Introduction

Diet is an important modifiable cardiovascular risk factor. It is widely recognized that combination of foods consumed, expressed as dietary patterns, and their potential synergistic effects are important in the prevention of chronic diseases rather than the impact of individual nutrients. This has led to the development of methods that can be used for the characterization of these dietary patterns.

Several diet quality indices, based on established nutrient requirements and dietary guidelines, have been developed to evaluate the health benefits of individual diets. These scores, reflecting overall diet quality, can help researchers to sort through the nutrient and food-specific findings and provide a measure of diet that incorporates nutrient and food interactions of likely biological importance.

Dietary indices represent a measure of “healthy” eating patterns and are known by various names including diet quality indices or healthy eating indices. Dietary Guidelines aim to provide science-based dietary advice that promotes good health and reduces major chronic diseases.

The Healthy Eating Index (HEI), which quantifies the adherence to dietary guidelines, was associated with only a modest reduction in risk of major chronic disease. Although such indices are based on the U.S. dietary guidelines, they
have been adapted for use in other countries by altering the threshold values. Recently, the Alternate HEI (AHEI) was created that was based on foods and nutrients predictive of chronic disease risk. This diet score, including 11 components, was associated with a 16% lower risk of major chronic diseases (cardiovascular disease, diabetes, and cancer). Several studies have confirmed the relevance of the AHEI-2010 diet score as being associated with lower incidence of obesity, healthy aging and well-being and a reduced risk of all cause, cardiovascular, and cancer mortality.

The dietary guidelines and recommendations for the Kingdom of Saudi Arabia were recently issued by the Saudi Ministry of Health and were developed to maintain the health and reduce the risk of chronic diseases in the Saudi population. The food guide, palm, was created to provide more specific guidance in the selection and quantity of daily food choices. Therefore, it seemed important to assess and to monitor adherence to these guidelines through a dietary scoring system to rate the quality of diet among Saudi people.

Dietary assessment and management appear to be essential to limit the impact of cardiovascular risk. Plaque instability and thrombosis are also important determinants of cardiovascular end-points such as acute coronary syndromes and stroke, in the presence of significant atherosclerosis. Carotid artery intima-media thickness (CIMT) is a validated surrogate marker of preclinical atherosclerosis that has been shown to predict cardiovascular morbidity and mortality.

However, data are scarce with respect to whole dietary patterns and their relationship to disease within populations. Furthermore, the vast majority of these studies have been conducted in Western populations. Since the development of the AHEI, substantial evidence has emerged to support a role of additional dietary factors in the development of chronic diseases. Given the lack of national dietary studies, we aimed to assess the association between diet quality, as measured by AHEI and coronary risk as determined by CIMT among Saudi adults.

**Methods**

A total of 210 participants were recruited sequentially from the outpatient clinics of the internal medicine department at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia. Participants were originally referred to this service by their general practitioner, and the cohort consisted of a mixture of both new and returning patients. A control Group of similar age and sex was recruited from the same catchment area as the case participants in a case–control study design. The study was approved by the Ethical Committee of KAUH. Exclusion criteria included a documented history of cardiovascular disease, renal disease, hepatic disease, or chronic inflammatory disease. A total of 105 age- and sex-matched individuals without diabetes were recruited from the same catchment site. None of the patients were receiving any medication that could interfere with our assessment (e.g., antioxidants supplements, anti-inflammatory drugs, and antiobesity therapies).

Data were collected using a structured questionnaire, which included questions on demographic factors, such as gender, age, marital status, education attainment, employment status, and use of medication(s). A family history of coronary heart disease (CHD) was defined as a history of sudden death, myocardial infarction, or coronary revascularization in a relative before the age of 55 (males) or 65 (females). Smoking status was categorized as never smoker, exsmoker, or current smoker. To assess the physical activity, participants were asked to report the frequency of spending at least 20 min of continuous physical activity that was performed <1 time, 1–2 times, or at least 3 times/week.

Dietary intake was determined using a previously validated semiquantitative food frequency questionnaire (FFQ). For each food item, a commonly used portion size was specified, and the participants were asked how often, on average, he or she had consumed that quantity over the past year. Frequencies ranged from “never” to “two or more servings per day.” Nutrients intakes were calculated by multiplying the frequency of intake for each food by its nutrient content and summing nutrient contributions across all food items. Nutrient analysis was conducted using a software program incorporating the use of McCance and Widdowson’s Food composition tables editions with supplements.

To assess overall diet quality, the AHEI-2010 was used and scored as described in detail elsewhere. The criteria for scoring each component are listed in Table 1. The AHEI-2010 is based on 11 components: the ideal intake for six of these was set at the highest intake (Vegetables, fruit, whole grains, nuts and legumes, long-chain omega-3 fats [Docosahexaenoic acid and eicosapentaenoic acid], and polyunsaturated fatty acids), one component for which moderate intake was considered to be ideal (alcohol), and four components for which avoidance or lowest intake was considered to be ideal (sugar-sweetened drinks and fruit juice, red and processed meat, trans fat, and sodium). Each component is given a minimal score of 0 and a maximal score of 10, with intermediate values scored proportionally, and has the potential to contribute 0–10 points to the total score. All the component scores are summed to obtain a total AHEI-2010 score, which ranges from 0 to 100, with a higher score representing a healthier diet. Recommended HEI criteria classifies the diet quality with scores of 81 or higher as “good” scores, between 51 and 80 as “needs improvement,” and scores under 50 as “poor.”

Resting blood pressure was measured using an automated sphygmomanometer and was recorded as the average of three measurements taken 5 min apart with the participant sitting.

All anthropometric measures were carried out with participants wearing light clothing and with shoes removed. Height and
Table 1: Healthy Eating Index-2010 components and standards for scoring (Chiuve et al., 2012)

| Component                  | Optimum score | Standard for maximum score | Standard for minimum score of zero |
|----------------------------|---------------|----------------------------|-----------------------------------|
| Adequacy                   |               |                            |                                   |
| Total fruit                | 5             | ≥ 0.8 cup eq/1000 kcal     | No fruit                          |
| Whole fruit                | 5             | ≥ 0.4 cup eq/1000 kcal     | No whole fruit                    |
| Total vegetables           | 5             | ≥ 1.1 cup eq/1000 kcal     | No vegetables                     |
| Greens and beans           | 5             | ≥ 0.2 cup eq/1000 kcal     | No dark-green                     |
| Whole grains               | 10            | ≥ 1.5 oz eq/1000 kcal      | No whole grains                   |
| Dairy                      | 10            | ≥ 1.3 cup eq/1000 kcal     | No dairy                          |
| Total protein foods        | 5             | ≥ 2.5 oz eq/1000 kcal      | No protein foods                  |
| Seafood and plant proteins| 5             | ≥ 0.8 oz eq/1000 kcal      | No seafood or plant proteins      |
| Fatty acids                | 10            | PUFA + MUFAs/SFAs ≥2.5     | PUFA + MUFAs/SFAs ≤1.2            |
| Moderation                 |               |                            |                                   |
| Refined grains             | 10            | ≤ 1.8 oz eq/1000 kcal      | ≥ 4.3 oz eq/1000 kcal             |
| Sodium                     | 10            | ≤ 1.1 g/1000 kcal          | ≥ 2.0 g/1000 kcal                 |
| Empty calories             | 20            | ≤ 19% of energy            | ≥ 50% of energy                   |

Notes:
1. Includes 100% fruit juice,
2. Includes all forms except fruit juice,
3. Includes all beans and peas not counted as total protein foods.
4. Includes all milk products, such as fluid milk, yogurt, cheese, and fortified soy beverages.
5. Beans and peas are included here (and not with vegetables) when the total protein foods standard is otherwise not met.
6. Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as total protein foods.
7. Calories from solid fats, alcohol, and added sugars; threshold ≥50% of energy.
8. Calories from solid fats, alcohol, and added sugars; threshold ≥2.5 oz eq/1000 kcal.
9. Calories from solid fats, alcohol, and added sugars; threshold ≥0.8 cup eq/1000 kcal.
10. Includes any beans and peas not counted as total protein foods.
11. Includes all forms except fruit juice.
12. Includes all forms except fruit juice.
13. Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as total protein foods.

**Results**

Personal behavior and medical history characteristics of the study population are presented in Table 2. The mean ± standard deviation age of the cohort was 57.8 ± 5.0 years. About one-third of the cohort was overweight as categorized by BMI value between 25 and 29.9 kg/m². Obesity, both overall (59%), and central (97%), were highly prevalent among the 210 study participants included in this analysis. The case group and the age- and sex-matched controls were comparable with regard to anthropometric measures, socioeconomic status, and smoking habits except for their physical activity level. Nearly 73% of the controls were physically inactive compared to 70% of the cases who reported performing physical activity 1–2 times/week (P < 0.0001). Approximately, one-third of the participants had a family history of heart diseases, one-third of the participants had a family history of peripheral vascular disease, and two-thirds had a family history of diabetes mellitus.

The mean AHEI score and the proportion of patients in each group are shown in Table 3. Of all AHEI components, the highest mean subscore was obtained for fatty acids (9.2 ± 0.2) and sodium (9.5 ± 0.5). The lowest subscores were attributed to the refined grains (4.1 ± 0.2) and “empty calories” (5.6 ± 0.8). The mean AHEI score for the total sample was 58.3 ± 1.67. About half of the total sample was classified as having a poor diet (i.e., ≤50), with higher scores representing a healthier diet.

There were no significant differences across categories of AHEI score with respect to their CIMT values (P > 0.05). However, patients with higher CIMT values tended to be of lower AHEI category [Figure 1].

An inverse relationship between CIMT values and the mean scores of AHEI (r = 0.197, P < 0.01) and its components, namely adequacy (r = −0.143, P < 0.05) and moderation (r = −0.177, P < 0.05).

**Alissa, et al.: Food pattern and carotid intima-media thickness**

**Introduction**

Carotid intima-media thickness (CIMT) is an established index of subclinical atherosclerosis. It is considered a good measure of early vascular disease and1 a predictor of future cardiovascular events.2

**Methods**

This was used to define patients with subclinical atherosclerosis. A plaque was defined as a focal wall region with CIMT ≥0.9 mm, protruding into the lumen.

**Results**

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Discussion

The assessment of diet patterns may have a number of potential applications. For example, they may be used to assess how well people comply with dietary guidelines and to monitor trends in the population over time. They may also be used as predictors of disease or as a summary of dietary behaviors to investigate interactions with other health behaviors or confounding of other exposure-disease relationships.

Most previously published papers were conducted on apparently healthy young adults. Although there are some reports about dietary intakes of patients with CHD, there are few studies on the quality of diet and whole diet indices among these patients. A lack of understanding of dietary guidelines and the misconceptions about healthy versus unhealthy food choices are...
a major obstacle to implementing a healthy diet policy.\textsuperscript{25} In our study population, a lower AHEI score, which reflects an unhealthy dietary pattern, was associated with the presence of subclinical atherosclerotic disease, as estimated by CIMT ≥0.9 mm [Figure 1]. Consistent with previous large prospective follow-up studies that showed that there was a negative association between AHEI-2010 scores and cardiovascular diseases mortality was independent of BMI.\textsuperscript{26} The majority of our study population were considered to have a poor dietary pattern irrespective of whether they were obese, as assessed by overall and central obesity anthropometric measures [Table 2]. A negative smoking history was reported by over 90% of the study cohort; however, this might be subjective to reporting or recall bias.

No significant difference was found in dietary patterns of individuals with and without subclinical atherosclerotic disease ($P > 0.05$). Given that the majority of our study participants were of poor socioeconomic status, they are likely to be less aware of a healthy dietary pattern, and this may partly explain their low AHEI scores. The unhealthy dietary pattern being followed by the majority of our study group indicates that the future dietary guidelines should be developed and promoted to address such patients with chronic diseases with special dietary needs. The previous studies have reported little or no association between HEI and the risk of major chronic diseases in large cohorts of health professional men and women.\textsuperscript{26,27} However, it is strongly believed that diet may contribute to the correlation between AHEI-2010 scores and the prevalence of cardiovascular risk factors.\textsuperscript{28} Calorie intake differences by CIMT value may be a confounder in comparing AHEI index and its components.\textsuperscript{29}

In the present study, after the adjustments were made for age and energy intake, CIMT remained significantly inversely associated with AHEI and its components: adequacy and moderation. Moreover, there was no evidence supporting an association between CIMT and the individual components of the AHEI.

The AHEI-2010 supports a diet high in vegetables, fruit, whole grains, seafood, and legumes. This dietary pattern would contain carotenoids, ascorbic acids, phytochemicals, dietary fibers, omega-3 fatty acids, and other nutrients that are well-known to have cardioprotective effects.\textsuperscript{30,31} Thus, more effective policy interventions for combatting cardiovascular risk factors are required. It has long been proposed that “Western” dietary patterns, that are high in red meat, processed meat, refined grains, and high-fat dairy products, are associated with higher

| Table 3: Scores of Alternate Healthy Eating Index-2010 and its components among the study population ($n=210$) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| AHEI component                  | Score range     | Controls without subclinical atherosclerosis ($n=105$) | Cases with subclinical atherosclerosis ($n=105$) | $P$          |
| Total fruit                     | 0-5             | 3.24±0.1        | 3.43±0.1        | NS            |
| Whole fruit                     | 0-5             | 3.05±0.1        | 3.11±0.1        | NS            |
| Total vegetables                | 0-5             | 3.5±0.27        | 3.3±0.24        | NS            |
| Greens and beans                | 0-5             | 3.52±0.3        | 3.32±0.2        | NS            |
| Whole grains                    | 0-10            | 4.86±0.1        | 4.91±0.1        | NS            |
| Dairy                           | 0-10            | 6.86±0.3        | 6.79±0.3        | NS            |
| Total protein foods             | 0-5             | 3.45±0.03       | 3.42±0.04       | NS            |
| Seafood and plant proteins      | 0-5             | 2.04±0.1        | 1.31±0.1        | NS            |
| Fatty acids                     | 0-10            | 9.39±0.3        | 9.05±0.2        | NS            |
| Adequacy score                  | 0-60            | 39.8±1.9        | 38.5±1.8        | NS            |
| Refined grains                  | 0-10            | 4.71±0.2        | 3.56±0.2        | NS            |
| Sodium                          | 0-10            | 9.69±0.5        | 9.32±0.4        | NS            |
| Empty calories                  | 0-20            | 5.57±0.7        | 5.60±0.8        | NS            |
| Moderation score                | 0-40            | 19.9±1.1        | 18.4±1.1        | NS            |
| AHEI total score                | 0-100           | 59.7±2.4        | 56.9±2.3        | NS            |
| AHEI category                   | Good (scores ≥81) | 19 (18)          | 17 (15)         | NS            |
|                                | Needs improvement (scores: 51-80) | 41 (39)          | 42 (38)         |               |
|                                | Poor (scores ≤50) | 45 (43)          | 52 (47)         |               |

Numeric data are presented as mean±SD and categoric data as n (%). Continuous variables are compared by Mann–Whitney U test and categorical data are compared by χ² test. NS: Nonsignificant; AHEI: Alternate Healthy Eating Index; SD: Standard deviation.

![Figure 1: Error bars of 95% confidence intervals of mean values of carotid artery intima-media thickness among the study population ($n=210$) as classified according to their Alternate Healthy Eating Index category. Participants’ diets are categorized as “poor” (score ≤50), “needs improvement” (score from 51 to 80), and “good” (score ≥81)
coronary risk compared to the “healthy” dietary pattern rich in fruits, vegetables, fish, poultry, and whole grains.[32,33]

Additional quantitative quality indices have been developed for therapeutic diets such as the Mediterranean diet.[34] The current study provides important information that advances our understanding of dietary components impact over the prevention of clinical atherosclerotic disease. AHEI scores were evident of lower whole grains, seafood, and plant proteins consumption as well as higher fatty acids and sodium consumption in both study groups. AHEI components track the consumption of key nutrients that are associated with improved diet quality.[35]

Limitations of our study included the retrospective design, which cannot establish causality. The sample size was relatively small (n = 260). Our results cannot be generalized to the wider Saudi population since the study sample was not representative of the population at large. While FFQs are prone to greater measurement errors, their use allows a reasonable assessment of long-term diet.[36] Furthermore, the underreporting of calorie intake by overweight and obese individuals are likely to make our estimates of the association between HEI and CIMT more significant.

Conclusions

Adherence to a healthier diet, as reflected by a higher AHEI score, is associated with lower coronary risk, as estimated by CIMT value, independently from obesity and lifestyle factors. Future studies are warranted to determine the ability of the dietary score to predict the incidence of CVD end-points in longer-term follow-up.

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Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization. Diet, Nutrition and the Prevention of Chronic Diseases. Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series no. 916. Geneva: World Health Organization; 2013.
2. Georgousopoulou EN, Pitsavos C, Yannakoulia M, Panagiotakos DB. The role of dietary patterns' assessment in the predictive ability of cardiovascular disease risk estimation models: A review. Int J Food Sci Nutr 2014;65:3-8.
3. Gil A, Ruiz-Lopez MD, Fernandez-Gonzalez M, Martinez de Victoria E. The FINUT healthy lifestyles guide: Beyond the food pyramid. Adv Nutr 2014;5:358S-67S.
4. Alkerwi A. Diet quality concept. Nutrition 2014;30:613-8.
5. Kant AK. Dietary patterns and health outcomes. J Am Diet Assoc 2004;104:615-35.
6. Fransen HP, Ocké MC. Indices of diet quality. Curr Opin Clin Nutr Metab Card Nutr 2008;11:1559-65.
7. Willett WC, Green A, Stampfer MJ, Speizer FE, Colditz GA, Rosner B, et al. Relative and absolute excess risks of coronary heart disease among women who smoke cigarettes. N Engl J Med 1987;317:1309-9.
8. Shatenstein B, Nadon S, Godin C, Ferland G. Diet quality of montreal-area adults needs improvement: Estimates from a self-administered food frequency questionnaire furnishing a dietary indicator score. J Am Diet Assoc 2005;105:1251-60.
9. Chiuve SE, Fung TT, Rimm EB, Hu FB, McCullough ML, Wang M, et al. Alternative dietary indices both strongly predict risk of chronic disease. J Nutr 2012;142:1099-18.
10. Boggs DA, Rosenberg L, Rodriguez-Bernal CL, Palmer JR. Long-term diet quality is associated with lower obesity risk in young African American women with normal BMI at baseline. J Nutr 2013;143:1363-41.
11. Samieri C, Sun Q, Townsend MK, Chiuve SE, Okereke Ol, Willett WC, et al. The association between dietary patterns at midlife and health in aging: An observational study. Ann Intern Med 2013;159:584-91.
12. Reedy J, Krebs-Smith SM, Miller PE, Liede AD, Kahle LL, Park Y, et al. Higher diet quality is associated with decreased risk of all-cause, cardiovascular disease, and cancer mortality among older adults. J Nutr 2014;144:881-9.
13. Ministry of Health, Kingdom of Saudi Arabia. Dietary Guidelines for Saudis. Available from: http://www.moh.gov.sa/en/HealthAwareness/Pages/SaudihealthFoodGuide.aspx. Last accessed on 2016 May 07.
14. Torres N, Guevara-Cruz M, Velázquez-Villegas LA, Tovar AR, Nutrition and atherosclerosis. Arch Med Res 2015;46:408-26.
15. Stein JH, Korcarz CE, Hurst RT, Lonn E, Kendall CR, Mohler ER, et al. Use of carotid ultrasound to identify subclinical vascular disease and evaluate cardiovascular disease risk: A consensus statement from the American society of echocardiography carotid intima-media thickness task force. Endorsed by the society for vascular medicine. J Am Soc Echocardiogr 2008;21:93-111.
16. Satcher D, Lee P, Joyner F, McMillen T. Physical Activity and Health: A Report of the Surgeon General Executive Summary. United States: National Center for Chronic Disease Prevention and Health Promotion; 1996.
17. Alissa EM, Bahjri SM, Al-Ama N, Ahmed WH, Starkey B, Ferns GA, et al. Dietary Vitamin A may be a cardiovascular risk factor in a Saudi population. Asia Pac J Clin Nutr 2005;14:137-44.
18. Giovannucci E, Stampfer MJ, Colditz GA, Rimm EB, Willett WC. Relationship of diet to risk of colorectal adenoma in men. J Natl Cancer Inst 1992;84:91-8.
19. McCance RA, Widdowson EM, Holland B. McCance and
Widdowson’s: The Composition of Foods. 6th ed. London, UK: Her Majesty’s Stationery Office; 2002.

20. Butrum R, Chang F, Rao N, Polatchew W, Leung W. Food Composition Tables for Use in East Asia. National Institute of Health: US Department of Health, Education and Welfare and Food and Agriculture Organization of the United Nations; 1972.

21. Bowman LM, Gerrior SA, Basiotis PP. The Healthy Eating Index: 1994-96. Publication No. CNPP-5. Alexandria, VA: US Department of Agriculture, Center for Nutrition Policy and Promotion; 1998.

22. Park KA, Jo HM, Han JS, Kim MJ, Kwun do H, Park MY, et al. Features of atherosclerosis in hemodialysis patients. Kidney Res Clin Pract 2013;32:177-82.

23. Sutton-Tyrrell K, Lassila HC, Meilahn E, Bunker C, Matthews KA, Kuller LH, et al. Carotid atherosclerosis in premenopausal and postmenopausal women and its association with risk factors measured after menopause. Stroke 1998;29:1116-21.

24. D’Alessandro A, De Pergola G. Mediterranean diet and cardiovascular disease: A critical evaluation of A priori dietary indexes. Nutrients 2015;7:7863-88.

25. Lucini D, Zanuso S, Blair S, Pagani M. A simple healthy lifestyle index as a proxy of wellness: A proof of concept. Acta Diabetol 2015;52:81-9.

26. McCullough ML, Feskanch D, Rimm EB, Giovannucci EL, Ascherio A, Varyam JN, et al. Adherence to the dietary guidelines for Americans and risk of major chronic disease in men. Am J Clin Nutr 2000;72:1223-31.

27. McCullough ML, Feskanch D, Stampfer MJ, Rosner BA, Hu FB, Hunter DJ, et al. Adherence to the dietary guidelines for Americans and risk of major chronic disease in women. Am J Clin Nutr 2000;72:1214-22.

28. Cooper AJ, Sharp SJ, Lentjes MA, Luben RN, Khaw KT, Wareham NJ, et al. A prospective study of the association between quantity and variety of fruit and vegetable intake and incident type 2 diabetes. Diabetes Care 2012;35:1293-300.

29. Willett WC, Stampfer M. Implications of total energy intake for epidemiologic analyses. In: Willet W, editor. Nutritional Epidemiology. 2nd ed. New York: Oxford University Press; 1998. p. 273-301.

30. Ciccone MM, Scicchitano P, Gesualdo M, Zito A, Carbonara S, Ricci G, et al. The role of omega-3 polyunsaturated fatty acids supplementation in childhood: A review. Recent Pat Cardiovasc Drug Discov 2013;8:42-55.

31. Scicchitanoa P, Camelib M, Maielloc M, Modesti P, Muesan M, Novo S, et al. Nutraceuticals and dyslipidaemia: Beyond the common therapeutics. J Funct Foods 2014;6:11-32.

32. Hu FB, Rimm EB, Stampfer MJ, Ascherio A, Spiegelman D, Willett WC, et al. Prospective study of major dietary patterns and risk of coronary heart disease in men. Am J Clin Nutr 2000;72:912-21.

33. Fung TT, Willett WC, Stampfer MJ, Manson JE, Hu FB. Dietary patterns and the risk of coronary heart disease in women. Arch Intern Med 2001;161:1857-62.

34. Gerber M. Qualitative methods to evaluate mediterranean diet in adults. Public Health Nutr 2006;9:147-51.

35. Hann CS, Rock CL, King I, Drewnowski A. Validation of the healthy eating index with use of plasma biomarkers in a clinical sample of women. Am J Clin Nutr 2001;74:479-86.

36. Schatzkin A, Kipnis V, Carroll RJ, Midthune D, Subar AF, Bingham S, et al. A comparison of a food frequency questionnaire with a 24-hour recall for use in an epidemiological cohort study: Results from the biomarker-based observing protein and energy nutrition (OPEN) study. Int J Epidemiol 2003;32:1054-62.