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Research Article

Impact of Dietary Behaviors on Dyslipidemia in Japanese Male Workers

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Abstract

Dyslipidemia such as hypercholesterolemia and hypertriglyceridemia, affecting atherosclerosis, is known to be induced by dietary behaviors including high-fat diets, but little is known about what kind of dietary behavior is associated with dyslipidemia. We explored which of lunch patterns such as box lunch, meals at restaurants, instant noodles, and rice-balls was more strongly connected with dyslipidemia. Data on dietary behaviors (e.g., breakfast-skipping, snacking, lunch patterns, dinner time irregularity, and daily ethanol intake) and the possible confounders (age, body mass index, sleep duration, smoking habit, regular exercise, and work stress), along with fasting serum levels of triglycerides, LDL-cholesterol and HDL-cholesterol, were collected from 1,582 male workers belonging to a health insurance union of automobile dealerships in Japan. Proportions of dyslipidemia among the workers were 17.3% for hypertriglyceridemia (≥ 150 mg/dl), 18.9% for hyper-LDL cholesterolemia (≥ 140 mg/dl), and 4.7% for hypo-HDL cholesterolemia (< 40 mg/dl). Given a multiple regression analysis with adjustment for possible confounders, the contribution ratio of lunch to lipid variations was between 0.1% and 0.8%. Also, habitual instant noodle ingestion showed a significant relation to triglycerides. Odds ratios of habitual instant noodle ingestion, after adjustment for the possible confounders, were 1.575 (95% confidence interval, 1.120 to 2.215) for hypertriglyceridemia and 2.039 (1.148 to 3.623) for hypo-HDL cholesterolemia; and, the former showed a dose-dependent relationship. Despite the small contribution of lunch to total food intake, it is suggested that habitual ingestion of instant noodles can lead to hypertriglyceridemia and hypo-HDL cholesterolemia in male workers.

Keywords: Dyslipidemia; Instant noodles; Triglycerides; Cholesterol; Lunch patterns

Abbreviations

LDL-C: Low-Density Lipoprotein Cholesterol; HDL-C: High-Density Lipoprotein Cholesterol; BMI: Body Mass Index; ALT: Alanine Aminotransferase; TG: Triglyceride; AST: Asparate Aminotransferase; GGT: γ-Glutamyltransferase; SD: Standard Deviation; OR: Odds Ratio; CI: Confidence Interval

Introduction

Hypercholesterolemia and hypertriglyceridemia are mainly induced by dietary behaviors including high-fat diets [1], and such dyslipidemias elevate the risk of atherosclerotic cardiovascular disease [2]. In addition, overaccumulation of saturated fatty acids in the liver has been suggested to trigger hepatocellular apoptosis or inflammation [3,4], which seems to result in elevated Alanine Aminotransferase (ALT) involved in nonalcoholic fatty liver disease [5,6]. For promoting the primary prevention of atherosclerosis and fatty liver, accordingly, it is crucial to identify dietary behaviors that are strongly associated with dyslipidemia.

In Korean men, a noodle-bread dietary pattern showing greater intake of noodles and bread has been reported to be in close association with hypercholesterolemia and abdominal obesity [7]. Also, snacking, a common feature in the Western diet, contributes to hepatic steatosis and obesity [8]. In Japanese workers, lunch patterns (e.g., box lunch, meals at restaurants, instant noodles like cup ramen, and rice-balls) seem to be generally unchanged while dinner pattern differs daily among the Japanese, Chinese and Western diets or in seasonal ingredients of fish and vegetables; for this reason, it may be easy to examine the lunch pattern. We formulated a hypothesis about dietary behaviors that a certain lunch pattern might lead to dyslipidemia in Japanese male workers and drew up a project designed to test it. In addition, we explored the extent of contributions of lunch to serum levels of Triglyceride (TG), Low-Density Lipoprotein Cholesterol (LDL-C) and High-Density Lipoprotein Cholesterol (HDL-C) and the strength of relationships between the lipid levels and liver markers such as ALT in the same subjects, because it has been demonstrated recently that ALT elevation is associated with habitual ingestion of instant noodles for lunch [9].

Materials and Methods

Study population

In February-March 2012, a self-reported questionnaire was distributed to approximately 2,200 male employees belonging to a health insurance union of motor vehicle dealerships in a prefecture of northeast Japan, including salesmen, mechanics, and office clerks, but excluding the managerial class [9]. Of them, 1,857 consented to

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our proposal and returned the forms to the occupational health nurse of the union (response rate = 84%). Two hundreds and seventy-five respondents were excluded: those who did not undergo the mandatory health checkup, conducted under the Industrial Safety and Health Law in Japan, in April-July 2012; those whose fasting blood could not be taken; those who suffered from ischemic heart disease, chronic renal failure, alcoholic dependency diagnosed by a psychiatrist, liver cirrhosis, or cancer; those whose serological tests for hepatitis B or C infection were positive; those who took antihyperlipidemic agent; and, those whose reported questionnaire forms contained imperfect information. The study population consisted of 1,582 male workers aged 19-29 years (28.1%), 30-39 years (39.4%), 40-49 years (20.2%), and 50-67 years (12.3%). Some mechanics in this study had underwent the specific health examination for organic solvent workers under the Industrial Safety and Health Law annually, but such workers had neither symptoms/signs of organic solvent poisoning nor abnormal findings in urinalysis. This study was conducted in accordance with the Declaration of Helsinki of 1964 as revised in 2000, after our study protocol was approved by the Ethical Review Committee of the Akita University Graduate School of Medicine.

Exposure and outcome variables

Breakfast, lunch, snack, and dinner, as well as smoking and drinking habits, regular exercise, stress at work, and sleep duration, were inquired via the questionnaire made for this study on lifestyle behaviors. For instance, each subject reported whether he felt any stress at work (yes/no). Habits of breakfast-skipping/snacking during work hours and dinner time irregularity were scored as “absence”=0 and “presence”=1. What each subject ate at lunch time on workdays, i.e., a home-made or takeout box lunch, meals at restaurants, instant noodles, rice-balls (*onigiri*, i.e., a ball of cooked rice usually formed by hand), and others, was also asked by a method of multiple responses. In addition, one more question about how often each ate instant noodles in a week was posed to the subjects who indicated that they did consume such noodles for lunch. Nocturnal sleep duration (min) was computed as the difference between bedtime and wake time on workdays. The weekly amount of each type of alcoholic beverage consumed was also asked as described previously [10,11]; e.g., “How many 180 ml-cups (or 1,800 ml-bottles) of sake do you drink in a week?” and “How many 350 ml-cans (500 ml-cans, or 633 ml-bottles) of beer do you drink in a week?” Types of alcoholic beverages listed were sake, beer, *shochu* (a Japanese distilled alcoholic beverage primarily made from barley or sweet potatoes), whisky, wine, and others (e.g., plum wine, brandy, gin, or vodka). A total of 100% ethanol equivalent dose (g/d) was calculated for each subject. Smoking habit was scored as “nonsmoker” = 0 and “current smoker” = 1. Regular exercise was defined as at least one 30-min session at least once per week. The responses of exercise and work stress were scored as “absence” = 0 or “presence” = 1.

Data on lipid markers, i.e., fasting serum TGs, LDL-C, and HDL-C, along with ALT, Asparate Aminotransferase (AST), γ-Glutamyltransferase (GGT), and body mass index (BMI, kg/m^2), were obtained for each subject from the annual health checkup record. These lipids and liver markers were measured by the Akita Foundation for Healthcare, according to the principles recommended by the Japan Society of Clinical Chemistry [12]. Based on conventional values recommended by the Japan Atherosclerosis Society [13], TGs of 150 mg/dl or more, LDL-C of 140 mg/dl or more, and HDL-C of less than 40 mg/dl were defined as hypertriglyceridemia, hyper-LDL cholesterolemia, and hypo-HDL cholesterolemia, respectively.

Statistical analysis

Since TGs, LDL-C, HDL-C, ALT, AST, and GGT did not show a normal distribution, they were logarithmically transformed in using the Pearson product-moment and partial correlation coefficients and multiple regression analysis, and the median, minimum and maximum, but not mean ± Standard Deviation (SD), were employed in the tables. The relations of lifestyle behaviors (sleep duration, breakfast-skipping, snacking, irregularity of dinner time, smoking, daily ethanol intake, regular exercise, and work stress), lunch patterns (box lunch, meals at restaurants, instant noodles, and rice-balls), and confounders (age and BMI) to serum lipid levels were analyzed by multiple regression analysis. Multiple logistic regression analysis with adjustment for lifestyle behaviors and confounders was also used to calculate Odds Ratio (OR) and 95% Confidence Interval (CI) of lunch patterns on dichotomous data of hypertriglyceridemia, hyper-LDL cholesterolemia, and hypo-HDL cholesterolemia, which could avoid the overestimate resulting from extremely high TGs (> 400 mg/dl). All analyses with two-sided P values were performed using the Statistical Package for the Biosciences (SPBS Ver. 9.65) [14] and the significance level was set at $P < 0.05$.

Results

Background characteristics of 1,582 male workers are shown in Table 1. Proportions of dyslipidemia among them were 17.3% for hypertriglyceridemia, 18.9% for hyper-LDL cholesterolemia, and 4.7% for hypo-HDL cholesterolemia. Given a linear regression, all regression coefficients of these lipid markers on age and BMI, except for that of HDL-C on age, were statistically significant (Figure 1), implying that age and BMI are essential confounders for the

Table 1: Background characteristics of 1,582 male workers.

	Mean ± SD (or, Median and range in parenthesis)		
Age (years)	36	±	10
Body mass index (kg/m^2)	23.3	±	3.7
Sleep duration (min)	420	±	55
Ethanol ingestion (g/d)	9		(0 - 243)
Lipids in serum (mg/dl):			
Triglycerides	83.5		(18 - 1,902)
LDL-cholesterol	113		(16 - 243)
HDL-cholesterol	57		(17 - 131)
Lifestyle behaviors (%):			
Eating for lunch [a]			
Box lunch	56.4		
Meals at restaurants	10.2		
Instant noodles	52.3		
Rice-balls	13.7		
Breakfast-skipping	25.2		
Snacking during work hours	45.8		
Irregularity of dinner time	59.2		
Smoking	59.2		
Drinking	68.4		
Regular exercise	16.9		
Work stress	64.3		

[a] Multiple responses.

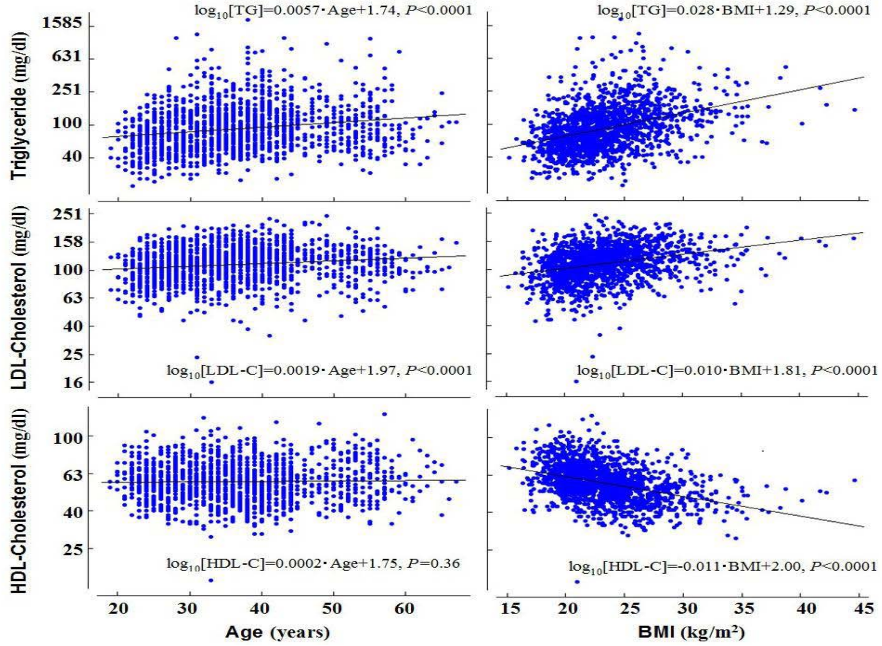

Figure 1: Relations of age and body mass index (BMI) to lipids.
Triglycerides (TG), LDL-cholesterol (LDL-C) and HDL-cholesterol (HDL-C) were measured in 1,582 male workers. These were logarithmically transformed (i.e., $\log_{10}$[TG], $\log_{10}$[LDL-C], and $\log_{10}$[HDL-C]), and results of linear regression showed that lipids had significant relations to age and BMI, except for the relation of HDL-C to age.

assessment of serum lipids. After adjusting for age, BMI, and daily ethanol intake, TGs were positively correlated with ALT, AST, and GGT (Table 2). Likewise, LDL-C was positively correlated with ALT and GGT; but, HDL-C was negatively correlated with ALT.

Table 3 represents results of multiple regression analysis. TGs were related positively to age, BMI, instant noodle ingestion, daily ethanol intake and sleep duration; but, negatively to dinner time irregularity. LDL-C was related positively to age, BMI, and breakfast-skipping; and, negatively to ethanol intake. Likewise, HDL-C was related positively to ethanol intake, and negatively to BMI and smoking. The contribution ratios (R^2) of multiple regression, using 14 lifestyle behaviors and confounders as independent variables, were 20.8% for TGs, 12.2% for LDL-C, and 19.9% for HDL-C. In employing 10 variables not including four patterns of lunch, the R^2 was 20.0% for TGs, 12.0% for LDL-C, and 19.8% for HDL-C (data not shown). Namely, the contribution of lunch to individual lipid variations was estimated to be between 0.1% and 0.8%.

The ORs of lunch patterns for dyslipidemia after adjusting for possible confounders are summarized in Table 4. Dietary behavior showing a significant OR for hypertriglyceridemia was instant noodle ingestion (P = 0.009). Hypo-HDL cholesterolemia was positively associated with instant noodle ingestion (P = 0.015). In addition, ORs of instant noodle ingestion at 1-2 and ≥ 3 times/week to hypertriglyceridemia were significantly high (P = 0.028 and P = 0.015, respectively), as compared to the workers who seldom ate instant noodles; also, the OR of the ingestion at 1-2 times/week for hypo-HDL cholesterolemia was statistically significant (P = 0.018).

Discussion

The principal finding of our study was that habitual ingestion of instant noodles was associated with hypertriglyceridemia in Japanese workers, and the risk ratio seemed to increase with the high frequency of instant noodle ingestion (Table 4). The dietary habit had continued over long periods prior to their health checkups in April-July 2012. These subjects did not always have enough time for lunch because they were usually busy with customers, who might walk into the showroom at any moment. As a result, such food readily to eat was

Table 2: Crude and partial correlation coefficients between serum lipids and liver markers transformed logarithmically ($\log_{10}$) in 1,582 male workers [a].

	ALT [b]			AST [b]			GGT [b]		
	Crude	Partial 1	Partial 2	Crude	Partial 1	Partial 2	Crude	Partial 1	Partial 2
Triglycerides	0.411**	0.258**	0.253**	0.321**	0.202*	0.197**	0.498**	0.381**	0.373**
LDL-cholesterol	0.272**	0.149**	0.155**	0.103**	0.022	0.027	0.168**	0.084**	0.092**
HDL-cholesterol	-0.222**	-0.050*	-0.055*	-0.032	0.045	0.037	-0.022	0.048	0.055*

[a] "Crude" means the Pearson product-moment correlation coefficient; "partial 1" represents the partial correlation coefficient after adjusting for age, body mass index, and daily ethanol intake; and, "partial 2" represents the partial correlation coefficient after adjusting for all lifestyle behaviors (see Table 1) in addition to age, body mass index, and daily ethanol intake.
[b] ALT, alanine aminotransferase (median 22 IU/l, range 4 to 260 IU/l); AST, asparate aminotransferase (median 22 IU/l, range 10 to 128 IU/l); GGT, γ-glutamyltransferase (median 29 IU/l, range 7 to 1,573 IU/l).
* P < 0.05, ** P < 0.001.

Table 3: Relations of lifestyle behaviors and confounders to lipid levels in 1,582 male workers: results of multiple regression analysis.

Lifestyle behaviors and confounders	$\log_{10}$[triglycerides]		$\log_{10}$[LDL-cholesterol]		$\log_{10}$[HDL-cholesterol]	
	Standardized regression coefficient	*P* value	Standardized regression coefficient	*P* value	Standardized regression coefficient	*P* value
Age	0.154	< 0.001	0.151	< 0.001	0.003	0.894
Body mass index	0.385	< 0.001	0.290	< 0.001	-0.400	< 0.001
Sleep duration	0.048	0.037	0.016	0.501	0.010	0.658
Eating for lunch [a]						
Box lunch	0.042	0.122	-0.018	0.523	-0.039	0.153
Meals at restaurants	0.030	0.194	-0.003	0.894	-0.008	0.732
Instant noodles	0.099	< 0.001	-0.022	0.444	-0.039	0.162
Rice-balls	0.011	0.624	0.046	0.062	-0.013	0.575
Breakfast-skipping	0.016	0.484	0.060	0.015	-0.041	0.085
Snacking	-0.036	0.117	0.028	0.244	0.012	0.590
Irregularity of dinner time	-0.059	0.012	0.004	0.868	-0.004	0.873
Smoking	0.024	0.310	-0.036	0.139	-0.112	< 0.001
Daily ethanol intake	0.106	< 0.001	-0.080	0.001	0.174	< 0.001
Regular exercise	-0.015	0.525	0.002	0.943	0.007	0.755
Work stress	0.012	0.613	0.030	0.211	-0.016	0.495
Multiple correlation coefficient (*R*)	0.456	< 0.001	0.349	< 0.001	0.446	< 0.001

[a] Multiple responses.

Table 4: Odds ratios of lunch patterns (and habitual instant noodle ingestion) to abnormal lipids after adjusting for possible confounders in 1,582 male workers: results of multiple logistic regression analysis [a].

	Hypertriglyceridemia [b]		Hyper-LDL cholesterolemia [b]		Hypo-HDL cholesterolemia [b]	
	Odds ratio	95% Confidence interval	Odds ratio	95% Confidence interval	Odds ratio	95% Confidence interval
Lunch patterns by multiple responses:						
Box lunch	1.113	(0.801 to 1.547)	1.051	(0.769 to 1.437)	1.574	(0.897 to 2.761)
Meals at restaurants	1.085	(0.692 to 1.702)	1.094	(0.708 to 1.691)	1.215	(0.566 to 2.611)
Instant noodles	1.575	(1.120 to 2.215)	1.057	(0.771 to 1.450)	2.039	(1.148 to 3.623)
Rice-balls	0.986	(0.652 to 1.492)	1.206	(0.820 to 1.772)	0.586	(0.257 to 1.337)
Instant noodle ingestion (times/week): [c]						
0	1		1		1	
1 to 2 (n = 454)	1.518	(1.046 to 2.203)	1.137	(0.806 to 1.605)	2.129	(1.138 to 3.981)
3 or more (n = 374)	1.671	(1.104 to 2.527)	0.948	(0.638 to 1.409)	1.904	(0.939 to 3.859)

[a]Possible confounders were age, body mass index, sleep duration, breakfast-skipping, snacking, irregularity of dinner time, daily ethanol intake, smoking, regular exercise, and work stress in Table 3.
[b] Hypertriglyceridemia, the level ≥ 150 mg/dl; Hyper-LDL cholesterolemia, the level ≥ 140 mg/dl; Hypo-HDL cholesterolemia, the level < 40 mg/dl.
[c] Possible confounders were other lunch patterns, in addition to the above confounders (a).

very convenient for them. Instant noodles, which are consumed worldwide [15], contain the highest saturated fatty acids of 7.31 to 8.72 g/100 g among cereal foods in Japan [16]. Furthermore, instant noodle consumers may show higher nutrient intake of energy and fats than non-instant noodle consumers as suggested by Korean researchers [17]. Thus, this may be the first report suggesting that one specific cause of hypertriglyceridemia in Japanese male workers is habitual instant noodle ingestion for lunch.

Habitual ingestion of instant noodle also was associated with hypo-HDL cholesterolemia, though the detailed analysis did not indicate a dose-response relation (Table 4). One possible reason for the disagreement may have been due to the lower prevalence rate of hypo-HDL cholesterolemia in the workers, compared to hypertriglyceridemia and hyper-LDL cholesterolemia. However, no significant link between the habitual ingestion and hyper-LDL cholesterolemia was seen, while excessive consumption of saturated fatty acids has been suggested to elevate LDL-C levels [18]. Since 34 of our subjects showed hypertriglyceridemia with TG levels ≥ 400 mg/dl, the LDL-C levels of such subjects might not be correct [13], but such high-level TGs would not heavily distort our results because they were transformed to dichotomous data (e.g., presence/absence of hyper-LDL cholesterolemia or hypertriglyceridemia) by using multiple logistic regression analysis. Further research is necessary to explain the metabolism of LDL-C and HDL-C resulting from saturated fatty acids.

This study indicated that the contribution of lunch to serum TG, LDL-C and HDL-C levels was between 0.1 and 0.8%, implying that the impact of lunch on lipids is apparently small. The remainder would be dietary behaviors related to breakfast and dinner, drinking habit, and regular exercise, in addition to age and BMI reflecting the degree of body fat (Table 3). However, since most of these factors represented only behaviors rather than individual food volumes, the above figures would be clearly underestimated. In fact, a randomized controlled trial in the Netherlands suggested that a hypercaloric diet with high meal frequency increased intrahepatic TG content and abdominal fat independent of caloric content and body weight gain [8]. Additional study including caloric contents of each consumed food is needed to estimate the precise contribution.

In the present study, significant correlations between serum liver markers (i.e., ALT, AST, and GGT) and lipids were observed, while the ranges of these liver markers shown in Table 2 were the same as those in 1,809 male workers of the previous study [9]. Especially, TGs appeared to strongly interact with these liver markers, as compared to LDL-C and HDL-C. Since the OR of habitual instant noodle ingestion for elevated ALT was 1.382 (95% CI, 1.083 to 1.764) in our previous study [10] and somewhat smaller than those for hypertriglyceridemia and hypo-HDL cholesterolemia (Table 4), it is suggested that dyslipidemia, probably induced by habitual ingestion of instant noodles along with ordinary dinner, preceded ALT elevation. Consequently, this would provide indirect evidence that hepatic over-accumulation of saturated fatty acids can trigger the inflammation and apoptosis [3,4,6].

In our study, daily ethanol intake was associated negatively with LDL-C and positively with TGs and HDL-C (Table 3). Such significant associations between ethanol intake and lipids have been demonstrated by many researchers [6,19,20]. In this way, these findings suggest that ethanol intake can facilitate hypertriglyceridemia and attenuate the risks of hypo-HDL cholesterolemia and hyper-LDL chelesterolemia. At the same time, information on ethanol intake is inevitable in analyzing lipid metabolism in humans.

Likewise, breakfast-skipping and irregularity of dinner time, together with age, BMI, smoking and sleep duration, were significantly related to dyslipidemia in this study. Only one exception is a link of age with HDL-C [21]. Of them, the effect of smoking on hypo-HDL cholesterolemia agrees with results of the previous reports [22,23]. The association between long sleep duration and hypertriglyceridemia in our study is consistent with those in US adults [24] and in Chinese people with impaired glucose regulation and diabetes [25]; as the possible causation, physiological alterations in mechanisms of lipid metabolism and unhealthy lifestyles such as excessive time in bed and low physical activity have been hypothesized [24]. By contrast, snacking, regular exercise and work stress had no close relations to dyslipidemia (Table 3), whereas the impact of exercise remains disputable [26]. In any way, these factors have to be considered in epidemiological research, because dietary lifestyles differ among individual countries.

There may have been some limitations in our study. We focused on lunch patterns that were thought to be generally unchanged in Japanese workers. Of course, dinner can affect serum TG and cholesterol levels greatly; for this reason, the contribution of lunch was very small in this study. Nevertheless, we could detect significant associations between habitual instant noodle ingestion and dyslipidemia, by using 1,582 workers who were in a socioeconomically homogenous condition and whose fasting blood was taken; hence, caution may be required in generalizing our results to the entire Japanese population. A self-reported questionnaire might introduce bias, but lunch patterns, about which approximately 5% of the subjects were directly asked by the occupational health nurse five months after the mandatory health checkup in 2012, remained unchanged [9]. Moreover, alcohol data of the present study kept a consistency with those of our past study carried out in 2002 [9,10]. These facts would not threaten temporal sequence involved in a causal effect [27]. Finally, various lifestyle behaviors such as ethanol intake, smoking, breakfast-skipping, snacking, irregularity of dinner time, and sleep duration, in addition to age and BMI [28], were considered in the data analysis. Thus, our data appear not to be heavily influenced by measurement bias or confounders.

Conclusion

Habitual ingestion of instant noodles can lead to hypertriglyceridemia and hypo-HDL cholesterolemia in male workers despite the small contribution of lunch to lipid variations. Nutritional education advising workers with this habit to have balanced diets (e.g., to reduce the frequency of instant noodle ingestion) should be implemented. Also, elevated ALT appears to follow dyslipidemia resulting from such habitual ingestion.

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References

1. Kopin L, Lowenstein C. In the clinic. Dyslipidemia. Ann Intern Med. 2010; 153: ITC21.
2. Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren M, et al. Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). Eur Heart J. 2012; 33: 1635-1701.
3. Alkhouri N, Dixon LJ, Feldstein AE. Lipotoxicity in nonalcoholic fatty liver disease: not all lipids are created equal. Expert Rev Gastroenterol Hepatol. 2009; 3: 445-451.
4. Byrne CD. Fatty liver: role of inflammation and fatty acid nutrition. Prostaglandins Leukot Essent Fatty Acids. 2010; 82: 265-271.
5. Clark JM, Brancati FL, Diehl AM. Nonalcoholic fatty liver disease. Gastroenterology. 2002; 122: 1649-1657.
6. Neuschwander-Tetri BA, Caldwell SH. Nonalcoholic steatohepatitis: summary of an AASLD Single Topic Conference. Hepatology. 2003; 37: 1202-1219.
7. Lee JE, Kim JH, Son SJ, Ahn Y, Lee J, Park C, et al. Dietary pattern classifications with nutrient intake and health-risk factors in Korean men. Nutrition. 2011; 27: 26-33.
8. Koopman KE, Caan MWA, Nederveen AJ, Pels A, Ackermans MT, Fliers E, et al. Hypercaloric diets with increased meal frequency, but not meal size, increase intrahepatic triglycerides: a randomized controlled trial. Hepatology. 2014; 60: 545-553.
9. Iwata T, Arai K, Saito N, Murata K. The association between dietary lifestyles and hepatocellular injury in Japanese workers. Tohoku J Exp Med. 2013; 231: 257-263.
10. Dakeishi M, Iwata T, Ishii N, Murata K. Effects of alcohol consumption on hepatocellular injury in Japanese men. Tohoku J Exp Med. 2004; 202: 31-39.
11. Dakeishi M, Murata K, Tamura A, Iwata T. Relation between benchmark dose and no-observed-adverse-effect level in clinical research: effects of daily alcohol intake on blood pressure in Japanese salesmen. Risk Anal. 2006; 26: 115-123.
12. Kawai T. Standardization of clinical examinations. Rinsho Kensa. 1993; 37: 459-461.
13. Teramoto T, Sasaki J, Ishibashi S, Birou S, Daida H, Dohi S, et al. Diagnostic criteria for dyslipidemia: executive summary of the Japan Atherosclerosis Society (JAS) guidelines for the diagnosis and prevention of atherosclerotic cardiovascular diseases in Japan - 2012 version. J Atheroscler Thromb. 2013; 20: 655-660.
14. Murata K, Yano E. Medical Statistics for Evidence-Based Medicine with

SPBS Users' Guide. Tokyo: Nankodo Publishers. 2002.

15. World Instant Noodles Association. National Trends in Instant Noodles Demands. 2013.

16. Ministry of Education, Culture, Sports, Science and Technology, Japan. Standard Tables of Food Composition in Japan. 5th edn Revised and Enlarged Edition. 2005.

17. Park J, Lee JS, Jang YA, Chung HR, Kim J. A comparison of food and nutrient intake between instant noodle consumers and non-instant noodle consumers in Korean adults. Nutr Res Pract. 2011; 5: 443-449.

18. Mensink RP, Katan MB. Effect of dietary fatty acids on serum lipids and lipoproteins. A meta-analysis of 27 trials. Arterioscler Thromb. 1992; 12: 911-919.

19. Grobbee DE, Rimm EB, Keil U, Renaud S. Alcohol and the cardiovascular system. Macdonald I, editor. In: Health Issues Related to Alcohol Consumption, 2nd edn. London: Blackwell Science. 1999: 125-179.

20. Nakanishi N, Yoshida H, Nakamura K, Kawashimo And H, Tatara K. Influence of alcohol intake on risk for increased low-density lipoprotein cholesterol in middle-aged Japanese men. Alcohol Clin Exp Res. 2001; 25: 1046-1050.

21. Yokoyama S, Ueshima H, Miida T, Nakamura M, Takata K, Fukukawa T, et al. High-density lipoprotein levels have markedly increased over the past twenty years in Japan. J Atheroscler Thromb. 2014; 21: 151-160.

22. Craig WY, Palomaki GE, Haddow JE. Cigarette smoking and serum lipid and lipoprotein concentrations: an analysis of published data. BMJ. 1989; 298: 784-788.

23. Rao Ch S, Subash Y E. The effect of chronic tobacco smoking and chewing on the lipid profile. J Clin Diagn Res. 2013; 7: 31-34.

24. Petrov ME, Kim Y, Lauderdale D, Lewis CE, Reis JP, Carnethon MR, et al. Longitudinal associations between objective sleep and lipids: the CARDIA study. Sleep. 2013; 36: 1587-1595.

25. Zheng Y, Wang A, Pan C, Lu J, Dou J, Lu Z, et al. Impact of Night Sleep Duration on Glycemic and Triglyceride Levels in Chinese with Different Glycemic Status. J Diabetes. 2014. (In Press).

26. Huffman KM, Hawk VH, Henes ST, Ocampo CI, Orenduff MC, Slentz CA, et al. Exercise effects on lipids in persons with varying dietary patterns - does diet matter if they exercise? Responses in studies of a targeted risk reduction intervention through defined exercise I. Am Heart J. 2012; 164: 117-124.

27. Fletcher RH, Fletcher SW. Clinical Epidemiology: The Essentials, 4th edn. Philadelphia: Lippincott Williams & Wilkins. 2005.

28. Patel CJ, Cullen MR, Ioannidis JP, Butte AJ. Systematic evaluation of environmental factors: persistent pollutants and nutrients correlated with serum lipid levels. Int J Epidemiol. 2012; 41: 828-843.

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