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ORIGINAL RESEARCH

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Self-reported hormonal changes-associated with fried potato chip consumption among female university students in Saudi Arabia, Makkah: A cross section study

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ABSTRACT

Background: Increased consumption of fried potatoes among university female students is obviously noticed in recent years.
Objectives: This study aimed to describe the pattern of consumption of potato chips (PC) by the university female students and its effect on their self-reported hormonal reproductive status.
Subjects and methods: This cross-sectional study was conducted on university female students in Home Science Education Department, Umm al-Qura University, Makkah, Saudi Arabia over a 6-month period starting from January 2018 to July 2018. A self-administered questionnaire was electronically distributed to all the students in the department. Data were analyzed using Statistical Package of Social Science. Significance was considered at $p < 0.05$.
Results: The response rate to the questionnaire was 89%. About 60% of the participants were between 21 and 24 years. Consumption of different types of PC and crisps was confirmed by 182 (92.9%). On average, the consumption was once per day 164 (83.7%). About 78% of them considered PC and crisps tasty.
Parents' education was not correlated to eating more PC and crisps yet older age of the parents' was.
Conclusion: Consumption of PC and crisps is common among the participants females university students during the early reproductive period. This study gives some clues about the association between PC consumption and reproductive hormonal changes like unusual hair appearance.
Recommendations: A health-education program to enhance female university students' dietary choices and lifestyle decisions and increasing the availability of healthy foods in the university cafeteria should be considered.

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Fried potato; potato chips; crispy; menarche; acrylamide; hormones; university students.

Introduction

Diet has greatly changed worldwide over the past two decades as the agriculture has evolved from an era of natural farming processes to scientific farming and food processing, involving genetic intervention (genetically modified food), which affects lifestyle disease patterns as well as food-processing techniques [1].

With the recent progress in technology and advanced modernization of lifestyles, individuals, tend to consume more of the unhealthy food, especially Fried Potato Chips (FPCs), being one of the most popular foodstuffs that are consumed in large quantities worldwide [2].

Potato chips (PC) and crisps have the highest concentration of acrylamide (ACR) (3,500 mg/kg), a carcinogen with several hazardous effects, including neurotoxicity, reproductive toxicity, carcinogenicity, genotoxicity, mutagenicity, and teratogenicity [3]. ACR, is a small organic molecule that is highly soluble in water and a known neurotoxin, is formed when foods high in carbohydrates and low in proteins are cooked being baked, roasted, or fried at temperatures >100°C and is found in numerous

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common foods as PC and French fries, due to interactions between asparagines and sugar [4].

Evidence-based studies revealed an association between dietary acrylamide intake and sex hormone levels in the reproductive females, leading to increase the risk of hormone-related cancers, as ovarian cancer, endometrial cancer, and estrogen receptor–positive breast cancer [5]. Also, several studies have found that acrylamide affects the levels of estradiol, progesterone, testosterone, and prolactin [6–8].

Therefore, it is worth examining the associations between the dietary acrylamide intake in PC and its effect on the circulating levels of sex hormones in females. However, to our knowledge, only one study has examined these associations, and it observed no overall associations among the U.S. women [9]. This study aimed to describe the pattern of consumption of PC by the female university students in one of the Saudi universities and its effect on the hormonal reproductive status.

Subjects and Methods

This cross-sectional descriptive study was conducted at Umm al-Qura University over a 6-month period starting from January 2018 to July 2018.

A self-administered questionnaire was constructed in English and translated into Arabic. It was distributed to a pilot group of students to ensure its face validity. It was revised in the light of their feedback then it was submitted electronically by email to all the female university students in the Home Science Education Department (n = 220).

The questionnaire was divided into three sections. Section one, covered the demographic data of the participants, including age, father's and mother's job, and the level of education and the family income, including the father's and mother's salary. Section two of the questionnaire included questions about the participants' habits related to eating of PC and crisps, whether they eat it or not, how often they eat it and the reason they eat it for. Section three included 11 questions assessing the effect of PC and crisps consumption on reproductive hormones. These questions included the age of the menarche, the duration, and amount of the menstruation and whether it is associated with pain requiring taking analgesics or visiting the physician or not. Also, they were asked if they are suffering from unusual body hair appearance for which they had visited the physician or took any medications.

Ethical considerations

Replying to the email and filling the question is considered an implicit consent from all the respondents to participate in the study.

Statistical analysis

The data of the study were analyzed using Statistical Package of Social Science. Responses of the participants who did not supply sufficient data because of not completing the questionnaires were excluded. The results were presented in the form of number and percentages. Significance was considered at $p < 0.05$.

Results

The questionnaire was distributed electronically to 220 students. Nearly, 196 of them responded and filled the questionnaire with a response rate 89%. The participants were categorized into three age groups. The participants between 21 and 24 years were 118 (60.4%). About 64% of the participants' fathers were retired and most of their mothers were house wives162 (82.7 %) (See Table 1).

As for the father's education, nearly quarter of them (25.5%) were university graduates, and 21.9% were of intermediate education. Mother's level of education was slightly lower than that of the fathers as only 52 (26.5%) of the mothers had intermediate education. Regarding the family income, two thirds of the participants families had either intermediate (2,000–5,000 SR) to high income (>10,000 SR) (See Table 1).

As for the consumption of the PC and crisps, the majority of the participants, 182 (92.9%) confirmed eating of the different types of PC and crisps, once or twice per day (83.7%, 11.2%, respectively), because they are tasty and available everywhere (78.1% and 15.8%, respectively) (See Table 2).

Table 3 described the symptoms related to the changes in the reproductive hormones reported by the participants. About 67% of the participants had their menarche at the age between 13 and 15 years and more than 75% of them considered this age comparable to that of females in their family. Menses is associated with intolerable pain in about 67% of the participant and more than 50% of them have to take painkillers during the menses. Most of the participants had menstruation for 7 or 5 days long (56.6%, 30.1%), respectively, and more than 67% of them considered this period comparable to their family members were suitable.

Table 1. The demographic characters of the participants.

Variables	Number (*n* = 196)	Percentage (%)
Age		
18–20	39	19.8
21–24	118	60.4
>24	39	19.
Father's job		
Retired	124	63.3
Educational profession (teacher or professor at universities)	20	10.2
Engineering professions	7	3.6
Medical professions	6	3.1
Others	39	19.8
Mother's job		
House wife	162	82.7
Educational institutions (teacher or professor at universities)	21	10.7
Engineering professions	-	-
Medical professions	1	0.5
Others	12	6.1
Father's level of education		
Illiterate	26	13.3
Primary education	17	8.7
Intermediate education	43	21.9
High school education	38	1.4
University education	50	25.5
Postgraduate education	22	11.2
Mother's level of education		
Illiterate	31	15.8
Primary education	31	15.8
Intermediate education	52	26.5
High school education	33	16.8
University education	38	19.4
Postgraduate education	11	5.6
Family income (father's and mother's salary)		
<2,000 S.R	62	9.7
2,000–5,000 S.R	54	31.6
5,000–10,000 S.R	61	27.6
10,000 S.R	19	31.1

Unfortunately, the majority of the participants (93.9%) visit the physician during their menses. Adding to that, more than 83% of the participants reported that they suffered from unusual hair appearance and most of them (94.4%) visited the physician and about 97% took medications to treat this unusual hair (See Table 3).

Discussion

Currently, consumption of FPC and French fries ranks number one in industrialized nations and developing countries and probably causes various impairments in quality of life [10]. FPCs became one of the most popular foodstuff, that are consumed in large quantities worldwide, especially by the college students, being tasty, easy accessible,

Table 2. Pattern of consumption of PC and crisps among the participants.

Question	Total number (*n* = 196)	Percentage (%)
Do you eat PC or crisps?		
Yes	182	92.9
No	14	7.1
If yes, how often do you take it?		
Once per day	164	83.7
Twice per day	22	11.2
3 times per day	5	2.6
More than	5	2.6
The reason for eating PC or crisps		
Tasty	153	78.1
Cheap	-	-
Available everywhere	31	15.8
Keeping up with friends	9	4.6
Other	3	1.5

and curiously satisfy hunger, yet FPCs consumption can cause significant unhealthy harmful effects [2]. Although the quantity ingested may be insignificant, the frequency of exposure increases the long-term deleterious effects due to cumulative exposure [11].

In this study, consumption of potato crisps and chips was found to be common (92.9%) among the female university students, on average once per day because they are tasty (as reported by 78.1% of the participants). This is in agreement with some previous studies as that were performed in Jordan; a study was performed to assess the risk of obesity among female university students [12]. They reported a frequent intake (more than three times per week) of PC among female university students who attributed this to their belief that PC are rich in energy and fat [12]. Ouhtit et al. [2] studied the reasons behind the consumption of increasing quantities of FPCs by individuals, especially children, even on a full stomach. The consumers reported that they believed that carbohydrates send a pleasing message to the brain.

Some researchers suggest that something else in the chips might make them highly desirable. A previous study involving rats fed on the different types of food rich in carbohydrates and fat showed remarkable preference to the chips. In this study, the rats' brains were mapped using manganese-enhanced magnetic resonance imaging to monitor brain activity during the experiments. The reward and addiction centers in the brain displayed maximal activity in the FPCs-fed rats [13].

Researcher has noticed an increased consumption of fried potatoes among female students with the limited education of the mother, whereas most of the mothers were of either intermediate or primary education. High monthly income of the family was also related to the great consumption of PC among the participants in this study.

The age of menarche in our participants was between 13 and 15 years with a mean of 14 years about 67%. This is considered comparable to data from a number of studies that the commencement of menarche is more rapid in girls and is observed at a much earlier age in many countries of the world. The average age of menarche among females in the States was estimated to be 14.2 years in 1900. Later in 1920s, it decreased to 13.3 years and was further lessened to 12.3 years in 2002. More or less similar average ages of menarche were noticed in other western countries. Likewise, the menarche ages observed in Ireland was 13.5 years in 1986 and was decreased to 12.5 years in 2006 [14]. An observational study in Italy showed that the menarche ages in girls have decreased at a rate of 3 months earlier as compared to their mothers [15,16].

Al-Agha et al. [17] in their study of the intake of cola drinks, beef, French fries, and other junk foods excessively in the daily diet and its correlation to increased obesity among girls in Saudi Arabia and the occurrence of early puberty, they reported that the mean menarche age in girls was found to be 11.5 years compared with 12.9 years for their mothers with a difference of almost 1.5 years between the menarche ages in young girls and that of their mothers. Several factors affect the age of menarche in Saudi Arabia as the insufficient diet, socioeconomic standard, the decreased physical activity, besides the environmental and hereditary factors [17]. Other studies stated that the age of menarche to occur between 9 to 13 years old in females, yet there has been a rapid shift in the starting age of menarche worldwide due to many participating factors. The most important factors include the type of dietary intake and the amount of consumption that might be responsible for genetic and hormonal changes [15,16,18]. Sex hormones that are used in food preparation, low consumption of vegetables among teenagers and the increased intake of junk meals with high fat and calories, and low nutrients can affect the level of sex hormones in the body leading to early puberty. However, increase the fiber intake was associated with late menarche and other health benefits [19]. Large percent of the participants in this study confirmed that

Table 3. Reproductive hormonal changes reported by the participants.

Questions	Number (*n* = 196)	Percentage (%)
At what age did the menarche start?		
10–12	49	25.0
13–15	131	66.8
16 and above	16	8.2
Do you consider this age comparable to your family members?		
Suitable	148	75.5
Late	9	4.6
Early	15	7.7
I do not know	24	2.2
Is the menstruation associated with intolerable pain?		
Yes	131	66.8
No	65	33.2
Do you have to take painkillers during your period?		
Yes	101	51.5
No	95	48.5
How long is the menstruation period?		
3 days	16	8.2
5 days	59	30.1
7 days	111	56.6
10 days	6	3.1
More than 10 days	4	2.0
Do you consider this period comparable to your family members?		
Suitable	133	67.9
Short	14	7.1
Long	12	6.1
I do not know	37	18.9
The amount of blood during menstruation		
Suitable	120	61.2
Small amount	27	13.8
Large amount	24	12.2
I do not know	25	12.8
Do you often visit the doctor during your period?		
Yes	184	93.9
No	12	6.1
Do you suffer from unusual hair appearance?		
Yes	163	83.2
No	33	16.8
Do you have to visit the doctor because of the unusual hair appearance?		
Yes	18	94.4
No	11	5.60
Do you have to take medications to treat this unusual hair?		
Yes	190	96.9
No	6	3.1

they suffer from unusual hair appearance for which most of them visited the physician and nearly all of them took medications. This may be attributed to the acrylamide content of fried potatoes.

Camacho et al. [7] evaluated the effects of a 14-day exposure to Acrylamide on reproductive tissues and the Hypothalamic–Pituitary–Gonadotrophins axis in male rats. The doses were approximately 2.5, 10, and 50 mg/kg per day. Serum levels of luteinizing hormone (LH) and the % area of LH-staining in the pituitary were significantly elevated by 10 and 50 mg/kg per day. Serum follicle stimulating hormone was decreased at the highest dose, while serum levels of progesterone and estradiol were unchanged [7].

This study has some limitations; first, the used questionnaire is self-reported, and therefore, is dependent upon the students' recall. Second, this cross-sectional study just indicating association between the study variables and does not infer any causality from the current findings, therefore one could not establish causal relationships between the study variables. Third, the small sample size of the participating subjects limits the generalizability of the present findings. Despite these limitations, our study can be used as a first step for the investigation of the harmful effects of the increased consumption of fried potatoes among university female students in Saudi Arabia. We hope that this study will motivate other researchers to carry out further in-depth studies on the correlation of fried potatoes on the reproductive life of female students particularly during early years of the reproductive years in Arab countries.

In conclusion, the present study demonstrated a high consumption of PC and crisps among the female university students in one of the Saudi Universities. It gives some clues about the association between PC consumption and reproductive hormonal changes like unusual hair appearance. It is, therefore, highly recommended to take healthy nutrition with lower quantities of French fries particularly. Public health measures should be implemented to improve malnutrition among females and to increase their awareness about the healthy dietary habits.

Female university students may benefit from a health-education program to enhance their dietary choices and lifestyle decisions and increasing the availability of healthy foods in the university cafeteria. Finally, the utility of prospective epidemiologic investigations to quantitatively assess exposure in the general population to acrylamide needs to be addressed. The above data suggest the necessity of systematic control, education, and investigation of the health effects of consumption of FPC and French fries in the world population.

Conflict of Interest

The author declares that he has no conflict of interest.

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