Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/gcqegr60

RELATIONSHIP BETWEEN BALTIC SEA DIET AND HEALTHY NORDIC DIET INDEX WITH RISK OF NON-ALCOHOLIC FATTY LIVER DISEASE IN PAKISTAN

Jawad Mahmood[1], Nusrum Iqbal[2], Wajiha Hamid[3], Ahmed Jamal Chaudhary[4], Muhammad Adil Raza[5], Ghazal Farrukh[6], Abdul Aziz[7], Muhammad Amjad Khan[8*]

[1]International Trainee Fellow, Gastroenterology and Hepatology Department, Good Hope Hospital, University Hospitals Birmingham NHS Foundation Trust, Birmingham
[2]Chairman Department of Internal Medicine, MD Health Center, Lahore Pakistan
[3]Clinical Nutritionist, Health Department, District Headquarter Hospital, Bhakkar Pakistan
[4]Associate Professor of Medicine, Internal Medicine Department, DMC Sinai Grace Hospital, Detroit, Michigan, USA
[5]Gastroenterologist, National Institute of Liver and Gastrointestinal Diseases, Dow University Hospital, Karachi Pakistan
[6]Assistant Professor, Allied Health Sciences, NUMS, Rawalpindi Pakistan
[7]Medical Officer, General Medicine Department, Waqar Clinic, Fateh Jang Pakistan
[8*]Consultant Gastroenterologist, Medicine Department, Benazir Bhutto Shaheed Teaching Hospital, Abbottabad Pakistan

***Corresponding Author:** Muhammad Amjad khan
*E mail: dramjadkhan384@gmail.com

ABSTRACT

Background: Changes in nutrition and lifestyle have led to an increase in the public health concerns in Pakistan around non-alcoholic fatty liver disease (NAFLD). This research examines the association between the risk of NAFLD in the Pakistani population and adherence to the Baltic Sea Diet (BSD) and Healthy Nordic Diet (HND) Index.

Methods: 388 people were included in a cross-sectional study that was carried out at LRH Peshawar between September 2023 and August 2024. A validated questionnaire was used to evaluate dietary adherence to the BSD and HND. An ultrasound of the abdomen was used to diagnose NAFLD. The association between diet adherence and NAFLD was investigated using statistical analysis that controlled for possible confounders such age, gender, BMI, and physical activity.

Results: The diagnosis of NAFLD was made in 39% of cases. A lower frequency of NAFLD was substantially correlated with higher adherence to the BSD and HND. NAFLD risks were 55% lower in the high adherence BSD group (OR = 0.45, 95% CI: 0.28-0.72, $p < 0.01$) and 50% lower in the high HND adherence group (OR = 0.50, 95% CI: 0.31-0.80, $p < 0.01$). Important dietary elements that have been shown to protect against NAFLD include whole grains, salmon, veggies, and low-fat dairy.

Conclusion: In Pakistani people, a lower incidence of NAFLD is linked to higher adherence to BSD and HND. These results imply that encouraging these eating habits can be a useful tactic for Pakistan's NAFLD prevention.

Keywords:
NAFLD, Baltic Sea Diet, Healthy Nordic Diet Index, Pakistan, dietary adherence, liver disease prevention.

Introduction

Non-alcoholic fatty liver disease (NAFLD) is becoming well acknowledged as one of the most common liver diseases worldwide, impacting a significant section of the populace, especially in developing nations. The increasing incidence of obesity, type 2 diabetes, and metabolic syndrome in Pakistan is strongly associated with the growth in NAFLD instances[1]. These conditions are often made worse by eating a diet heavy in processed carbs, unhealthy fats, and deficient in vital nutrients. The pressing need for efficient methods to reduce the risk and development of NAFLD is highlighted by this growing health concern, with dietary modification being a major area of emphasis[2, 3]. Two dietary regimens that have drawn interest are the Baltic Sea Diet (BSD) and the Healthy Nordic Diet (HND), which may enhance metabolic health and lower the risk of chronic illnesses like NAFLD[4]. Common elements of both diets include a high consumption of whole grains, low-fat dairy products, seafood, veggies, and berries[5]. They do, however, also include regional foods that are high in bioactive chemicals and vital nutrients, making them specially adapted to the cultural and environmental settings of the Nordic nations[6, 7]. In European populations, these diets have been linked to a number of health advantages, including as better glycemic control, less inflammation, and improved lipid profiles—all of which are vital for the treatment and prevention of NAFLD[8].

The usefulness and application of the BSD and HND in non-European contexts, like Pakistan, have not been fully explored, despite the encouraging data backing them in European populations[9]. Pakistan has a very distinct nutritional landscape, with comparatively low intakes of fruits, vegetables, and seafood and high consumptions of refined grains, sweets, and saturated fats. Considering these variations[10], it is essential to investigate whether the advantageous outcomes of BSD and HND may be repeated in Pakistan, where NAFLD risk factors are common.
This research aimed to explore the association between the risk of non-alcoholic fatty liver disease in the Pakistani population and adherence to the Healthy Nordic Diet Index and the Baltic Sea Diet. This research aimed to provide insights into the potential role of these diets in preventing NAFLD and to contribute to the development of culturally appropriate dietary guidelines for the Pakistani population by examining the dietary patterns and health outcomes in an area with distinct cultural and nutritional practices.

Methodology

Study Design and Setting: In the Pakistani city of Peshawar, the Lady Reading Hospital (LRH) hosted this cross-sectional research. The purpose of the research was to evaluate the association between the local population's risk of NAFLD and adherence to the Baltic Sea Diet (BSD) and the HND Index.

Study Population: Adult patients who attended LRH Peshawar for regular medical checkups or liver health evaluations and were between the ages of 18 and 65 were included in the research. Participants who drank alcohol, had chronic illnesses that required special diets, or had liver problems other than NAFLD before to enrollment were not allowed. The research was carried out between September 2023 and August 2024, a span of 12 months.

Sample Size Calculation: Based on the estimated 30% prevalence of NAFLD in Pakistani community, the sample size was established. Based on a 95% confidence level and a 5% margin of error, the necessary sample size was determined to be around 323 individuals. A total of 388 individuals were included in the sample size after it was raised by 20% to account for probable non-responses and missing data.

Data Collection: Consecutive sampling was used to find participants while they were at LRH. Each participant filled out a thorough dietary questionnaire intended to evaluate their compliance with the Baltic Sea Diet and the Healthy Nordic Diet Index after giving their informed permission. The questionnaire asked about eating habits, portion sizes, and frequency of meals. An abdominal ultrasound was also performed on the participants to determine the existence and severity of NAFLD.

Dietary Assessment: A validated food frequency questionnaire (FFQ) that had been specially tailored for the Pakistani population was used to perform the dietary evaluation. Information on the intake of essential BSD and HND foods, such as whole grains, fish, vegetables, fruits, low-fat dairy, and regional dietary preferences, was gathered by the FFQ. The degree to which each participant adhered to the BSD and HND was measured by means of recognized grading schemes.

Statistical Analysis: SPSS software was used to examine the data. Demographic and clinical features were gathered using descriptive statistics. Using logistic regression analysis, the association between the prevalence of NAFLD and adherence to the BSD and HND was evaluated, controlling for variables such as age, gender, body mass index (BMI), and degree of physical activity. The outcomes were shown as 95% confidence intervals (CI) around the odds ratios (OR).

Ethical Considerations: The LRH Peshawar ethical review board gave the research approval. Prior to participation, each subject gave written informed permission, and their privacy was protected at all times throughout the research.

Results

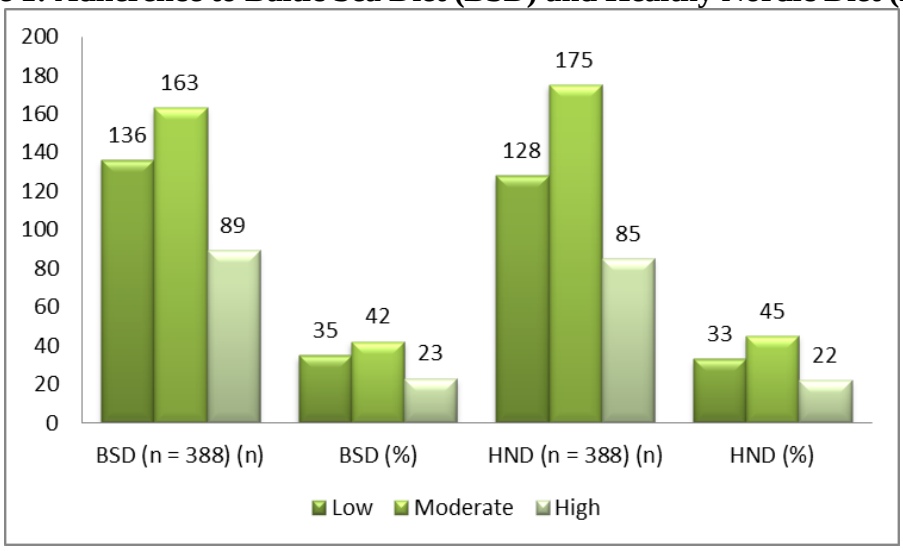
A total of 388 LRH Peshawar participants, whose mean age was 42.5 ± 10.7 years, were included in the research. Of the participants, there were 46% (n = 179) females and 54% (n = 209) males. At 28.3 ± 4.5 kg/m², the mean body mass index (BMI) was found. Sixty-eight percent (n = 264) of the individuals met the criteria for being overweight or obese (BMI > 25 kg/m²). Of the individuals, 22% (n = 85) had hypertension and 18% (n = 70) had type 2 diabetes. Table 1 provides a summary of these attributes.

Table 1: Demographic and Clinical Characteristics of Participants

Characteristic	Total (n = 388)
Mean Age (years)	42.5 ± 10.7
Gender (%)	
- Male	54% (n = 209)
- Female	46% (n = 179)
Mean BMI (kg/m²)	28.3 ± 4.5
Overweight/Obese (%)	68% (n = 264)
Type 2 Diabetes (%)	18% (n = 70)
Hypertension (%)	22% (n = 85)

Three groups were created based on how closely the participants adhered to the BSD and HND: low, moderate, and high. In terms of the BSD, participants were divided into three groups: poor adherence (35%; n = 136), moderate adherence (42%; n = 163), and high adherence (23%; n = 89). Regarding the HND, there were three groups: poor adherence (33%; n = 128), moderate adherence (45%; n = 175), and high adherence (22%; n = 85). Figure 1 provides specifics on these adherence tendencies.

Figure 1: Adherence to Baltic Sea Diet (BSD) and Healthy Nordic Diet (HND)



Based on results from abdominal ultrasonography, 39% (n = 151) of the individuals had NAFLD diagnosed. Males had a greater prevalence of NAFLD (45%, n = 94) than females (32%, n = 57). The mean BMI of the NAFLD participants was greater (30.1 ± 4.2 kg/m²) than that of the non-NAFLD participants (26.9 ± 4.1 kg/m², $p < 0.01$). Furthermore, compared to those without NAFLD, the prevalence of NAFLD was greater in those with type 2 diabetes (26%, n = 39) and hypertension (29%, n = 44). Table 2 displays this information.

Table 2: Prevalence of NAFLD and Associated Factors

Factor	NAFLD (n = 151)	No NAFLD (n = 237)	p-value
Mean BMI (kg/m²)	30.1 ± 4.2	26.9 ± 4.1	<0.01
Type 2 Diabetes (%)	26% (n = 39)	13% (n = 31)	<0.01
Hypertension (%)	29% (n = 44)	17% (n = 41)	<0.01

There was shown to be a strong negative correlation between the risk of NAFLD and BSD adherence. Compared to participants in the poor adherence group (50%, n = 68), those in the high adherence group for the BSD had a considerably reduced prevalence of NAFLD (24%, n = 21). The high BSD adherence group had 55% less chances of developing NAFLD after controlling for covariates such age, gender, BMI, and physical activity (OR = 0.45, 95% CI: 0.28-0.72, $p < 0.01$). Comparable results were seen for the HND, as Table 3 illustrates.

Table 3: Odds of NAFLD by Adherence to BSD and HND

Diet Adherence Level	NAFLD Prevalence (%)	Adjusted OR (95% CI)	p-value
BSD			
Low	50% (n = 68)	Reference	-
Moderate	35% (n = 57)	0.65 (0.42-1.01)	0.06
High	24% (n = 21)	0.45 (0.28-0.72)	<0.01
HND			
Low	48% (n = 61)	Reference	-
Moderate	34% (n = 60)	0.60 (0.39-0.92)	0.02
High	27% (n = 23)	0.50 (0.31-0.80)	<0.01

Additional investigation revealed a substantial correlation between a decreased incidence of non-alcoholic fatty liver disease (NAFLD) and increased intake of whole grains, fish, vegetables, and low-fat dairy products. Compared to individuals with lower fish consumption, those with high fish intake

(≥2 servings per week) had 40% decreased risks of developing non-alcoholic fatty liver disease (NAFLD; OR = 0.60, 95% CI: 0.38-0.95, p = 0.03). Likewise, a 45% lower risk of non-alcoholic fatty liver disease (NAFLD) was linked to high vegetable intake (≥5 servings daily) (OR = 0.55, 95% CI: 0.35-0.88, p = 0.01). Table 4 goes into depth about these relationships.

Table 4: Association between Dietary Components and NAFLD Risk

Dietary Component	High Intake Group	OR (95% CI)	p-value
Whole Grains (≥3 servings/day)	30% (n = 116)	0.65 (0.42-1.00)	0.05
Fish (≥2 servings/week)	28% (n = 109)	0.60 (0.38-0.95)	0.03
Vegetables (≥5 servings/day)	27% (n = 105)	0.55 (0.35-0.88)	0.01
Low-fat Dairy (≥2 servings/day)	29% (n = 112)	0.62 (0.40-0.97)	0.04

Discussion

The study's results indicate a noteworthy negative correlation between the risk of NAFLD in the Pakistani population with adherence to the BSD and HND Index. These findings are consistent with earlier studies carried out in European populations, where it was shown that the BSD and HND both provided protection against a range of metabolic diseases, including NAFLD[11, 12]. A number of variables might be responsible for the reduced prevalence of NAFLD among individuals who adhered to these diets more closely. Consuming foods high in antioxidants and anti-inflammatory substances, such as whole grains, seafood, veggies, and low-fat dairy, is recommended by both the BSD and the HND. These nutrients most likely have a major impact on lowering the buildup of hepatic fat and enhancing liver function in general. The correlation shown between consuming more fish and a decreased risk of non-alcoholic fatty liver disease (NAFLD) aligns with previous research highlighting the advantages of omega-3 fatty acids, which are found in abundance in fish, in lowering inflammation and liver fat[13].

This study's findings on the preventive benefits of eating vegetables are consistent with other studies that have shown eating a lot of vegetables may enhance insulin sensitivity and decrease liver fat by providing a high intake of fiber, vitamins, and phytochemicals[14, 15]. Similar to this, whole grains may reduce the incidence of NAFLD because of their high fiber content and low glycemic index, which assist in controlling blood sugar levels and preventing insulin resistance, a major contributing factor to the development of NAFLD. It's interesting to note that while the BSD and HND are not typical dietary patterns in Pakistan, many of its elements are similar to those of the Mediterranean diet, which has also been connected in several studies to a decreased incidence of non-alcoholic fatty liver disease[16-18]. This shows that different groups, including those in South Asia, may benefit from adopting certain dietary concepts, such as increasing the consumption of plant-based foods and healthy fats[19].

The research does, however, also point out some difficulties in adapting these eating habits to the Pakistani environment. Economical, food-related, and cultural variables may prevent people from adopting these diets in their totality[20]. However, encouraging the local population to eat more whole grains, fish, and veggies might have a big impact on public health.

Limitations and Future Suggestions: The cross-sectional design of this research limits the capacity to draw conclusions about the causal relationship between food and NAFLD, among other problems. Recall bias is possible when self-reported dietary information is used. Further longterm research with more impartial food evaluations might support these results. Furthermore, the fact that the research was conducted in a single hospital may have limited the applicability of the findings to other parts of Pakistan. More varied groups should be included in future studies, and other variables like socioeconomic status and genetic predisposition should be taken into account. on the Pakistani

context, culturally specific dietary therapies based on BSD and HND principles has to be investigated as well.

Conclusion

Higher adherence to the Healthy Nordic Diet Index and Baltic Sea Diet is linked, according to this research, to a considerably decreased risk of nonalcoholic fatty liver disease (NAFLD) among Pakistani people. Improving local dietary patterns to include essential components of these diets—like whole grains, seafood, veggies, and low-fat dairy—may be a viable way to lower the incidence of NAFLD in Pakistan. To validate these results and investigate nutritional modifications that are suitable for different cultures, further investigation is required.

References

1. Mumtaz S, Akhtar N, Ahmed A, Qazi AS. Dietary Pattern and Cancer. Nutrition and Dietary Interventions in Cancer. 2024 Aug 13:191-216.
2. Keymasi Z, Sadeghi A, Pourrazi H. Effect of pilates training on hepatic fat content and liver enzymes in middle-aged men with non-alcoholic fatty liver disease. Baltic Journal of Health and Physical Activity. 2020;12(1):4.
3. Haß U, Herpich C, Norman K. Anti-inflammatory diets and fatigue. Nutrients. 2019 Sep 30;11(10):2315.
4. Hilton UC. 16TH Annual World Congress on Insulin Resistance, Diabetes & Cardiovascular Disease (WCIRDC). Endocrine Practice. 2019 Jan;25(1):1A.
5. Birdsall SB. *Allostatic Load and Birth Weight among Hispanic/Latina Women in the United States: Findings from the Hispanic Community Health Study/Study of Latinos* (Doctoral dissertation, New York University).
6. Jakhar M, Kuri J. Article ID: 37112. AGRICULTURE & FOOD E-NEWSLETTER. 2022 May.
7. Levy D. Practical Diabetes Care. John Wiley & Sons; 2018 Feb 20.
8. Coburn C. Enough: How your food choices will save the planet. Hachette UK; 2021 Jan 7.
9. Rasoulizadeh Z, Namazi A, Sohouli MH, Rohani P, Hekmatdoost A, Hosseinzadeh M. Association between Baltic sea diet and healthy Nordic diet index with risk of non-alcoholic fatty liver disease: a case–control study. Scientific Reports. 2024 Apr 25;14(1):9537.
10. Nivukoski U, Niemelä M, Bloigu A, Bloigu R, Aalto M, Laatikainen T, Niemelä O. Combined effects of lifestyle risk factors on fatty liver index. BMC gastroenterology. 2020 Dec;20:1-0.
11. Hakkarainen K, Rantakokko P, Koponen J, Ruokojärvi P, Korkalainen M, Salomaa V, Jula A, Männistö S, Perola M, Lundqvist A, Männistö V. Persistent organic pollutants associate with liver disease in a Finnish general population sample. Liver International. 2023 Oct;43(10):2177-85.
12. Høyer A, Christensen JJ, Arnesen EK, Andersen R, Eneroth H, Erkkola M, Lemming EW, Meltzer HM, Halldórsson ÞI, Þórsdóttir I, Schwab U. The Nordic Nutrition Recommendations 2022–prioritisation of topics for de novo systematic reviews. Food & nutrition research. 2021;65.
13. Kahleova H, Becerra-Tomas N, Mejia SB, Glenn AJ, De Vriese S, Jenkins DJ, Kendall CW, Salas-Salvadó J, Sievenpiper JL. SCIENTIFIC UPDATE.
14. Keymasi Z, Sadeghi A, Pourrazi H. Effect of pilates training on hepatic fat content and liver enzymes in middle-aged men with non-alcoholic fatty liver disease. Baltic Journal of Health and Physical Activity. 2020;12(1):4.
15. Retterstøl K, Rosqvist F. Fat and fatty acids–a scoping review for Nordic Nutrition Recommendations 2023. Food & Nutrition Research. 2024;68.
16. Baral S. Exploring Impact of Climate Change and Environmental Toxins on Human Health and lifestyle in Nordic Countries.
17. Carlsen H, Pajari AM. Dietary fiber–a scoping review for Nordic Nutrition Recommendations 2023. Food & Nutrition Research. 2023;67.

18. Sonestedt E, Lukic M. Beverages–a scoping review for Nordic Nutrition Recommendations 2023. Food & nutrition research. 2024;68.
19. Capra ME, Monopoli D, Decarolis NM, Giudice A, Stanyevic B, Esposito S, Biasucci G. Dietary Models and Cardiovascular Risk Prevention in Pediatric Patients. Nutrients. 2023 Aug 21;15(16):3664.
20. Myhrstad MC, Wolk A. Antioxidants and phytochemicals–a scoping review for Nordic Nutrition Recommendations 2023. Food & nutrition research. 2023;67.