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Effect of fried food consumption on lipid profile of non-breakfast eaters among university going adults

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Abstract

Breakfast is considered the most important meal of the day but breakfast consumption has dramatically decreased in adults, especially in university students since the past few years. These students skip breakfast in the morning but consume fried junk food in university timings. Therefore, this study aimed at evaluating the lipid profile and dietary intake of healthy food breakfast eaters, fried food breakfast eaters, and non-breakfast eaters. Ninety healthy young adults of both genders aged 20-25 years, were divided into three groups: Fried food breakfast eaters, Healthy breakfast eaters and Non-breakfast eaters. Results showed that excessive intake of fried foods leads to increased amounts of total cholesterol, triglycerides, low-density lipoprotein cholesterol, very low-density lipoprotein cholesterol and enhanced intake of total calories, fats and carbohydrates. Moreover, non-breakfast eaters who skip breakfast and consume fried food are observed to have higher BMI than healthy breakfast eaters. Therefore, the consumption of healthy breakfast must be encouraged for the nutritional wellbeing of people.

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Introduction

The word "breakfast" literally means breaking the fast since it is the meal taken after overnight sleep. Breakfast is considered as the most important meal of the day because of its major contribution in nutritional well-being, total daily energy and nutrient intake (Nicklas *et al.*, 1993). The consumption of breakfast has been positively associated with improved nutrition and enhanced cognitive, academic and psychosocial performance (Matthys *et al.*, 2007) while skipping breakfast has been observed to contribute towards dietary inadequacies, which are rarely replenished by other meals during the day (Nicklas *et al.*, 2004). It has been reported that skipping breakfast is associated with an inappropriately higher body mass index (BMI) as compared to having breakfast. In adults who take healthy breakfast, the daily energy intake (EIs) remains unaffected but lower levels of EIs and higher BMI is reported in breakfast skippers (Berkey *et al.*, 2003). Further investigations in children (Albertson *et al.*, 2003) adolescents (Berkey *et al.*, 2003), and adults (Ma *et al.*, 2003) have also confirmed the negative relation between breakfast consumption and the risk of obesity.

In recent years global diet regimen has incurred a massive shift. Breakfast consumption has dramatically decreased in adults especially in university students. These students skip breakfast in morning but consume fried junk food in university timings. The term junk food was coined as an informal term in 1972 by Michael Jacobson, Director of the Center for Science, Washington D.C. It is used for empty calorie foods which are perceived to have little or no nutritional value, and are considered unhealthy when eaten regularly or even consumed at all (Ashakiran and Deepthi, 2012; Arya and Mishra, 2013). Excessive amounts of fat particularly cholesterol, sugar and salts present in fried junk food pose adverse effects on human health leading to cardiovascular diseases, hypertension, high blood pressure, diabetes, cancer, gall bladder disease, liver damage, vomiting, headache, depression, obesity, tooth decay and other chronic diseases. Having higher amounts of fat and sugar in combination, junk foods are capable of producing a dopamine-driven surge of intense pleasure in people with a propensity for addictive behavior. It has also been observed that such foods alter brain activity in a manner similar to addictive drugs like cocaine or heroin (Colantuoni *et al.*, 2002).

Lipids, represented by phospholipids, cholesterol, triglycerides (TG) and fatty acids, are considered essential to the human body. They form basic structure of cell membranes, act as a precursor to steroid hormones, bile acids and vitamin D, as well as act on fluidity of cell membranes and in the activation of enzymes located there. Normal blood lipid profile has total cholesterol <200 mg/dL, LDL <130 mg/dL, HDL ≥ 40 mg/dL and triglycerides <150 mg/dL. Due to incorporation of higher amount of fried food in diet, an increase in total cholesterol, LDL, triglycerides levels or decrease in HDL levels results in an abnormality in the levels of lipid profile known as Dyslipidemia (Tapan, 2005). Fried junk food dense in calories, when oxidized in the body causes enormous formation of Acetyl CoA. Acetyl CoA in excess is channelized out of mitochondria for its participation in other metabolic pathways. These pathways include de-novo fatty acid synthesis and biosynthesis of cholesterol, which causes excess fatty acid and cholesterol formation. Due to which dense plaque deposition occurs in the arteries and thus human heart has to assert more effort in pumping blood, causing it to be in fatigue. Hence higher cholesterol along with higher salt contents can cause increased risk of blood pressure, stroke and heart disease in chain whereas excessive amounts of salt can impair kidney function as well.

Hence, every individual in the society needs to be educated about such foods and their impact on human health. Therefore, the aim of the present study was to check the effect of fried food on lipid profile of non-breakfast eaters of both genders: male and female and to estimate the dietary intake of healthy food breakfast eaters, fried food breakfast eaters and non breakfast eaters.

Material and methods

Current study was performed on students of Bahauddin Zakariya University. The study population comprised of total ninety healthy young adults aged 20 to 25 years, of both genders, out of which 45 were male and 45 were female. Both groups were further divided into three groups. Healthy young women with regular menstruation, neither lactating nor pregnant and with no self-reported history of hyperglycemia, hypercholesterolemia, dyslipidemia, or any other serious medical condition, were selected. Healthy males with no history of smoking, alcohol consumption, hyperglycemia, hypercholesterolemia, dyslipidemia or any other serious medical condition were selected. Subjects were divided into three groups: Healthy breakfast eaters (HBE), Fried food breakfast eaters (FBE) and Non-breakfast eaters (NBE).

Anthropometric measurements

Anthropometric measurements including height, weight and BMI of all participants were measured. Weight was measured by weighing scale when subjects were wearing light clothing, were not wearing shoes and had empty pockets. Height was measured by using stadiometer to nearest 0.1cm. BMI of all subjects was calculated by using BMI calculating formula.

BMI = Wt (kg)/ Ht (m^2) (Weight in KGs /Height in meter square).

Dietary assessment

Data for dietary assessment was collected by questioning about the foods taken in the whole day e.g. what they eat in morning, in breakfast, lunch and dinner in the whole day along with any beverages, snacks, fruits and sweets among these meals. For this purpose, the respondents were requested to give complete information about what they have eaten in last 24 hours or previous day. Three different types of questionnaires were prepared for all three groups according to group's specifications and the gender requirements. The medical histories, dietary choices, eating habits, portion sizing of each meal (grams/bowls/cups) of the subjects as well as the foods they usually consume in most days of a week were recorded through these questionnaires. Portion size of meals was then converted into grams and total dietary caloric intake was estimated of all individuals with the help of Pakistan food composition table 2001 (Hussain, 1985).

Lipid profile analysis

All tests of lipid profile including total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c), and very low density lipoprotein cholesterol (VLDL-c) were performed on routine chemistry analyzer "Evolution 3000".

Sample collection

All subjects were asked to fast overnight for 12 hours and to take no exercise other than required for activities of daily life. Then blood samples were withdrawn after overnight fasting (12 h) of all three groups. Samples were then added in gel voiles (specified for lipid blood chemistry including lipid profiling) and left for 10 minutes to clot the blood. The clotted blood samples were then centrifuged in centrifugation machine at 5000 rpm for 5 minutes for separating serum and RBCs. After centrifugation the serum was separated in eppendorf tube and stored in freezer at 2^oC for latter assessment of lipid profile including total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c) and non HDL cholesterol. The tests were conducted using commercial kits.

Tests performed

All tests of lipid profile were performed by commercially available kits using following methods: total serum cholesterol was analyzed by CHOD-PAP method (Stockbridge *et al.*, 1989). HDL-c was analyzed by using HDL cholesterol Precipitant method (Assmann, 1979) triglycerides were determined by using GPO-PAP method (Colombo *et al.*, 1985) whereas LDL-c and VLDL-c were calculated by using generalized formula of Friedewald

(Friedewald *et al.,* 1972).

Results and discussion

In the current study, significant (*p≤0.05)* differences were observed in cholesterol of all groups (Table 1). Highest cholesterol was noted in non-breakfast eaters (206.13 ± 24.52) in all groups. Among gender comparison, the present study showed maximum cholesterol in male population (HBE= 129.13 ± 15.39, FBE= 160.80 ± 5.90, NBE= 206.13 ± 24.52) as compared to the cholesterol levels of female population (HBE=119.67± 5.02, FBE=140.07 ±11.53, NBE=162.87 ± 19.00).

These results are also supported by the study of Resnicow (1991) who reported that breakfast skippers have higher total cholesterol levels. So, it was supposed that non-breakfast eaters take more fried food than fried food breakfast eaters and healthy breakfast eaters (Resnicow, 1991).

Table 1. Lipid profile (mg/dl) levels in All Groups (HBE, FBE, and NBE) and Genders.

Parameters	Gender	Groups			Overall Mean
		HBE	FBE	NBE	
TC	Male	$129.13^{cd} \pm 15.39$	$160.80^{b} \pm 5.90$	$206.13^{a} \pm 24.52$	165.36^{a}
	Female	$119.67^{d} \pm 5.02$	$140.07^{c} \pm 11.53$	$162.87^{b} \pm 19.00$	140.87^{b}
TG	Male	$122.13^{bc} \pm 97.26$	$172.00^{b} \pm 75.18$	$241.40^{a} \pm 115.17$	178.51^{a}
	Female	$107.73^{c} \pm 43.94$	$86.33^{c} \pm 32.18$	$102.00^{c} \pm 52.27$	98.69^{b}
HDL-c	Male	$36.00^{cd} \pm 8.28$	$33.66^{d} \pm 6.10$	$35.73^{cd} \pm 7.59$	35.13^{b}
	Female	$39.53^{bc} \pm 6.02$	$44.73^{a} \pm 7.14$	$42.26^{sb} \pm 6.39$	42.17^{a}
LDL-c	Male	$69.07^{de} \pm 14.61$	$91.13^{bc} \pm 29.14$	$118.20^{s} \pm 28.00$	92.80^{a}
	Female	$57.87^{e} \pm 12.91$	$77.93^{cd} \pm 8.83$	$99.80^{b} \pm 16.43$	78.53^{b}
VLDL-c	Male	$22.60^{c} \pm 11.88$	$33.60^{b} \pm 19.64$	$47.93^{s} \pm 23.15$	34.71^{a}
	Female	$20.20^{c} \pm 8.11$	$17.06^{c} \pm 6.25$	$20.46^{c} \pm 10.82$	19.24^{b}

HBE= Healthy Breakfast eaters
FBE= Fried Breakfast Eaters
NBE= Non Breakfast Eaters
TC= Serum Total Cholesterol
TG-= Triglycerides
HDL-c= High Density Lipoprotein cholesterol
LDL= Low Density Lipoprotein Cholesterol
VLDL-c= Very Low Density Lipoprotein Cholesterol

Triglycerides are the most common fat present in human body. Normal levels of triglycerides vary according to age and gender. Higher levels of triglycerides combined with higher LDL-c or lower HDL-c boost up atherosclerosis, which increases the risk of heart attack by building up fatty deposits in arteries (Ma, 2004). Table 1 showed significant (*p≤0.05)* differences in triglycerides levels of each gender and group. Increased triglycerides levels were observed in non breakfast eater males (241.40 ± 115.17) as compared to males and females of healthy and fried breakfast eater groups. These results are in line with the study of Smith *et al.* (2010) who also found a negative relation between breakfast consumption patterns and triglycerides.

High density lipoprotein cholesterol (HDL-c) is known as good cholesterol because it is composed of a lot of protein and very little amount of cholesterol. HDL-c extracts extra cholesterol deposits from walls of blood vessels and brings them back to liver (Johnson *et al.*, 2004). The current study showed insignificant difference in HDL-c among groups while significant variations were noted in gender (Table 1).

Table 2. Dietary assessment of All Groups (HBE, FBE, and NBE) and Genders.

Parameters	Gender	Groups			Overall Mean
		HBE	FBE	NBE	
BMI	Male	$20.56^{b} \pm 1.56$	$20.96^{b} \pm 1.88$	$23.88^{a} \pm 2.76$	21.80^{a}
	Female	$20.22^{b} \pm 1.82$	$20.61^{b} \pm 1.96$	$25.38^{a} \pm 3.81$	22.07^{a}
Total Kcal	Male	$1890.6^{b} \pm 47.24$	$1887.9^{b} \pm 166.15$	$2238.8^{a} \pm 421.56$	2005.8^{a}
	Female	$1721.1^{b} \pm 272.22$	$1696.3^{b} \pm 282.81$	$1719.2^{b} \pm 690.33$	1712.2^{b}
Total Fat	Male	$17.80^{f} \pm 1.20$	$24.93^{d} \pm 1.48$	$34.66^{a} \pm 2.87$	25.80^{a}
	Female	$19.53^{e} \pm 0.91$	$26.55^{c} \pm 0.91$	$31.80^{b} \pm 1.52$	25.96^{a}
Total Carbs	Male	$57.66^{d} \pm 1.44$	$62.66^{b} \pm 2.05$	$64.53^{a} \pm 2.26$	61.62^{a}
	Female	$57.20^{d} \pm 1.56$	$59.73^{c} \pm 1.53$	$60.42^{c} \pm 1.52$	59.11^{b}
Total Pro	Male	$21.06^{a} \pm 2.18$	$14.80^{b} \pm 1.26$	$13.06^{d} \pm 1.09$	16.31^{b}
	Female	$21.13^{a} \pm 1.59$	$17.86^{b} \pm 1.30$	$13.40^{d} \pm 2.29$	17.46^{a}

HBE= Healthy Breakfast eaters
FBE= Fried Breakfast Eaters
NBE= Non Breakfast Eaters
BMI= Body Mass Index
Total Cal=Total Kilo Calories
Total Carbs= Total Percentage of Carbohydrates
Total Fat= Total Percentage of Fat
Total Pro= Total Percentage of Protein

High levels of HDL-c were observed in female population (HBE= 39.53 ± 6.02, FBE= 44.73 ± 7.14, NBE= 42.26 ± 6.39) as compared to the HDL-c level of male population (HBE= 36.00 ± 8.28, FBE= 33.66 ± 6.10, NBE= 35.73 ± 7.59).

Low density lipoprotein cholesterol (LDL-c) is composed of a lot of cholesterol and a little protein. It is bad for cardiovascular health, because LDL is one of the main sources of plaque in the arteries (Ma, 2004). Table 1 showed significant ($p \leq 0.05$) variations in LDL-c between gender and groups. Among male population, higher levels of LDL-c were noted in non breakfast eaters (118.20 ± 28.00) followed by the LDL-c levels of fried breakfast eaters (91.13 ± 29.14) and healthy breakfast eaters (69.07 ± 14.61). Maximum LDL-c among female population was noted in non breakfast eaters (99.80± 16.43) followed by that of fried breakfast eaters (77.93± 8.83) and healthy breakfast eaters (57.87± 12.91).

The study of Farshchi *et al.* (2005) has also validated these results. Very low density lipoprotein cholesterol (VLDL-c) is a type of LDL-c composed of very little protein and a lot of cholesterol. It is also considered as bad cholesterol because high levels of VLDL-c have been linked with higher risk of coronary heart diseases (Georg *et al.*, 2000). Significant ($p \leq 0.05$) variations in VLDL-c between gender and groups were noted in this study (Table 1).

Among male population higher VLDL-c was observed in non-breakfast eaters as compared to that of breakfast-eater groups. Current study showed insignificant differences in VLDL-c levels in female population of all groups, whereas, significant ($p \leq 0.05$) differences were observed between genders with in groups. Among fried breakfast eaters maximum VLDL-c was observed in male population (33.60 ± 19.64) as compared to that of female population (17.06 ± 6.25). Among non breakfast eaters high VLDL-c was noted in male participants (47.93 ± 23.15) followed by female participants. The study revealed insignificant differences among healthy breakfast eating male and female participants. These results were in agreement with

the study of Alquraishi *et al.* (2016).

BMI is an inexpensive, non-invasive and simple indicator of body fat because it measures excessive weight instead of excess fat (Alquraishi *et al.,* 2016).In this study, significant (*p≤0.05)* variations were observed among BMI of groups (Table 2). Among male population, maximum BMI was noted in non-breakfast eaters (23.88 ± 2.76) as compared to breakfast eaters groups.

Among female population higher BMI was also noted in non-breakfast eaters (25.38 ± 3.81) as compared to that of breakfast eater groups. While insignificant variations were observed among healthy breakfast and fried breakfast eater groups of both genders. These results were in agreement with the study of Crawley and Summerbell (Crawley and Summerbell, 1997).

Calorie is a measuring unit for energy producing value of food. Significant (*p≤0.05)* variations were observed between total caloric intake of non breakfast eaters among both genders (Table 2). Among male population, maximum calories were calculated in non-breakfast eaters (2238.8 ± 421.5) followed by that of breakfast eater groups. In current study non-significant results were observed in female caloric intake among non breakfast eaters and breakfast eaters' groups. While significant differences were observed among gender. These results were similar to the results of Farshchi *et al.* (2005). Maximum calories were recorded in male population (2005.8) as compared to that of female population (1712.2).These results were in agreement with the study of Kiefer *et al.* (2005). They also reported that children, adolescents and adult males consume more energy, fat, and cholesterol but less carbohydrates and fiber than females.

Fats and oils are water insoluble compounds that provide nutritive value as well as add texture, flavor, mouth feel and aroma to food. Table 2 showed significant (*p≤0.05)* variations in total fat intake between groups and gender. Among male population, maximum fat intake was calculated in non-breakfast eaters (34.66 ± 2.87) as compared to that of breakfast eater groups. Among female population maximum total fat was also noted in non-breakfast eaters (31.80 ± 1.52) followed by that of fried breakfast eaters. Significant variations were observed in gender, so it might be supposed that due to cultural differences, female population of Pakistan have higher fat intake as compared to that of male population. Among groups (HBE, FBE) significant variation (19.53± 0.91, 26.55 ± 1.74 respectively) were observed in female population as compared to that of male population (17.80 ± 1.20, 24.93 ± 1.48 respectively). While in non-breakfast eaters maximum fat intake was noted in male participants (34.66 ± 2.87) as compared to that of female population (31.80 ± 1.52). These results were similar to the results of Courtenay who also observed that males consume more fat and dietary cholesterol than females (Courtenay *et al.*, 2000).

Carbohydrates play an important role in the body such as glucose is the main source of energy in body (Caffall and Mohnen, 2009). This study recorded significant (*p≤0.05)* variations in total carbohydrates between gender and groups (Table 2). Among male population, maximum carbohydrate intake was noted in non-breakfast eaters (64.53 ± 2.26) followed by that of fried breakfast eaters (62.66 ± 2.05) and healthy breakfast eaters (57.66 ± 1.44). Among female population maximum total carbohydrate was noted in non breakfast eaters (60.42± 1.52) followed by fried breakfast eaters (59.73 ± 1.53) and healthy breakfast eaters (57.20 ± 1.56).

In current study significant (*p≤0.05)* differences were observed in groups. Among fried breakfast eaters group the maximum total carbohydrate was observed in male population (62.667 ± 2.05) as compared to that of female population (59.73 ± 1.53). Among non-breakfast eaters the maximum carbohydrate intake was noted in male population (64.53 ± 2.26) as compared to that of female population (60.42 ± 1.52). Present study showed insignificant differences among healthy breakfast eating males and females. These results were in agreement with WHO health report of

2003 (WHO, 2003).

Proteins are the basic building blocks of body required in large amounts for growth and development. Table 2 showed significant (*p≤0.05)* variations in protein intake between groups and genders. Among male population, maximum protein intake was noted in healthy breakfast eaters (21.06 ± 2.18) followed by that of fried food breakfast eaters (14.80 ± 1.26) and non-breakfast eaters (13.06 ± 1.09). Among female population maximum protein intake was noted in healthy breakfast eaters (21.13 ± 1.59) as compared to fried breakfast eaters (17.86 ± 1.30) and non-breakfast eaters (13.40 ± 2.29). These results were similar to the study of Casperson and Roemmich (2017).They also found significant relationship between gender and dietary protein level. Among groups, maximum protein intake was noted in fried food breakfast eaters' female population (17.86 ± 1.30) as compared to that of male populations (14.80 ± 1.26). While insignificant differences were observed in male and female populations of healthy breakfast eaters and non-breakfast eaters. These results were in agreement with the study of European Health and Nutrition report (Elmadfa and Kornsteiner, 2009).

Conclusion

The present study concludes that skipping breakfast and consuming fried foods has a substantial impact on dietary intake and lipid profile of individuals. Increased consumption of fried foods leads to higher levels of total cholesterol, triglycerides, low density lipoprotein cholesterol, very low density lipoprotein cholesterol and a greater intake of total calories, fats and carbohydrates. Therefore, skipping breakfast and consuming fried foods instead of it might pose detrimental effects on cardio-metabolic health. These lipid abnormalities might serve as the prime risk factor for the onset of atherosclerosis and other diseases linked to CVDs. Moreover, non-breakfast eaters who skip breakfast and consume fried food are observed to have higher BMI than healthy breakfast eaters. So, they are at a greater risk of obesity and several associated health complications. The information obtained from this research can be incorporated into community-based interventions to create awareness regarding adverse effects of skipping breakfast and consuming fried foods. Consumption of a healthy breakfast comprising of a variety of nutrient-rich foods must be promoted to ensure enhanced nutritional wellbeing in people. It might help in reducing the disease burden of CVDs and the growing prevalence of obesity as well.

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References

Nicklas TA, Bao W, Webber LS, Berenson GS. 1993. Breakfast consumption affects adequacy of total daily intake in children. Journal of the American Dietetic Association **93(8),** 886-891. https://doi.org/10.1016/0002-8223(93)91527-W

Matthys C, De Henauw S, Bellemans M, De Maeyer M, De Backer G. 2007. Breakfast habits affect overall nutrient profiles in adolescents. Public Health Nutrition **10(4),** 413-421. https://doi.org/10.1017/S1368980007248049

Nicklas TA, O'Neil C, Myers L. 2004. The importance of breakfast consumption to nutrition of children, adolescents, and young adults. Nutrition Today **39(1),** 30-39. https://doi.org/10.1097/00017285-200401000-00009

Berkey CS, Rockett H, Gillman MW, Field A, Colditz G. 2003. Longitudinal study of skipping breakfast and weight change in adolescents. International Journal of Obesity **27(10),** 1258.

Albertson AM, Anderson GH, Crockett SJ, Goebel MT. 2003. Ready-to-eat cereal consumption: its relationship with BMI and nutrient intake of children aged 4 to 12 years. Journal of the American Dietetic Association **103(12),** 613-619. https://doi.org/10.1016/j.jada.2003.09.020

Ma Y, Bertone ER, Stanek III EJ, Reed GW, Hebert JR, Cohen NL. 2003. Association between eating patterns and obesity in a free-living US adult population. American Journal of Epidemiology **158(1),** 85-92.
https://doi.org/10.1093/aje/kwg117

Arya G, Mishra S. 2013. Effects of junk food & beverages on adolescent's health–a review article. IOSR-JNHS **1(6),** 26-32.

Ashakiran DR, Deepthi R. 2012. Fast foods and their impact on health. JKIMSU **1(2),** 7-15.

Colantuoni C, Rada P, McCarthy J, Patten C, Avena NM, Chadeayne A. 2002. Evidence that intermittent, excessive sugar intake causes endogenous opioid dependence. Obesity Research **10(6),** 478-488.
https://doi.org/10.1038/oby.2002.66

Tapan E. 2005. Penyakit Degeneratif. Jakarta: Elex Media Komputindo, 19-20.

Stockbridge H, Hardy R, Glueck C. 1989. Photometric determination of cholesterol (CHOD-PAP method). Journal of Clinical Medicine **114,** 142-151.

Assmann G. 1979. HDL-cholesterol precipitant. Randox Labs. Ltd. Crumlin Co. Antrim, N. Ireland. Internist **20(559),** 64.

Colombo M, Annoni G, Donato MF, Conte D, Martines D, Zaramella MG. 1985. Serum type III procollagen peptide in alcoholic liver disease and idiopathic hemochromatosis: its relationship to hepatic fibrosis, activity of the disease and iron overload. Hepatology **5(3),** 475-479.
https://doi.org/10.1002/hep.1840050322

Friedewald WT, Levy RI, Fredrickson DS. 1972. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clinical chemistry **18,** 499-502.

Enig MG. 2000. Know your fats: The complete primer for understanding the nutrition of fats, oils and cholesterol. Bethesda Press Silver Spring.

Tabas I. 2002. Cholesterol in health and disease. The Journal of Clinical Investigation **110(5),** 583-590.
https://doi.org/10.1172/JCI16381

Resnicow K. 1991. The relationship between breakfast habits and plasma cholesterol levels in schoolchildren. Journal of School Health **61(2),** 81-85.
https://doi.org/10.1111/j.1746-1561.1991.tb03242.x

Ma H. 2004. Cholesterol and human health. Nature and Science **2(4),** 17-21.

Smith KJ, Gall SL, McNaughton SA, Blizzard L, Dwyer T, Venn AJ. 2010. Skipping breakfast: longitudinal associations with cardiometabolic risk factors in the Childhood Determinants of Adult Health Study. The American Journal of Clinical Nutrition **92(6),** 1316-25.
https://doi.org/10.3945/ajcn.2010.30101

Johnson ML, Pietz K, Battleman DS, Beyth RJ. 2004. Prevalence of comorbid hypertension and dyslipidemia and associated cardiovascular disease. Heart Disease (CHD)**2,** 3.

Farshchi HR, Taylor MA, Macdonald IA. 2005. Beneficial metabolic effects of regular meal frequency on dietary thermogenesis, insulin sensitivity, and fasting lipid profiles in healthy obese women. The American Journal of Clinical Nutrition **81(1),** 16-24.
https://doi.org/10.1093/ajcn/81.1.16

Georg P, Ludvik B. 2000. Lipids and diabetes. Journal of clinical and basic cardiology **3(3),** 159-62.

Alquraishi B, Rababah E. 2016. Lipid profiles and body mass index of young students in

JordanbioRxiv042697.
https://doi.org/10.1101/042697

Crawley H, Summerbell C. 1997. Feeding frequency and BMI among teenagers aged 16–17 years. International Journal of Obesity **21(2),** 159. https://doi.org/10.1038/sj.ijo.0800380

Farshchi HR, Taylor MA, Macdonald IA. 2005. Deleterious effects of omitting breakfast on insulin sensitivity and fasting lipid profiles in healthy lean women. The American Journal of Clinical Nutrition **81(2),** 388-396.
https://doi.org/10.1093/ajcn.81.2.388

Kiefer I, Rathmanner T, Kunze M. 2005. Eating and dieting differences in men and women. Journal of Men's Health and Gender **2(2),** 194-201.
https://doi.org/10.1016/j.jmhg.2005.04.010

Courtenay WH. 2000. Behavioral factors associated with disease, injury, and death among men: Evidence and implications for prevention. The Journal of Men's studies **9(1),** 81-142.
https://doi.org/10.3149%2Fjms.0901.81

Caffall KH, Mohnen D. 2009. The structure, function, and biosynthesis of plant cell wall pectic polysaccharides. Carbohydrate Research **344(14),** 1879-900.
https://doi.org/10.1016/j.carres.2009.05.021

World Health Organization. 2003. Diet, nutrition, and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation. World Health Organization.

Casperson S, Roemmich J. 2017. Impact of dietary protein and gender on food reinforcement. Nutrients **9(9),** 957.
https://doi.org/10.3390/nu9090957

Elmadfa I, Kornsteiner M. 2009. Fats and fatty acid requirements for adults. Annals of Nutrition &Metabolism **55(1-3),** 56.
https://doi.org/10.1159/000228996