)

<i>Demographics</i>	
Gender (% females)	66.8
Age (yrs)	20.8 \pm 1.6
Nationality (% Belgian)	96.2
Ethnicity parents (% of students of which one of the parents is from foreign origin)	13.9
Residency (% living in student residence)	32.7
<i>Anthropometrics</i>	
BMI (kg/m ²)	22.0 \pm 3.6
<i>BMI classification</i>	
Underweight (%)	8.7
Normal weight (%)	79.5
Overweight (%)	7.7
Obese (%)	4.1
<i>Socio-Economic Status (SES)</i>	
Education mother (% diploma higher education)	62.5
Education father (% diploma higher education)	61.4
<i>Education</i>	
Human sciences (%)	49.1
Exact & applied sciences (%)	24.3
Biomedical sciences (%)	26.6
Recent dieting (% dieters)	12.8
Smoking (% non-smokers)	85.3
<i>Dietary preferences</i>	
Omnivore (%)	89.6
Pesco-vegetarian (%)	0.9
Almost vegetarian (%)	8.1
Vegetarian (%)	1.4
Vegan (%)	0.0
Mean fruit & vegetable consumption (g/day)	178.8 \pm 146.0
Mean fat intake (g/day)	56.2 \pm 26.6

In table 2 possible determinants of fruit & vegetable and fat intake are presented.

Table 2: Determinants of fruit & vegetable and fat intake

Characteristics

Gender, age, BMI, recent dieting, dietary preferences, residency, ethnicity, education mother, education father

Determinants

Body image: perceived health, perceived fitness, body satisfaction

Subjective norm

Perceived control: on/nearby campus, at home

Perceived threat (feeling guilty)

Perceived knowledge*

Perceived advantages: losing weight, improving health, increasing body satisfaction, increasing mental health, (ecological advantages)*

Self-efficacy: on most days, when feeling bad, when being busy, if other products need to be bought, comment of social environment, social situations, (reducing fat intake)*

Perceived barriers: lack of time, lack of self-discipline, appeal of other foods (food temptation), lack of interest, lack of social support, non-tasty fruits & vegetables/non-tasty low fat foods, food variety, cost, lack of knowledge, lack of skills, on/nearby campus availability, availability of cooking supplies, mass media and advertising

Social norms: partner, parents, friends/student colleagues

Social support: partner, parents, friends/student colleagues

Social models: partner, parents, friends/student colleagues

* only for fat intake

Results of the regression analysis for fruit & vegetable intake are presented in table 3. After conducting univariate regression analyses following characteristics and determinants were found to be significant positive correlates of fruit & vegetable consumption: being female, being older, living in a student residence, being currently on a diet, more vegetarian dietary preferences, higher subjective norm, higher perceived control, higher perceived threat, more social norms, more social support, more social models, higher perceived advantages and higher self-efficacy. Perceived barriers like lack of time, lack of self-discipline, appeal of other foods, lack of interest, non-tasty fruits & vegetables, food variety, lack of knowledge and lack of skills were found to be significant factors influencing fruit & vegetable consumption negatively. Additionally, a trend towards significance ($p < 0.1$) was found for lack of social support.

All significant characteristics and determinants were included in the multiple regression analysis. No multicollinearity ($r > 0.6$) was found between significant variables. In the multivariate regression analysis, following factors remained significant: being female, being currently on a diet, more vegetarian dietary preferences, higher subjective norm, higher perceived control and more social models. Dietary preferences ($\beta = 0.303$) was the strongest influencing factor of fruit & vegetable consumption. 41.8% of total variance in fruit & vegetable consumption was explained by the multivariate regression model.

Table 3: Influencing factors of fruit & vegetable intake in university students (*t*-values, β -values, adj R²)

Correlates	<i>t</i>	β	adj R ²
<i>Univariate</i>			
Characteristics			
Gender (0=male; 1=female) (n=204)	2.331*	0.162	0.021
Age (n=186)	2.978**	0.214	0.041
Residency (0=living at home; 1=living in a student residence) (n=204)	2.053*	0.143	0.016
Ethnicity (0=from Belgian origin; 1=from foreign origin) (n=203)	-1.595	-0.112	0.008
BMI (n=192)	1.090	0.079	0.001
Education mother (n=204)	-0.129	-0.009	-0.005
Education father (n=203)	0.530	0.037	-0.004
Recent dieting (0=not currently dieting; 1=currently dieting) (n=204)	2.306*	0.160	0.021
Dietary preferences (n=204)	5.600***	0.367	0.130
Determinants			
Body image (n=204)	0.314	0.022	-0.004
Subjective norm (n=204)	7.695***	0.476	0.223
Perceived control (n=204)	6.106***	0.395	0.152
Perceived threat (n=203)	3.078**	0.212	0.040
Social norms (n=200)	2.596*	0.181	0.028
Social support (n=199)	2.867**	0.200	0.035
Social models (n=198)	3.831***	0.264	0.065
Perceived advantages (n=203)	2.902**	0.201	0.035
Self-efficacy (n=204)	5.913***	0.384	0.143
Perceived barriers (n=199)	-4.585***	-0.310	0.092
lack of time (n=190)	-2.876**	-0.205	0.037
lack of self-discipline (n=192)	-4.808***	-0.329	0.104
appeal of other foods (food temptation) (n=196)	-2.747**	-0.193	0.032
lack of interest (n=191)	-4.636***	-0.320	0.097
lack of social support (n=183)	-1.900 ^T	-0.140	0.014
non-tasty fruits & vegetables (n=192)	-5.236***	-0.355	0.121
food variety (n=192)	-4.778***	-0.327	0.103
cost (n=190)	-1.036	-0.075	0.000
lack of knowledge (n=186)	-2.764**	-0.200	0.035
lack of skills (n=189)	-2.008*	-0.145	0.016
on/nearby campus availability (n=193)	-0.465	-0.034	-0.004
availability of cooking supplies (n=180)	-1.081	-0.081	0.001
mass media and advertising (n=192)	-0.080	-0.006	-0.005
<i>Multivariate (n=170)</i>			
Gender	2.395*	0.156	
Age	1.371	0.087	
Residency	1.074	0.068	
Recent dieting	2.364*	0.151	
Dietary preferences	4.620***	0.303	
Subjective norm	3.026**	0.221	
Perceived control	3.061**	0.222	
Perceived threat	-1.282	-0.090	
Social norms	-0.565	-0.041	
Social support	1.192	0.081	
Social models	2.097*	0.152	
Perceived advantages	0.881	0.059	
Self-efficacy	0.958	0.071	
Perceived barriers	0.237	0.018	
			0.418

* $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$, ^T = trend towards significance ($p < 0.1$), $\alpha = 0.05$

Table 4 shows results of the regression analysis for fat intake. After conducting univariate regression analyses following characteristics and determinants were found to be significant correlates of fat intake. Lower fat intakes were found when being female, being currently on a diet, lower body image, higher subjective norm, higher perceived threat, more social norms, more social models and higher perceived advantages. Residency, BMI and perceived barriers showed a trend towards significance ($p < 0.1$). Significant perceived barriers, which influenced fat intake positively, were lack of interest, lack of social support and non-tasty low fat foods, whereas for lack of skills a trend towards significance ($p < 0.1$) was found.

All significant characteristics and determinants were included in the multiple regression analysis. No multicollinearity ($r > 0.6$) was found between significant variables. Only perceived threat ($\beta = -0.269$) remained significant in the multivariate regression model. For subjective norm a trend towards significance ($r < 0.6$) was found. 16.1% of total variance of fat intake was explained by the multivariate regression model.

Table 4: Influencing factors of fat intake in university students (*t*-values, β -values, adj R²)

Correlates	<i>t</i>	β	adj R ²
<i>Univariate</i>			
Characteristics			
Gender (0=male; 1=female) (n=209)	-3.079**	-0.209	0.039
Age (n=191)	-0.445	-0.032	-0.004
Residency (0=living at home; 1=living in a student residence) (n=209)	-1.850 ^T	-0.128	0.012
Ethnicity (0=from Belgian origin; 1=from foreign origin) (n=207)	-0.684	-0.048	-0.003
BMI (n=197)	-1.847 ^T	-0.131	0.012
Education mother (n=209)	-0.248	-0.017	-0.005
Education father (n=208)	-1.444	-0.100	0.005
Recent dieting (0=not currently dieting; 1=currently dieting) (n=209)	-2.914**	-0.198	0.035
Dietary preferences (n=209)	-0.991	-0.069	0.000
Determinants			
Body image (n=209)	3.032**	0.206	0.038
Subjective norm (n=209)	-3.670***	-0.247	0.057
Perceived control (n=209)	1.164	0.081	0.002
Perceived threat (n=209)	-5.473***	-0.356	0.122
Perceived knowledge (n=209)	-0.803	-0.056	-0.002
Social norms (n=200)	-3.550***	-0.245	0.055
Social support (n=204)	-1.230	-0.086	0.003
Social models (n=202)	-2.036*	-0.142	0.015
Perceived advantages (n=208)	-2.130*	-0.147	0.017
Self-efficacy (n=209)	-1.337	-0.093	0.004
Perceived barriers (n=207)	1.919 ^T	0.133	0.013
lack of time (n=193)	0.476	0.034	-0.004
lack of self-discipline (n=202)	1.231	0.087	0.003
appeal of other foods (food temptation) (n=204)	0.535	0.038	-0.004
lack of interest (n=202)	3.338***	0.230	0.048
lack of social support (n=190)	2.045*	0.147	0.017
non-tasty low fat foods (n=195)	2.239*	0.159	0.020
food variety (n=200)	0.703	0.050	-0.003
cost (n=193)	0.331	0.024	-0.005
lack of knowledge (n=197)	0.883	0.063	-0.001
lack of skills (n=199)	1.669 ^T	0.118	0.009
on/nearby campus availability (n=200)	-0.546	-0.039	-0.004
availability of cooking supplies (n=186)	-0.643	-0.047	-0.003
mass media and advertising (n=192)	-0.521	-0.038	-0.004
<i>Multivariate (n=194)</i>			
Gender	-0.451	-0.034	
Recent dieting	-0.604	-0.044	
Body image	1.079	0.084	
Subjective norm	-1.869 ^T	-0.143	
Perceived threat	-3.263***	-0.269	
Social norms	-1.381	-0.111	
Social models	-0.449	-0.035	
Perceived advantages	0.458	0.035	
			0.161

* $p < 0.05$, ** $p < 0.01$, *** $p \leq 0.001$, ^T = trend towards significance ($p < 0.1$), $\alpha = 0.05$

Discussion

The purpose of this study was to assess which factors influence fruit & vegetable and fat intake of students at the Vrije Universiteit Brussel. Furthermore, we wanted to explain to what extent fruit & vegetable and fat intake were being influenced by these determinants.

Controlled for all significant univariate correlates, we found that being female, being currently on a diet, more vegetarian dietary preferences, higher subjective norm, higher perceived control and more social models significantly resulted in higher fruit & vegetable intake. Concerning fat intake, only higher perceived threat significantly resulted in lower fat intake after controlling for all significant univariate correlates.

Daily fruit & vegetable and fat intake

In agreement with previous studies, mean fruit & vegetable consumption (178.8 ± 146.0 g/day) among university students participating in present study fails to meet recommendations. Only 8.8% of students consumed the minimum of 400 g of fruits and vegetables per day recommended by the WHO (WHO, 2012a). This is an even more alarming outcome than the less than 30% of freshman and senior students meeting recommendations, found in a study by Racette et al. (2008). These very low values could be partially the result of shortcomings of the FFQ used in this study. Concerning fat intake, a healthy adult should consume maximum 66.7-77.8 and 83.3-97.2 grams of fat per day, for women and men respectively, taking into account maximum total fat intakes of 30-35%E and fat delivering 9 kcal/g (FAO, 2010). With a mean fat intake of 56.2 ± 26.6 g/day, Flemish university students meet recommendations for daily fat intake. This is in contrast with a US college where only 31% of students reported eating 30% or less of energy from fat (Schuette et al., 1996). These positive outcomes could be influenced by students underreporting their fat intake and by shortcomings concerning the FFQ used in this study. On the other hand, the lower intakes of daily fat might be explained by the absence of fast food restaurants on

campus. Even though high-fat foods are available on/nearby campus, students can decide to consume much more healthy options.

Student characteristics

With regard to student characteristics, only gender and recent dieting were significant correlates of both fruit & vegetable and fat intake. Female university students showed healthier dietary habits than their male student colleagues by consuming higher amounts of fruits & vegetables and lower amounts of fat. A previous study among US college students obtained similar results, female students consumed more fruits & vegetables and less high-fat foods (Silliman et al., 2004). These findings could be explained by the fact that female students are more concerned about their weight status and male students seem to care less about the healthiness of their dietary habits (Silliman et al., 2004; Yahia et al., 2008; LaCaille et al., 2011). The same tendencies were found among current dieters. Although many dieters still practice unhealthy dieting strategies, higher intakes of fruits & vegetables and lower fat intakes are considered as key factors for healthy dieting (Brownell et al., 1994; Ackard et al., 2002).

Other significant student characteristics resulting in higher fruit & vegetable intake were being older, living in a student residence and more vegetarian dietary preferences. Dietary preferences explained 13% of total variance in fruit & vegetable consumption and was therefore the strongest characteristic influencing fruit & vegetable intake. In accordance, self-reported dietary preferences was recognised by Story et al. (2002) as a factor strongly influencing food choices. Neumark-Sztainer et al. (1999) also mentioned vegetarian beliefs to be a factor influencing dietary habits, though adolescents in this study reported this factor as being of minor importance. The influence of residency on fruit & vegetable intake was contradictory compared to previous studies where living away from the parental home resulted in a lower consumption of fruits & vegetables among European university students

(El Ansari et al., 2012; Papadaki et al., 2007). This might be a consequence of the varied assortment of plates containing cooked/raw vegetables offered in the student restaurant. Furthermore, in the student restaurant of the Vrije Universiteit Brussel students are not allowed to buy only French fries without a salad on the side. Nevertheless, students need to be encouraged to eat more fruits & vegetables since their mean fruit & vegetable consumption still remains too limited as mentioned above.

Furthermore, concerning fat intake, a trend towards significance was found for residency and BMI. In accordance, El Ansari et al. (2012) found that students living away from the parental home did not show significantly divergent consumption of high-fat foods (e.g. snacks and fast food). Papadaki et al. (2007) on the other hand, found a significant increase in certain high-fat foods in students living away from the parental home compared to other students.

Determinants

Students with a higher subjective norm showed a higher consumption of fruits & vegetables and lower fat intake. Regarding fruit & vegetable consumption it was the strongest influencing determinant. In accordance, a previous study notified that subjective norm was associated with self-reported healthy eating in Australian university students (Louis et al., 2007). On the other hand, subjective norm was not a significant predictor of fruit consumption in college students in the Netherlands (de Bruijn et al., 2010). Though, it must be said that the investigators in these studies also integrated the influence of parents, friends, ... in the item subjective norm. In our study only students' personal motivation was included in the item subjective norm. Controlled for all significant univariate correlates, higher subjective norm remained significant in the multivariate model.

Results also showed that perceived control was a strong significant determinant, however only for fruit & vegetable consumption. The less difficult students found it to eat fruits & vegetables at home and on/nearby campus, because of presence of other products, the

higher their intake of fruits & vegetables was. In a study by LaCaille et al. (2011), college students also reported perceived control as a facilitator of healthy eating behaviour. After controlling for all significant univariate correlates, higher perceived control remained significant in the multivariate model.

Self-efficacy was another significant factor with a strong influence on fruit & vegetable consumption, but not significantly influencing fat intake. Students who were confident that they could eat sufficient fruits & vegetables on most days, when feeling bad, when being busy, ... effectively showed higher intakes of fruits & vegetables. In accordance, a review conducted by Shaikh et al. (2008) found strong evidence for self-efficacy as a factor influencing fruit and vegetable intake in adults.

For fat intake, perceived threat was the strongest significant determinant. Students with a higher level of guilt after eating high-fat foods showed lower daily fat intake. Whereas, for fruit & vegetable consumption, students with a higher level of guilt when not eating fruits & vegetables for one day showed a higher intake of these nutritious foods. To the best of our knowledge, no studies investigated the effects of perceived threat on fruit & vegetable and fat intake among university students yet. Concerning fat intake, higher perceived threat was the only factor remaining significant after controlling for all significant univariate correlates.

The social environmental determinants investigated in this study showed a significant influence on fruit & vegetable and fat intake. Controlled for all significant univariate correlates, more social models remained significant in the multivariate model. These findings were in accordance with previous studies. College students participating in focus groups indicated the importance of social norms concerning healthy eating (LaCaille et al., 2009). These students also noted that social support from family and friends, and social models like friends and student colleagues motivated them to practice a healthy diet (LaCaille et al., 2011; Greaney et al., 2009). However, it should be recognized that for social support we did not find a significant influence on university students' fat intake.

For both fruit & vegetable and fat intake, perceived advantages was a significant correlate. Students who perceived losing weight, improving health, increasing body satisfaction, increasing mental health and ecological advantages (only for fat intake) as important advantages of healthy eating, showed a higher consumption of fruits & vegetables and a lower intake of fat. In accordance, focus groups in a previous study described losing weight, physical fitness, and health maintenance and disease prevention as advantages of healthy eating (House et al., 2006).

Perceived barriers correlated significantly with lower consumption of fruits & vegetables, whereas for fat intake a trend towards significance was found. Concerning fruit & vegetable consumption, lack of time, lack of self-discipline, appeal of other foods (temptation), lack of interest, non-tasty fruits & vegetables, food variety, lack of knowledge and lack of skills were significant negative correlates of fruit & vegetable consumption. The results are in the same line as previous studies, which reported similar factors of influence on students' dietary habits (Greaney et al., 2009; LaCaille et al., 2011; Nelson et al., 2009). Barriers like cost, availability of cooking supplies, on/nearby campus availability, and mass media and advertising did not significantly influence fruit & vegetable intake, although these factors were commonly cited in previous studies (Greaney et al., 2009; LaCaille et al., 2011, Sallis et al., 2002; Story et al., 2002). It is possible that students did not perceive a great lack of cooking supplies and on/nearby campus availability of fruits & vegetables. This might explain the lack of significant influence on fruit & vegetable intake.

Additionally, students who had a higher body image showed higher daily intakes of fat. This might be explained by the fact that these students care less about what they eat because they are satisfied with their body.

Strengths and limitations

A first strength of this study is that we controlled for characteristics as gender, age, BMI, recent dieting, dietary preferences, residency, ethnicity and parental education in the multivariate model. A second strength is the relatively large sample size (n = 211). The latter allowed us to create sufficient degrees of freedom to perform the multivariate regression models.

A first limitation of this study is that the FFQ we used has only been validated for post-menopausal women. Therefore, typical student meals like pizza, hamburgers, kebab and other fast foods were not included in the FFQ. Also other high-fat products like oils and butter used in the preparation of meals were not questioned in the FFQ. This might explain the relatively low fat intake found in our sample. For future research it is recommended to develop an FFQ specifically for university students because of their divergent dietary habits. Another limitation is that all subjects were volunteers, which makes it possible that mostly students with healthier dietary habits participated in this study. Finally, a self-reporting questionnaire was used. This might have led to students overestimating fruit & vegetable intake or underestimating fat intake.

CONCLUSION

In conclusion, being female, being older, living in a student residence, being currently on a diet, more vegetarian dietary preferences, higher subjective norm, higher perceived control, higher perceived threat, more social norms, more social support, more social models, higher perceived advantages, higher self-efficacy and less perceived barriers were significant correlates of higher fruit & vegetable intake. Whereas for fat intake, being female, being currently on a diet, lower body image, higher subjective norm, higher perceived threat, more social norms, more social models and higher perceived advantages were significant correlates of lower fat intake. Therefore, future interventions should focus on male students

and students not currently dieting to promote healthier dietary habits among university students.

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Appendices

1. Questionnaire (see CD-ROM)
2. Author guidelines Appetite