



Diet Quality as a Determinant of Physical Activity, Sleep Patterns, and Quality of Life in Young Adults

*Pinar Hamurcu

Department of Nutrition and Dietetics, Faculty of Health Sciences, Istinye University, Istanbul, Türkiye

*Correspondence: Email: pinarham@gmail.com

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Abstract

Background: This study aimed to examine the relationship between nutritional status assessed by the diet quality index with physical activity, sleep, and quality of life among young adults.

Methods: This descriptive, cross-sectional research utilized a sample of 700 university students enrolled in the 2021–2022 academic year at a private university's Faculty of Health Sciences in Istanbul, Türkiye. Data were collected using face-to-face interviews with Information Form, Pittsburgh Sleep Quality Index (PSQI), International Physical Activity Questionnaire (IPAQ), World Health Organization Quality of Life-Short Form-Turkish Version (WHOQOL-BREF-TR) and 24-Hour Food Consumption Record. The dietary quality of the participants assessed via Diet Quality Index-International (DQI-I).

Results: The study revealed inadequate diet quality among young adults, with a mean DQI-I score of 33.08 ± 7.03 . According to PSQI assessment, 85.3% of them had impoverished sleep quality, and according to IPAQ assessment, 23.3% of them were physically inactive. In comparing participants' characteristics with DQI-I, a positive correlation observed between age and both DQI-I-Total ($P=0.017$) and Variety sub-dimension ($P=0.027$). Furthermore, statistically significant differences identified between Moderation sub-dimension and economic situation ($P=0.032$), as well as between Variety sub-dimension and sleep duration ($P=0.044$). No statistically significant association found between diet quality and either sleep quality or physical activity levels ($P>0.05$). However, a significant relationship observed solely between Variety sub-dimension and social relationship sub-dimension of WHOQOL-BREF-TR ($P=0.033$).

Conclusion: This study observed a significant correlation between dietary diversity and quality of life, whereas no significant correlation observed between diet quality and sleep quality, physical activity level, or quality of life.

Keywords: Nutrition; Dietary pattern; Physical activity; Sleep quality; Quality of life

Introduction

According to the WHO, health is not merely the absence of illness or disability but complete physical, mental, and social well-being. Maintaining individual health is essential for a well-being society

(1). Healthy lifestyle behaviors, such as diet, physical activity, sleep routine, personal health responsibility, and stress management, are modifiable risk factors linked to mental and physical health and overall quality of life (2).



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Non-communicable diseases are the main cause of early death in low- and middle-income countries (3). The rapid dissemination of evidence-based research and epidemiological studies in recent years has contributed to clarifying the role of healthy nutrition in preventing morbidity and mortality caused by non-communicable diseases (4,5). Globally, diet-related risk factors are a major cause of ill health and mortality, highlighting the importance of monitoring diet quality. Diet quality includes a balanced, diverse, and sustainable diet providing essential nutrients and energy for growth and a healthy lifestyle (1).

Diet, physical activity, and adequate sleep help prevent weight gain and chronic diseases, but require long-term adherence for benefits (6). A study comparing traditional (such as non-smoking, physical activity, and healthy diet) and non-traditional (such as sleeping for 7 to 8 hours per day, reduced sedentariness, and strong social network) health behaviors in older adults found that engaging in physical activity, reducing sedentariness, and obtaining sufficient sleep were linked to an enhanced health-related quality of life (7).

During the university period, which is characterized by various significant changes such as physical development, adaptation, homesickness, future anxiety, new roles, financial stress, and cultural diversity, a healthy diet is often deprioritized. Since these habits may affect quality of life and persist into adulthood, young adults are a key target for nutrition education. These changes may affect individuals, their families, and society, making intervention essential. Therefore, this study aimed to examine the relationship between diet quality with physical activity, sleep, and quality of life among young adults.

Materials and Methods

This cross-sectional, descriptive study was conducted in the 2021-2022 academic year at a private university's Faculty of Health Sciences, comprising a population of 3800 university students in Istanbul, Türkiye. The calculated sample size was 378 students (95% confidence interval, 5% margin

of error). The study sample consisted of 700 university students.

Ethical approval was obtained from Uskudar University Non-Interventional Research Ethics Committee with the number 61351342/2021-63 on 30.12.2021. Information about the purpose of the study was provided to the participants, and "Voluntary Participation Consent" was obtained. This research was conducted in accordance with the "Helsinki Declaration Principles" and "Research and Publication Ethics".

The inclusion criteria for the study were being 18 years of age or older and having no health problems that could prevent understanding of what is read. Exclusion criteria were not meeting the inclusion criteria and having special conditions such as pregnancy or lactation.

Data Collection

Data were collected through face-to-face interviews.

Information Form includes 7 self-report questions on age, gender, anthropometrics, health, physical activity, sleep, and income levels.

Pittsburgh Sleep Quality Index (PSQI) is a self-reported seven subscales and 19-item scale developed by Buysse et al. (1989) to assess sleep quality and disturbance over the past month. The Turkish validity and reliability study of the PSQI was conducted by Ağargün et al. (1996). A PSQI total score <5 indicates "good" sleep quality, ≥ 5 indicates "poor" sleep quality (8).

International Physical Activity Questionnaire (IPAQ) was developed in 1998 to monitor physical activity status based on a global standard. In this study, the Turkish validity and reliability study employed the IPAQ-Short Form consisting of seven questions. This form covers walking, moderate/vigorous activities, and sitting time. MET (Metabolic Equivalent of Task) expresses resting oxygen need. Scores are calculated by multiplying duration and frequency by MET value, resulting in

MET-minutes/week. Based on these scores, individuals are classified as “physically inactive” (MET-minutes/week <600), “minimally active” (MET-minutes/week = 600-3000), or “highly active” (MET-minutes/week >3000) (9).

Turkish Version of the WHO Quality of Life Scale - Short Form (WHOQOL-BREF-TR) was developed by WHO, the WHOQOL-BREF includes four sub-dimensions and 26 questions assessing perceived quality of life. Eser et al. (1999) validated the scale in Turkish. An additional national item expanded the WHOQOL-BREF-TR to 27 questions. Higher scores reflect better quality of life; each domain is calculated from its specific items (10).

Diet Quality Index-International (DQI-I) was developed by Kim et al. (2003) to assess links between chronic diseases and diet, and to evaluate inadequate/excessive nutrient intake (11). DQI-I allows international monitoring and comparison of diet quality. DQI-I is evaluated through four components: Variety (0-20 points) is evaluated through two subcategories: Overall Food Group Variety (meat/poultry/fish/eggs; dairy/beans; grain; fruit; vegetable) and Within-Group Variety For Protein Source (meat, poultry, fish, dairy, beans, eggs). Adequacy (0-40 points) evaluates the intake of nutrients (protein, fiber, iron, calcium, vitamin C, and fruit, vegetable, grain groups) based on the Recommended Dietary Allowances (RDA), aiming to prevent malnutrition and nutrient deficiencies. Moderation (0-30 points) evaluates the intake of nutrients and foods (total fat, saturated fat, cholesterol, sodium, and empty calorie foods) due to their association with chronic diseases. Overall Balance (0-10 points) assesses macronutrient (carbohydrate: protein: fat) and fatty acid (PUFA:MUFA:SFA) ratios. DQI-I total score ranges from 0 to 100. Scores ≤ 60 indicate “poor diet quality”, while scores > 60 indicate “good diet

quality”. DQI-I is assessed using 24-hour dietary recall data (11).

Energy and nutrient values (carbohydrates, protein, fat, vitamins, minerals) of the foods consumed by individuals within a 24-hour period were analyzed using the full version of the “Computer-Assisted Nutrition Program, Nutrition Information System (BeBIS) 9 Package Program 2021”.

Statistical analysis

Demographic characteristics were analyzed using descriptive statistics. Frequency and percentage were utilized to present categorical variables, while normality of numerical variables was assessed with the Shapiro-Wilk Test. Normally distributed data were presented as mean $\pm$ standard deviation, and non-normally distributed data as median (min-max). The Mann-Whitney U Test compared two independent groups with non-normal distributions, and the Kruskal-Wallis H Test compared more than two groups. Medians were annotated with letter notation for multiple comparisons. Spearman's Rank Correlation Coefficient, a non-parametric method measuring the relationship between two variables, analyzed the associations between the scales. The analysis was performed using SPSS v26 software (IBM Inc., Chicago, IL, USA).

Results

The study included 700 university students, 86% of whom were female. Students' mean age was 21.47 ± 3.74 years, body mass index was (BMI) 21.86 ± 3.49 kg/m², and daily sleep duration was 7.50 ± 1.37 hours. Of the participants, 57.4% reported income to be sufficient for expenses, 58.1% rated health as “good”, 15.7% reported physical activity level as “poor”, and 16% reported sleep quality as “poor” as shown in Table 1. Summary statistics of DQI-I scores as shown in Table 2.

Table 1: Descriptive statistics of demographic, health, physical activity, and sleep findings of young adults

Characteristic	n	%
Gender		
Male	98	14.0
Female	602	86.0
Years ($\bar{X} \pm sd$)	21.47 $\pm$ 3.74	
BMI ($\bar{X} \pm sd$)	21.86 $\pm$ 3.49	
Underweight (<18.5 kg/m ²)	98	14.0
Normal (18.5-24.9 kg/m ²)	505	72.1
Overweight (25-29.9 kg/m ²)	67	9.6
Obese ($\geq$ 30 kg/m ²)	30	4.3
Economic Situation		
Income<expenses	140	20.0
Income=expenses	401	57.4
Income>expenses	158	22.6
Self-Assessment of Health Status		
Good	407	58.1
Moderate	276	39.5
Poor	17	2.4
Self-Assessment of Physical Activity Level		
Good	166	23.7
Moderate	424	60.6
Poor	110	15.7
Sleep Duration	7.50 $\pm$ 1.37	
<7 hour	173	24.7
7-9 hour	401	57.3
>9 hour	126	18.0
Self-Assessment of Sleep Quality		
Good	195	27.9
Moderate	393	56.1
Poor	112	16.0
TOTAL	700	100.0

BMI: Body Mass Index

Table 2: Summary statistics of DQI-I Scores

Variable	Score Range	$\bar{X} \pm sd$
DQI-I Total	0-100	33.08 $\pm$ 7.03
Variety	0-20	10.66 $\pm$ 4.06
-Overall food group variety	0-15	6.56 $\pm$ 3.10
-Within-group variety for protein source	0-5	4.10 $\pm$ 1.30
Adequacy	0-40	13.12 $\pm$ 5.27
-Vegetable group	0-5	0.93 $\pm$ 1.49
-Fruit group	0-5	0.61 $\pm$ 1.32
-Grain group	0-5	0.04 $\pm$ 0.35

Table 2: Continued...

-Fiber	0-5	1.49±1.46
-Protein	0-5	4.90±0.48
-Iron	0-5	1.01±1.52
-Calcium	0-5	1.45±1.50
-Vitamin C	0-5	2.69±2.05
<u>Moderation</u>	0-30	8.99±5.00
-Total Fat	0-6	0.31±1.07
-Saturated Fat	0-6	0.26±1.03
-Cholesterol	0-6	4.01±2.47
-Sodium	0-6	3.92±2.45
-Empty calorie foods	0-6	0.49±1.41
<u>Overall Balance</u>	0-10	0.30±1.03
-Macronutrient ratio	0-6	0.09±0.66
-Fatty acid ratio	0-4	0.21±0.74

DQI-I: Diet Quality Index-International

The PSQI assessment revealed that 85.3% of students had poor sleep quality, and the IPAQ assessment showed that 23.3% were physically

inactive. Summary statistics of WHOQOL-BREF-TR are presented in Table 3.

Table 3: Descriptive and summary statistics of data collection tools

Variable	N	%
PSQI Total ($\bar{X} \pm sd$)	7.81±3.22	
Good Sleep Quality	103	14.7
Poor Sleep Quality	597	85.3
IPAQ Total ($\bar{X} \pm sd$)	3639.99±3907.03	
Inactive	163	23.3
Minimally Active	191	27.3
Highly Active	346	49.4
WHOQOL-BREF-TR		
Physical Health Domain	68.73±17.07	
Psychological Domain	58.38±17.00	
Social Relationships Domain	62.17±19.04	
Environment Domain	61.61±13.89	

PSQI: The Pittsburgh Sleep Quality Index; IPAQ: The International Physical Activity Questionnaire; WHOQOL-BREF-TR: Turkish Version of the World Health Organization Quality of Life Scale-Short Form

It was determined that gender, BMI, income status, and daily sleep duration were not distinguishing factors for the total DQI-I score. However, when the subscales of DQI-I were examined, statistically significant differences were observed for male students in terms of the Adequacy score median compared to female students ($P=0.016$), for students who reported their income as being above their expenses in terms of the Moderation

score median compared to other students ($P=0.032$), and for students with less than 7 hours of sleep in terms of the Adequacy score median compared to students with more than 9 hours of sleep ($P=0.044$). Additionally, significant positive correlations were found between students' ages and both the total DQI-I score and the Diversity score, with very weak correlations ($s=0.090$ and $s=0.084$, respectively; $P<0.05$).

Specifically, as students' ages increased, the DQI-I total score and the Diversity score increased by

9% and 8.4%, respectively as shown in Table 4.

Table 4: Comparison of DQI-I total and subscale scores based on young adults' demographic, health, physical activity, and sleep findings

Variable		DQI-I Total	Variety	Adequacy	Moderation	Overall Balance
		Median (min-max)	Median (min-max)	Median (min-max)	Median (min-max)	Median (min-max)
Gender						
Male		33 (20-60)	11 (4-20)	15 (2.5-27.5)	9 (0-24)	0 (0-4)
Female		32.5 (13-54.5)	11 (0-20)	12.5 (2.5-27.5)	9 (0-27)	0 (0-10)
U		26808.5	27120.5	25069	27000.5	29214.5
p		0.147	0.193	0.016*	0.169	0.772
Years (X$\pm$sd)	s	0.090	0.084	0.033	0.009	-0.011
	p	0.017*	0.027*	0.380	0.805	0.766
Economic Situation						
Income<expenses		32.5 (18.5-49)	11 (4-20)	12.5 (2.5-27.5)	9 ^a (0-24)	0 (0-6)
Income=expenses		32.5 (13-54.5)	11 (0-20)	12.5 (2.5-27.5)	9 ^a (0-27)	0 (0-10)
Income>expenses		33.75 (17-60)	11 (4-20)	15 (5-27.5)	12 ^b (0-24)	0 (0-8)
H		2.523	0.621	0.433	6.880	3.310
p		0.283	0.733	0.805	0.032*	0.191
BMI						
Underweight		32.5 (17-52)	11 (4-20)	12.5 (2.5-25)	9 (0-18)	0 (0-6)
Normal		33 (13-54.5)	11 (3-20)	12.5 (2.5-27.5)	9 (0-27)	0 (0-10)
Overweight		33 (22-60)	11 (4-17)	15 (2.5-22.5)	9 (0-24)	0 (0-4)
Obese		32 (20.5-42.5)	9 (0-20)	12.5 (5-25)	9 (0-18)	0 (0-2)
H		1.504	4.274	2.112	0.883	1.966
p		0.681	0.233	0.549	0.829	0.579
Self-Assessment of Health Status						
Good		33 (13-60)	11 (3-20)	12.5 (2.5-27.5)	9 (0-27)	0 (0-10)
Moderate		33 (18-52.5)	11 (0-20)	12.5 (2.5-27.5)	9 (0-24)	0 (0-6)
Poor		33.5 (21-43.5)	11 (4-20)	12.5 (5-22.5)	9 (0-15)	0 (0-4)
H		0.127	1.406	0.365	1.877	0.071
p		0.938	0.495	0.833	0.391	0.965
Sleep Duration						
<7 hour		33.5 (19-54.5)	11 (3-20)	15 ^b (2.5-27.5)	9 (0-27)	0 (0-4)
7-8 hour		32.5 (18-53.5)	11 (0-20)	12.5 ^{ab} (2.5-27.5)	9 (0-24)	0 (0-6)
8-9 hour		33 (20-52.5)	11 (4-17)	12.5 ^{ab} (2.5-25)	9 (0-24)	0 (0-10)
>9 hour		32.25 (13-60)	11 (4-20)	12 ^a (2.5-27.5)	9 (0-24)	0 (0-6)
H		6.829	4.047	8.106	2.341	0.979
p		0.078	0.256	0.044*	0.505	0.806

DQI-I: Diet Quality Index-International; PSQI: The Pittsburgh Sleep Quality Index; IPAQ: The International Physical Activity Questionnaire; WHOQOL-BREF-TR: The World Health Organization Quality of Life Scale Short Form - Turkish Version, U: Mann-Whitney U Test; H: Kruskal-Wallis H Test; s: Spearman Correlation Coefficient; a, b: The difference between medians that do not share a common letter is significant

No significant correlation was found between total DQI-I scores and PSQI ($P=0.227$), IPAQ ($P=0.208$), and WHOQOL-BREF-TR (Physical Health's $P=0.931$, Psychological's $P=0.745$, Social Relationships's $P=0.374$, Environment's $P=0.816$) scores. However, a weak positive correlation ($r=0.081$; $P<0.05$) was found between

the Variety subscale and the Social Relationship domain of WHOQOL-BREF-TR, meaning that as Social Relationship scores increased, the Diversity subscale of DQI-I increased by 8.1% as shown in Table 5.

Table 5: Correlation coefficients between DQI-I total and subscale scores with PSQI, IPAQ total scores, and WHOQOL-BREF-TR domains scores

Variable			DQI-I Total	Variety	Adequacy	Moderation	Overall Balance
	PSQI Total	s	-0.046	0.002	-0.022	-0.028	-0.047
		P	0.227	0.948	0.563	0.460	0.212
	IPAQ Total	s	0.048	0.029	0.029	0.026	-0.030
		P	0.208	0.436	0.447	0.485	0.433
WHOQOL-BREF-TR	Physical Health	s	0.003	0.032	0.011	-0.020	-0.024
		P	0.931	0.399	0.769	0.598	0.534
	Psychological	s	-0.012	0.058	-0.010	-0.043	-0.030
		P	0.745	0.126	0.792	0.252	0.423
	Social Relationships	s	0.034	0.081	-0.012	-0.017	0.025
		P	0.374	0.033*	0.760	0.662	0.512
	Environment	s	0.009	0.029	-0.007	0.003	-0.054
		P	0.816	0.436	0.857	0.941	0.154

DQI-I: Diet Quality Index-International; PSQI: The Pittsburgh Sleep Quality Index; IPAQ: The International Physical Activity Questionnaire; WHOQOL-BREF-TR: The World Health Organization Quality of Life Scale Short Form - Turkish Version; s: Spearman's Rank Differences Correlation Coefficient

Discussion

The concept of diet is multidimensional and complex, and can vary across countries in terms of their dietary patterns. Evaluating dietary quality in developing countries is important for both micronutrient adequacy and the prevention of excessive body weight and chronic diseases.

In this study, the mean DQI-I score for university students was 33.08 ± 7.03 points. According to DQI-I, a score under 60 indicates poor dietary quality. Similarly, in a study conducted with university students studying at the Faculty of Health Sciences, the mean DQI-I score was 52.3 ± 8.31 points, and 85.4% were found to have poor diet quality (12). The EVASYON Study showed a mean diet quality score of 49.2 ± 12.6 in the study subjects (13). This study found that young adults have poor diet quality, particularly with regards to

the Adequacy, Moderation, and Overall Balance components. Specifically vegetable, fruit, and grain consumption was low, while protein sources consumption was considerably high. In addition, cholesterol and sodium intake were excessively high, indicating poor moderation. The macronutrient and fatty acid ratios were also observed to be poor, which is indicative of an imbalanced overall diet. However, in terms of diet variety, students received the highest scores, which is a positive sign. In a study on 39,208 individuals, which revealed that during the COVID-19 pandemic, individuals who spent more time on screens tended to consume more processed foods and less fruits and vegetables (14). This situation can be attributed to university students living away from home in dormitories or student housing who may not have the inclination to prepare healthy meals and are more inclined towards low-nutrient fast

food products that are popular in today's culture. Although more than half of participants reported income exceeding their expenses, the low budget allocated for food expenses by university students in this age group could also be a contributing factor. Improving diet quality is essential to prevent chronic diseases and enhance quality of life.

This study found that 85.3% of students had poor sleep quality. This finding is supported by the fact that only 27.9% of students rated their sleep quality as good. A study found 72.2% of university students had poor sleep quality (15), while in a different study, 25.3% of university students were found to have poor sleep quality (16). When examining the literature, poor sleep quality among university students is linked to factors such as smartphone addiction, academic workload (15), sedentary lifestyle, and late-night caffeine consumption (16).

This study found that 23.3% of students were physically inactive according to the IPAQ. Furthermore, consistent with this finding, only 15.7% rated their physical activity level as poor. A systematic review showed that university students' physical activity levels decreased by 32.5-36.5% compared to previous periods during the COVID-19 pandemic (17). The current results may reflect increased activity due to the lifting of restrictions and the return to face-to-face education.

This study found no significant relationship between diet quality and sleep quality. Some studies report a positive correlation (18,19), while Bagci- lar's study, which also found no significant relationship, aligns with these findings (20). Although poor sleep quality may lead to decreased diet quality due to snacking or emotional eating (21), further research is needed to explore the mechanisms behind this relationship.

This study found no significant association between diet quality and physical activity levels. This is consistent with the findings of a previous investigation conducted with a sample of 957 university students, which failed to detect any significant relationship between physical activity levels and diet quality scores (22). In contrast, the link between diet, physical activity, and mental health has been well-documented, with both behaviors serving as

stress-coping mechanisms. However, students often face challenges in maintaining a healthy diet due to time and financial constraints upon transitioning to college (23). Despite the importance of physical activity and diet quality, Kosendiak's study which involving 226 prisoners, also found no significant relationship between physical activity and diet quality (24). University life is a critical period for developing healthy lifestyle habits, yet the high stress levels associated with academia often lead to unhealthy behaviors, such as poor diet and inadequate physical activity. These behaviors increase the risk of chronic conditions, including type 2 diabetes mellitus and cardiovascular disease, as well as mental health issues (23).

In the present study, a significant relationship was observed only between the "Variety" dimension of diet quality and the "Social Relationship" dimension of quality of life, while no significant relationship was found between the other sub-dimensions. This phenomenon could be attributed to the fact that individuals who possess a sociable nature tend to be receptive to novelty in their food preferences owing to their outgoing personality or attitude. Existing literature shows varying results, with some studies reporting a significant relationship between diet quality and quality of life among older adults (25), as well as obese patients with metabolic syndrome (26), while others found no such association (27). A review of epidemiological studies indicated that prior methods have not established a clear link between diet quality and mortality in older adults (28). Conversely, a systematic review of seventeen studies highlighted the importance of promoting healthy diets to maintain good health-related quality of life (29). The discrepant findings may primarily stem from methodological variations across studies and the use of different instruments to assess both diet quality and quality of life.

The concept of diet quality, which is based on the principles of adequate and balanced nutrition, has played a key role in preventive treatment by preventing the development of metabolic syndrome, type 2 diabetes mellitus, cardiovascular diseases, neurodegenerative diseases, and certain types of cancer (30).

Strengths and limitations of the study

This study is distinctive as no other research has explored associations among these factors in this particular group of young adults. Previous studies conducted on children, adolescents, or elderly populations have examined relationships between diet and sleep quality or diet and quality of life, but no study has been identified that evaluates these instruments and the multidimensional aspects of physical activity, another healthy lifestyle behavior among young adults. However, there are several limitations that should be considered. First, the study was conducted at a single foundation university, which limits the generalizability of the findings to a broader population. Additionally, the sample was predominantly female (86%), and the average age of participants was relatively young (21.47 ± 3.74 years), which may influence the applicability of the results to other demographic groups. Furthermore, the use of self-reported measures for the scales may introduce bias, as participants could have responded in socially desirable ways or in a manner that minimizes their perceived shortcomings. To address these limitations and gain a more comprehensive understanding of the relationships explored in this study, future research should include more diverse samples, such as community-based groups with a more balanced gender distribution, and employ objective measures where possible.

Conclusion

This study observed a significant correlation between dietary diversity and quality of life, whereas no significant correlation was observed between diet quality and sleep quality, physical activity level, or quality of life. Therefore, there is a potential for developing diversification of diet plans and policies aimed at enhancing the lifestyle of young adults.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The author declares no conflicts of interest.

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