ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

The Relationship Between Adherence to the Mediterranean Diet and Quality of Life, Sleep Quality: Cross-Sectional Research

Akdeniz Diyetine Uyum ile Yaşam Kalitesi ve Uyku Kalitesi Arasındaki İlişki: Kesitsel Araştırma

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ABSTRACT Objective: This study examines the association between adherence to the Mediterranean diet (MD) and its impact on various aspects of well-being, including sleep quality (SQ) and overall quality of life (QOL). **Material and Methods:** A total of 702 healthy adults aged 18-65 in this cross-sectional research. The study utilized questionnaires to assess sociodemographic information, anthropometric measurements, MD adherence (using the Mediterranean Diet Adherence Scale), SQ (using the Richard-Campbell Sleep Scale), and overall QOL [using the Short Form of the Quality-of-Life Scale (SF-36)]. **Results:** Most participants demonstrated low or moderate adherence to the MD, irrespective of gender. Adherence to MD was negatively correlated with waist circumference (r=-0.169, p<0.01) and waist-to-hip ratio (r=-0.177, p<0.01). However, no significant associations were found between MD adherence and SQ or overall QOL (p>0.05). Age was positively correlated with MD adherence (r=0.106, p<0.01). Participants with high MD adherence had a higher mean health perception score than those with average and low adherence. In addition, MD adherence was positively correlated with certain subscales of the SF-36, such as role limitation (emotional problems) (r=0.132, p<0.01), energy and vitality (r=0.092, p<0.05), mental health (r=0.084, p<0.05) even after controlling for age. **Conclusion:** This study highlights that most participants exhibited low to moderate adherence to the MD, and while adherence was associated with improved body composition, no significant relationship was observed with SQ and overall QOL. The complexity of the relationship between adherence to the MD and well-being underscores the need for further research in this area.

Keywords: Mediterranean diet; sleep quality; quality of life

ÖZET Amaç: Bu çalışma, Akdeniz diyetine (AD) uyum ile uyku kalitesi (UK) ve genel yaşam kalitesini (YK) içeren refahın çeşitli yönleri arasındaki ilişkiyi incelemektedir. **Gereç ve Yöntemler:** Bu kesitsel araştırmaya yaşları 18-65 arasında değişen toplam 702 sağlıklı erişkin birey katılmıştır. Çalışmada kullanılan anket formu ile bireylerin sosyodemografik bilgileri, antropometrik ölçümleri, AD'ye uyumu (Akdeniz Diyet Uyum Ölçeği kullanılarak), UK (Richard-Campbell Uyku Ölçeği kullanılarak) ve genel YK [Yaşam Kalitesi Ölçeği-Kısa Formu (SF-36) kullanılarak] değerlendirilmiştir. **Bulgular:** Katılımcıların çoğu, cinsiyetten bağımsız olarak AD'ye düşük veya orta düzeyde uyum göstermektedir. AD uyum, bel çevresi (r=-0,169, p<0,01) ve bel-kalça oranı (r=-0,177, p<0,01) ile negatif korelasyon göstermiştir. Bununla birlikte, AD uyum ile UK veya YK arasında anlamlı bir ilişki bulunmamıştır (p>0,05). Yaş, AD'ye uyum ile pozitif korelasyon göstermiştir (r=0,106, p<0,01). AD'ye uyumu yüksek olan katılımcıların ortalama sağlık algısı puanları, orta ve düşük uyuma sahip olanlardan daha yüksektir. Ayrıca AD'ye uyum, yaşa göre düzeltme yapıldığında bile SF-36'nın rol sınırlaması (duygusal sorunlar) (r=0,132, p=<0,01), enerji ve zindelik (r=0,092, p<0,05), zihinsel sağlık (r=0,084, p<0,05) alt ölçekleriyle pozitif korelasyon göstermiştir. **Sonuç:** Bu çalışmada, çoğu katılımcı AD'ye düşük ila orta düzeyde uyum göstermiştir ve AD'ye uyum daha iyi vücut kompozisyonu ile ilişkili bulunmasına rağmen, UK ve genel YK ile anlamlı bir ilişki gözlenmemiştir. AD'ye uyum ile refah arasındaki ilişkinin karmaşıklığı, bu alanda daha fazla araştırmaya duyulan ihtiyacı vurgulamaktadır.

Anahtar Kelimeler: Akdeniz diyeti; uyku kalitesi; yaşam kalitesi

The daily habits and behaviours of individuals hold considerable sway over their health and quality of life (QOL). Among these habits, nutrition and consistent eating routines play a pivotal role in overall well-being. Surprisingly, many remain unaware of the profound impact that dietary choices can exert on

health, often leading to issues such as disrupted sleep, fatigue, and weakness. However, embracing a balanced diet and maintaining regular eating habits can yield a positive influence on both QOL and overall health. Conversely, poor food choices and inadequate nutrition tend to exacerbate existing health problems. Recognizing the significance of well-informed dietary decisions is instrumental in promoting a healthy lifestyle and enhancing overall well-being.[1,2] The Mediterranean diet (MD) emerges as a well-rounded eating pattern that champions good health. It places emphasis on the consumption of vegetables, fruits, whole grains, legumes, and nuts. Olive oil takes center stage as the preferred fat source, with moderate consumption of red meat, fish, and wine. This harmonious dietary approach offers protective effects, potentially reducing the risk of non-communicable diseases.[3]

Intriguingly, a study involving older adults uncovered a direct association between adherence to the MD and self-perceived physical and mental function, as well as life satisfaction.[4]

Sleep, far from being mere rest, is a vital rejuvenation process crucial for optimal bodily functioning. Adequate sleep is a necessity for all living organisms, with individual sleep needs varying based on factors such as age, gender, health, physical activity, emotions, medication, environment, and substance use. Quality sleep ensures waking up refreshed, energized, and ready to tackle the day. It plays a pivotal role in mental and physical health, significantly enhancing overall QOL. The presence of restful sleep is paramount for remaining alert, safe, and functioning optimally, thus making a substantial contribution to overall well-being.[5,6] QOL encompasses fulfillment and overall well-being, drawing from both objective and subjective evaluations of health, material well-being, family dynamics, and emotions. It gauges contentment and happiness by evaluating external circumstances and internal perceptions.[7]

Furthermore, sleep quality (SQ) is universally recognized as a critical component of overall well-being. Poor sleep has been linked to a spectrum of adverse health outcomes, including an increased risk of cardiovascular disease, obesity, and mood disorders.[8] Intriguingly, dietary factors, including specific nutrients and dietary patterns like the MD, have been implicated in shaping sleep patterns and SQ.[9,10] In a separate study involving university graduates in Spain, adherence to the MD was correlated with improved physical and mental health-related QOL.[11]

While individual studies have probed into the relationship between adherence to the MD and either QOL or SQ, few have simultaneously examined both aspects within a single comprehensive investigation. Our cross-sectional study aims to bridge this gap by scrutinizing the association between adherence to the MD and both QOL and SQ across a diverse population. The insights gained from this research endeavor stand to shed light on the potential holistic advantages of the MD for individuals' overall well-being. Specifically, this study centers on the connection between adherence to the MD and its impact on various facets of well-being, with a particular focus on how the diet's principles may promote healthier eating habits and, consequently, contribute to an improved QOL. This research endeavors to gauge participants' level of adherence to the MD and explore its potential influence on SQ and overall well-being.

MATERIAL AND METHODS

PARTICIPANTS AND STUDY DESIGN

An observational, cross-sectional research design was used in the study and ethical approval was obtained from İzmir Kâtip Çelebi University Non-Interventional Clinical Research Ethics Committee before the application (date: December 22, 2022, no: 0608). Participants who agreed to contribute voluntarily to this study were asked to sign a written consent form according to the Declaration of Helsinki. The study was carried out in İzmir province from January to May 2023 and included 702 healthy adult participants aged 18 years or older. Participants were required to demonstrate proficiency in reading, comprehending, and writing in Turkish. Conversely, the exclusion criteria for this study encompassed non-compliance with the voluntary consent form for study participation, the presence of mental health conditions, and pregnancy or lactation in female participants.

Before starting the study, our main goal was to reach a minimum sample size of 385. This calculation was based on a margin of error of 0.05 with a 95% confidence interval using G Power software (G*Power 3.1.9.2 version, Heinrich-Heine Universität, Düsseldorf, Germany), based on a sample of unknown population sample.

The researchers conducted face-to-face interviews to collect the data. The study included six sections in its questionnaire. The first section covered sociodemographic information. Anthropometric measurements were collected in the second section. The third section used the Mediterranean Diet Adherence Screener (MEDAS). The fourth section employed the Richard-Campbell Sleep Scale, while the fifth section utilized the Short Form of the Quality-of-Life Scale (SF-36). Researchers measured participants' anthropometric data, including height (m), body weight (kg), waist circumference (WC), and hip circumference.[12] From this data, they calculated the body mass index (BMI) using the formula [body weight (kg)/height (m)*height (m)]. Additionally, the waist-to-hip (WH) ratio was computed. BMI was then evaluated due to the classification provided by The World Health Organization.[13,14]

The original version of the MEDAS was initially developed and validated in Spain.[15] Subsequently, Özkan Pehlivanoğlu et al. conducted a validation study in Türkiye to assess its reliability and applicability in the Turkish context.[16] The study utilized MEDAS to assess participants' nutritional behaviours and their Ad-MD. The questionnaire consisted of 16 questions, with 12 positive and 4 negative questions. Positive responses received +1 point, while negative responses received -1 point. The total points obtained, alternating from 0 to 12, determined the evaluation score. Scores were categorized into three classifies: (1) >9 points indicated optimal Ad-MD (good), (2) 7-9 points suggested room for improvement in adherence (medium), and (3) <7 points indicated very low nutritional quality (low).[16]

The Richard-Campbell Sleep Questionnaire's Turkish validity and reliability were previously established by Özlü and Özer in 2015.[17] The questionnaire consists of six questions related to the quality of sleep experienced the previous night, covering aspects such as falling asleep, frequency of awakening, waking time, and noise disturbance from external factors. Each question is scored out of 100, and the total score obtained from the scale is divided by the number of questions (excluding item 6) for evaluation. Scores between "0-25" show very poor sleep, while scores between "76-100" indicate very good sleep. A higher score on the scale corresponds to better SQ among the participants.

The SF-36 scale, which was developed by Ware in 1987 and validity and reliability study was conducted by Koçyiğit et al. in 1999, has been used to assess the QOL of individuals.[18,19] The SF-36 scale is scored out of 100 points for each component, with scores ranging from 0 to 100. Higher scores on scale show a enhance level of health, while lower scores show a decline in health. The SF-36 scale comprises 36 questions divided into 4 sections. It begins with 2 questions evaluating the individual's overall health and any changes compared to the previous year. The next section contains 20 questions assessing the impact and limitations of health on daily physical activities. The General Health Department follows with 4 questions measuring the person's perception of their health status. Lastly, section 4 concludes with the Your Feelings section, consisting of 10 questions concerning the individual's psychological state.

DATA ANALYSIS

In this study, data analysis was conducted using version 22 of the SPSS software (SPSS Inc., Chicago, IL, USA). Continuous variables were presented as mean ($\overline{X}$) and standard deviation, while categorical variables were expressed as frequency (n) and percentages (%). The normality assumption was evaluated using the Kolmogorov- Smirnov test. To compare categorical data, the chi-square test was employed, while for continuous variables with more than two groups, one-way analysis of variance with the Tukey post hoc test was utilized. Pearson's correlation test was applied when normality conditions were met, and in cases where normality assumptions were not met, Spearman's correlation test was used. The significance level was set at $p < 0.05$ to determine statistical significance.

RESULTS

The study enrolled 702 participants (437 women, 265 men) with a mean age of 32.14±11.94 years. Approximately 49.1% had a high school degree. The majority were single (63.0%) and earned minimum wage or more (63.5%) per month. Further participant characteristics based on Ad-MD can be found in Table 1. The study population was divided into three groups based on adherence: low (41.0%), average (46.7%), and high (12.3%). Those with low adherence were significantly younger than those with high adherence (p<0.05). Gender and marital status also displayed differences among adherence groups (p<0.05). Participants with low adherence had no-tably higher mean WC and waist/hip ratio than those with high adherence (p<0.05). But there was no differences in education degree, presence of chronic disease, and income among the three groups (p>0.05).

The study population's adherence to the MD, assessed by the MEDAS score, was 6.93±2.16. A majority of the participants (68.5%) reported having a moderate level of SQ. But, no significant differences were seen in SQ scores or SQ classification based on Ad-MD (p>0.05). When evaluating the QOL in relation to the MD, apart from the general health perception score, no significant differences were found. Notably, participants with high Ad-MD had a higher mean health perception score than those with average and low adherence (p<0.05) (Table 2).

TABLE 1: General characteristics of participants according to adherence MD.									
Variables	All (n=702)		Low-MD (n=288)		Average-MD (n=328)		High-MD (n=86)		p value
Age (years) X̄±SD	32.14±11.94		30.81±11.35[a]		32.46±12.29[ab]		35.4±11.96[b]		**0.006****
	n	(%)	n	(%)	n	(%)	n	(%)	
Gender									
Men	265	37.7	127[a]	44.1	119[a]	36.3	19[b]	22.1	**0.001***
Women	437	62.3	161[a]	55.9	209[a]	63.7	67[b]	77.9	
Marital status									
Married	260	37.0	91[a]	31.6	124[a]	37.8	45[b]	52.3	**0.002***
Single	442	63.0	197[a]	68.4	204[a]	62.2	41[b]	47.7	
Education level									
Primary school	33	4.7	14	4.9	14	4.3	5	5.8	0.185*
Secondary school	39	5.6	18	6.3	14	4.3	7	8.1	
High school	345	49.1	147	51.0	166	50.6	32	37.2	
University	246	35.0	93	32.3	120	36.6	33	38.4	
Master/PhD	39	5.6	16	5.6	14	4.3	9	10.5	
Presence of chronic disease									
No	592	84.3	244	84.7	281	85.7	67	77.9	0.205*
Yes	110	15.7	44	15.3	47	14.3	19	22.1	
Body weight (kg) X̄±SD	70.32±16.18		71.3±16.5		70.07±16.18		67.97±14.93		0.229**
Height (cm) X̄±SD	169.3±8.82		170±9.01		169.16±8.69		167.47±8.41		0.059**
BMI (kg/m²) X̄±SD	24.34±4.61		24.48±4.55		24.3±4.72		24.03±4.38		0.709**
WC (cm) X̄±SD	82.24±15.68		83.97±16.25[a]		81.7±15.53[ab]		78.45±13.5[b]		**0.011****
HC (cm) X̄±SD	100.62±11.31		100.84±11.64		100.69±11.4		99.63±9.83		0.675**
Waist/Hip X̄±SD	0.81±0.12		0.83±0.12[a]		0.80±0.13[ab]		0.78±0.11[b]		**0.002****
BMI classification	n	(%)	n	(%)	n	(%)	n	(%)	
Underweight	43	6.1	19	6.6	20	6.1	4	4.7	
Normal	387	55.1	149	51.7	188	57.3	50	58.1	0.830*
Pre-Obese	186	26.5	84	29.2	80	24.4	22	25.6	
Obese	86	12.3	36	12.5	40	12.2	10	11.6	

*One-way ANOVA was used for the test of differences and Tukey's post-hoc test; Different lower letters in the same column indicate a statistical difference among the groups;

**Chi-square test; Bold values are for p<0.05; MD: Mediterranean diet; SD: Standard deviation; BMI: Body mass index; WC: Waist circumference (cm); HC: Hip circumference.

TABLE 2: Measurement of Quality of Life and Sleep due to levels of adherence to the MD.								
	All (n=702)		**Low-MD (n=288)**		**Average-MD (n=328)**		**High-MD (n=86)**	**p value**
MEDAS score	6.93±2.16		4.84±1.17[a]		7.82±0.79[b]		10.55±0.78[c]	**<0.001****
RCSQ score	6.17±2.07		73.30±20.77		70.98±20.01		70.51±19.82	0.213**
	n	(%)	n	(%)	n	(%)	n	(%)	
RCSQ classification									
Moderate SQ	411	58.5	151[a]	52.4	204[b]	62.2	56[a,b]	58.5	**0.021***
Very good SQ	291	41.5	137[a]	47.6	124[b]	37.8	30[a,b]	41.5	
SF-36 subscales									
Physical functioning	85.45±17.27		86.01±17.24		85.44±18.12		83.58±13.78	0.519**
Role limitations (physical problems)	70.51±39.45		70.92±42.96		69.36±37.54		73.55±34.16	0.664**
Role limitation (emotional problems)	58.45±31.41		55.32±29.09		59.86±33.96		63.57±27.83	0.055**
Energy and vitality	52.38±23.33		50.91±21.83		52.87±25.5		55.41±18.98	0.255**
Mental health	61.59±18.15		60.08±18.35		62.2±18.34		64.37±16.44	0.112**
Social functioning	68.91±22.4		68.8±22.29		69.05±22.44		68.75±22.91	0.988**
Bodily pain	66.71±24.3		68.03±23.9		65.55±25.04		66.74±22.78	0.450**
General perception of health	65.25±78.85		61.47±18.93[a]		63.07±18.8[a]		86.24±219.51[b]	**0.030****

*One-way ANOVA was used for the test of differences and Tukey's post-hoc test; Different lower letters in the same column indicate a statistical difference among the groups;
**Chi-square test; Bold values are for p<0.05; MD: Mediterranean diet; SD: Standard deviation; MEDAS: Mediterranean Diet Adherence Scale;
RCSQ: Richard-Campbell Sleep Questionary.

There were no significant correlations between individuals' Ad-MD and the RCSQ score (p>0.05). However, it was observed that as individuals advanced in age, their level of compliance with the MD increased significantly (p<0.05). Moreover, the MEDAS score showed a positive association with the role limitation (emotional problems), energy and vitality, and mental health subscales of the SF-36. Even after controlling for age in the data analysis, the MEDAS score maintained its positive correlation with the role limitation (emotional problems), energy, and vitality subscales of the SF-36 (Table 3).

■ DISCUSSION

We have investigated the association between Ad-MD and QOL, SQ. The number of high adherences to MD is lower in both men and women compared to low and medium adherence (p=0.001).

The review of relevant studies indicates that most participants showed low or moderate Ad-MD, irrespective of gender. This can be attributed to various interlinked factors, including cultural influences, individual taste preferences, accessibility and affordability of Mediterranean foods, limited awareness and knowledge about diet, lifestyle choices, and socioe-

conomic factors. These complex elements collectively influence individuals' dietary behaviours and choices concerning the MD.[20,21]

In this study, the WC and WH ratios of subjects were decreased by adherence to MD. Furthermore, Ad-MD was negatively correlated with BMI, WC and WH ratio. A study showed higher adherence to dietary recommendations, including MD, was linked with lower WC and WH ratios in adults.[22] Another study reported that higher Ad-MD was significantly correlated with lower WC, in both men and women.[23] Evidence suggests that following the MD can offer various health advantages, such as enhanced body composition and physical fitness. By prioritizing whole, minimally processed foods and healthy fats, and practicing portion control, the MD can promote a healthier body weight and lower the likelihood of chronic illnesses.[20-22]

We did not find a difference in SQ scores or SQ classification based on Ad-MD and most of subjects reported moderate SQ. However, other researchers have stated a positive correlation between Ad-MD and better SQ. One study found that university students with good Ad-MD were more prone to have good SQ.[24] Another study indicated that high Ad-MD

TABLE 3: Correlation and partial correlation coefficients among variables MEDAS, age, anthropometric measurements, RCSQ Score, and SF-36 subscales.

Variables	r	MEDAS	Age	BMI	Waist circumference	Waist/hip	RSQS-core	SF-36 subscales							
								Physical functioning	Role limitations (physical problems)	Role limitation (emotional problems)	Energy and vitality	Mental health	Social functioning	Bodily pain	General perception of health
MEDAS	r	1	0.106**	-0.028	-0.118**	-0.138**	-0.020	0.007	0.038	0.132**	0.092*	0.084*	0.024	-0.013	0.068
Age	r		1	0.391**	0.366**	0.288**	<0.001	-0.277**	-0.037	0.033	0.062	0.171**	0.008	-0.052	-0.008
BMI	r	-0.076*	-	1	0.760**	0.490**	-0.018	-0.189**	-0.069	0.030	-0.037	0.032	0.014	-0.020	-0.041
Waist Circumference	r	-0.169**	-	0.720**	1	0.767**	0.041	-0.098**	0.032	0.033	0.013	0.110**	0.062	0.041	0.004
Waist/Hip ratio	r	-0.177**	-	0.428**	0.742**	1	0.048	-0.033	0.055	0.013	0.011	0.057	0.023	0.065	0.008
RCSQ Score	r	-0.020	-	-0.020	0.043	0.050	1	0.077*	0.049	-0.024	0.132**	0.174**	0.082*	0.070	-0.014
Physical functioning	r	0.038	-	-0.091*	0.004	0.051	0.080*	1	0.260**	0.100**	0.200**	0.135**	0.267**	0.235**	0.119**
Role limitations (physical problems)	r	0.042	-	-0.059	0.048	0.068	0.049	0.260**	1	0.381**	0.349**	0.295**	0.374**	0.264**	0.073
Role limitation (emotional problems)	r	0.130**	-	0.018	0.022	0.004	-0.024	0.114**	0.383**	1	0.292**	0.279**	0.268**	0.140**	0.015
Energy and vitality	r	0.086*	-	-0.066	0.051	-0.008	0.132**	0.227**	0.353**	0.292**	1	0.657**	0.450**	0.287**	0.117**
Mental health	r	0.067	-	-0.039	0.064	0.009	0.177**	0.193**	0.306**	0.277**	0.658**	1	0.440**	0.249**	0.144**
Social functioning	r	0.023	-	0.012	0.065	0.022	0.082*	0.281**	0.374**	0.268**	0.450**	0.446**	1	0.472**	0.161**
Bodily pain	r	-0.007	-	0.001	0.065	0.084	0.071	0.229**	0.263**	0.142**	0.292**	0.262**	0.473**	1	0.116**
General perception of health	r	0.069	-	-0.041	0.008	0.011	-0.014	0.122**	0.073	0.016	0.117**	0.147**	0.161**	0.115**	1

*p<0.05; **p<0.01; Partial correlation coefficients controlling for age; -: controlled variable; BMI: Body mass index; MEDAS: Mediterranean Diet Adherence Scale; RCSQ: Richard-Campbell Sleep Questionary.

was associated with favourable SQ among community-dwelling Greek older population.[25] The patterns and requirements of sleep are shaped by a intricate interplay of genetic, behavioural, environmental, and social factors.[26] Further studies are needed to fully understand the potential relationship between adherence to MD and SQ.[24]

In our study, SQ was positively correlated with SF-36 subscales such as physical functioning, energy and vitality, mental health and social functioning. Consistent with our results, in a study conducted on patients with novel coronavirus, it was reported that there was a relationship between SQ scores and SF-36 subscales such as physical functioning, energy and vitality, mental health and social functioning.[27]

The Short-Form 36 questionnaire is a tool used to determine QOL. Several studies have investigated relationship between adherence to MD and SF-36 scores.[28,29] The link between adherence to MD and QOL is an area of ongoing research, and the available data is mixed. While some studies have reported a positive association between Ad-MD and QOL, others have not found a significant relationship.[25,30,31] We have not found association between the two. We only found a difference between the general perception of health and MD adherence. The study's inability to establish a link between Ad-MD and QOL lacks clarity, but potential explanations could be attributed to variations in study design, participant demographics, measurement instruments, or unaccounted factors influencing QOL within the study. Another possible explanation for these results may be related to the fact that study participants predominantly exhibited moderate Ad-MD and reported average SQ scores. This prevalence of moderate compliance with the diet and average SQ levels within the study cohort might account for the lack of significant associations between Ad-MD and SQ or overall QOL.

LIMITATIONS

Despite the advantage of reaching a large sample size, our results should be interpreted with some limitations in mind. First, since this is a cross-sectional study, a cause-and-effect relationship cannot be established. Secondly, the majority of the individuals were moderately adherent to the MD and had moderate SQ. Another limitation of this study is the uneven gender distribution, despite our efforts to recruit more male participants. Despite the aforementioned limitations, this study provides valuable and significant findings, underscoring the need for further longitudinal research.

CONCLUSION

Overall, the findings revealed that most participants exhibited low or moderate adherence to MD. While adherence to MD was related with improved body composition no significant association was observed with SQ and overall QOL. It is important to note that the MD is not a one-size-fits-all approach and individual outcomes may vary. The relationship between adherence to MD and QOL remains an area of ongoing research, and the available data are mixed. Further investigations involving individuals with varying levels of adherence and SQ scores could offer a more comprehensive understanding of the potential relationships between Ad-MD and various well-being outcomes.

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