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When More Is Not Better: The Complex Association Between Digital Healthy Diet Literacy and Orthorexia Nervosa in Young Adults

İrem KAYA CEBİOĞLU

irem.cebioglu@yeditepe.edu.tr

Yeditepe University

Gözde DUMLU BİLGİN

Yeditepe University

Sude ŞEN

Yeditepe University

Çağla Gizem KARAMUK

Üsküdar HospitalTürk Hospital

Salma DABOUL

University of Aberdeen, King's College

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Abstract

Background

Excessive digital healthy diet literacy can shift from a functional skill into a form of anxiety-driven pattern rather than critical evaluation capacity due to excessive exposure to information and repetitive search habits. Misinformation that relates to healthy diet and nutrition might have detrimental effects, leading to some disorders manifesting with compulsive behaviors, particularly orthorexia nervosa. Thus, the primary aim of this study is to examine the relationship between digital healthy diet literacy and orthorexia nervosa among young adults.

Methods

A total of 743 eligible undergraduate students completed the e-Healthy Diet Literacy Questionnaire and the Test of Orthorexia Nervosa-17 scales, along with demographics and daily screen time data.

Results

The overall e-healthy diet literacy was statistically higher among students at risk of orthorexia nervosa; those were approximately 2.7 times more likely to be at risk than those with lower literacy. The daily screen time was correlated to “Disorder Symptoms,” of Test of Orthorexia Nervosa-17, reflecting the pathological dimensions. Accordingly, as screen time increased, pathological orthorexia tendency was increased. Furthermore, the level of e-health nutrition literacy was a statistically significant contributor that increased the total orthorexia nervosa score and its three subfactor scores.

Conclusions

In conclusion, this study reported the increased tendency towards orthorexia nervosa when individuals' levels of healthy eating literacy rose above a certain level. Accordingly, individuals with higher e-health literacy may be more prone to make excessive online investigations for reassurance. However, it should be highlighted that high e-health literacy does not always reduce the urge to seek out excessive online health information; in fact, it may even trigger the emergence of anxiety symptoms that might lead to cyberchondria, which might be the potential mediator of orthorexia nervosa. The ability to research online that comes with digital literacy may not always yield the desired results; in fact, it can unknowingly lead individuals to become overly obsessive, highly anxious, and excessively search for health-related issues. Therefore, it is crucial to use targeted and audience-oriented content and appropriate methods in efforts to promote digital health literacy.

Background

The rapid evolution of digital technology has made the internet a primary resource for many people, and according to the literature, around 72% of internet users seek health-related information online (1–3). This is acceptable because the internet provides the advantage of rapid and straightforward access to a vast amount of up-to-date information, as well as the opportunity to interact with healthcare specialists through a variety of innovative solutions including telemedicine, mobile health tools, and content published on social outlets (4, 5). In light of these numerous developments that have taken place, it is imperative to acknowledge the evolution of the conventional concept of health literacy into e-health literacy, which encompasses the capacity to locate, comprehend, appraise, and interpret health-related information from electronic sources (2, 4). This digital transformation has achieved considerable traction within healthcare applications, particularly among young adults, who place significant value on the convenience offered by online resources. A review of 32 studies reported that search engines and social media are the two main platforms used by young adults to seek health information (6). Consequently, digital resources have been demonstrated to have considerable potential, particularly in the areas of nutrition and lifestyle, thus empowering individuals to make more informed decisions about their health, thus giving rise to the concept of 'e-health literacy' (7).

However, approximately 40% of health-related content in the digital environment lacks evidence-based information; moreover, the information shared is often found to be unreliable, exaggerated, or incorrect (1, 8). Individuals with inadequate knowledge -even if they have sufficient digital health literacy- may develop a tendency for self-diagnosis based on those kinds of manipulated and biased online data, resulting in the erroneous interpretation of symptoms and, consequently, increased anxiety. This dilemma has the potential to turn into a public health concern, known as 'cyberchondria '-a condition characterized by an exacerbated sense of health anxiety and emotional distress stemming from the excessive and repeated pursuit of medical information through online sources (1, 9). Studies reported that, in particular, young individuals with elevated health anxiety frequently overinterpret their physical signals more than older adults (10, 11) and that cyberchondria is even more prevalent among those under 35 years old (1, 7, 12).

There is evidence suggesting that higher digital health literacy is associated with more intense cyberchondria (7, 9, 13, 14). This kind of excessive digital health-seeking behavior can worsen anxiety or distress, leading to further negative consequences, including being repetitive, compulsive, and time-consuming, similar to the manifestations of obsessive-compulsive disorder (1, 9); that is, it might pose as a mediating factor in orthorexia nervosa. Online content promoting specific health claims- such as 'healthy eating', 'detox', 'purity' and 'longevity'-can put extra social pressure on internet users, even if they lack a solid scientific basis and do not meet any recommendations. That kind of misinformative messages related to healthy diet and nutrition might have detrimental effects on individuals, leading to some kind of disorders manifesting with compulsive behaviors, particularly orthorexia nervosa (15–19). Since the diagnostic criteria of orthorexia nervosa were described by Bratman in 1997 (20), subsequent literature has indicated that it is particularly associated with the concept of " extreme dietary purity" (21, 22). Therefore, to cope with cyberchondria, and consequently orthorexia nervosa, individuals should be encouraged to critically analyze online health content, particularly that related to food and nutrition,

which is one of the areas where digital health content is both most intensively produced and rapidly consumed (7, 11).

In the case of digital health or healthy diet literacy exceeding a certain level, it can shift from being a functional skill into a form of anxiety-driven pattern, by the combination of excessive exposure to information and repetitive search habits, rather than critical evaluation capacity. At this point, the digital health literacy level should be considered more as a variable that may pose a risk under certain conditions than a protective factor. Thus, the primary aim of this study is to examine the relationship between digital healthy diet literacy and orthorexia nervosa among young adults.

Methods

Study Design and Population

This cross-sectional study aimed to investigate the impact of digital nutrition literacy and screen time on the risk of orthorexia nervosa among university students, with the ethical approval of the Yeditepe University Non-Interventional Clinical Research Ethics Committee dated and numbered E.83321821-805.02.03-497, in accordance with the Helsinki Declaration.

The study population consisted of 15,536 undergraduate students aged 18 or older at Yeditepe University, and the minimum sample size was calculated at 375 participants using a known-population sampling formula (95% confidence interval, d = 5%, and p = 5%). The data were collected from a total of 743 eligible students, excluding those studying nutrition and dietetics, who volunteered and signed informed consent to participate in the study.

Data Collection and Tools

Data were collected through face-to-face interviews and online by the researchers using a three-section questionnaire that lasts approximately 15 minutes to complete. The first section - “Demographic Information and Screen Time”- provided data on age, sex, accommodation, and daily screen time of the participants. The second section included the “e-Healthy Diet Literacy Questionnaire” (e-HDL) developed by Van Doung et al. (2020), and validated in Turkish by Onbaşı & Türker (2023) (23, 24). The scale comprises 15 items across five sub-dimensions that measure the ability to find, understand, judge, and apply digital nutrition information. Scores vary by sub-dimension, with a total possible score of 71; higher scores indicate higher digital healthy diet literacy (25). Lastly, the Test of Orthorexia Nervosa-17 (TON-17)- a 17-item scale that uses a 5-point Likert rating with General Factor (FG) / total score ranging from 17 to 85 and 3 sub-factors: Control of Food Quality (F1), Fixation on Healthy Eating (F2), and Disorder Symptoms (F3)- was used (26, 27). A cut-off value of 61 has been suggested as an indicator of the risk of orthorexia nervosa (26).

Statistical Analysis

Data were analyzed using IBM SPSS software (Armonk, NY, USA). Normality was assessed using the skewness and kurtosis values that fall between ± 2. For normally distributed data, independent-samples t-tests and one-way ANOVA were applied; for non-normally distributed data, the Mann-Whitney U and Kruskal-Wallis tests were used. Associations between categorical variables were evaluated using Pearson's chi-square test. Correlations between variables were assessed using correlation coefficients, and a linear regression test was used to reveal the association between variables. A p-value < 0.05 with a confidence interval of 95% was considered statistically significant.

Results

The descriptive statistics and demographic characteristics of 743 participants were presented in Table 1, in which data were categorized according to the TON-17 threshold score of 61, which identifies the risk of ON; 31 participants (4.2%) were classified as at risk for ON (TON-17 ≥ 61), while 712 (95.8%) were classified as non–ON-risk (TON-17 < 61). The overall sample had a mean age of 21.35 ± 1.89 years and consisted predominantly of women (71.2%). When TON-17 scores were compared between sexes, women exhibited slightly higher proportions in the ON-risk compared to men (4.5% and 3.3%, respectively), although this difference was not statistically significant ($p > 0.05$). Even though daily screen time is slightly higher among those with ON-risk than among overall students (340 ± 132.11 minutes) and in the non-ON-risk group, the difference was not statistically significant ($p > 0.05$).

The overall e-HDL total score for students was 28.63 ± 5.85, which was statistically higher among ON-risk students than among non-ON-risk students (33.20 ± 8.36 and 28.43 ± 5.64, respectively; $p < 0.05$). The same phenomenon was observed for all e-HDL sub-factor scores, where the ON-risk group achieved higher scores in every sub-factor ($p < 0.05$ for all), except for the e-HDL "Judging" ($p > 0.05$).

The students' mean total TON-17 scores were 45.12 ± 9.42, and their disorder symptom (pathological orthorexia) sub-factor mean score was 13.19 ± 4.37. Both healthy (CFQ and FHD) and pathological orthorexia (DS) sub-scores were significantly higher in the ON at-risk group ($p < 0.05$, for all).

Table 1. The descriptive characteristics of participants regarding their TON-17 total score

Overall (n=743)		TON-17 total score						
				≥ 61 (ON-risk)		< 61 (non-ON-risk)		
		n	%	n	%	n	%	Sig.
				31	4.2	712	95.8	p value
Sex	Men	214	28.8	7	3.3	207	96.7	0.435 [a]
	Women	529	71.2	24	4.5	505	95.5	
		Mean ± S.D. (Min. - Max.)		Mean ± S.D. (Min. - Max.)		Mean ± S.D. (Min. - Max.)		
Age		21.35 ± 1.89 (18.00 - 35.0)		21.03 ± 1.68 (18.00 - 24.00)		21.37 ± 1.90 (18.00 - 35.00)		0.428 [b]
Screen time (minutes)		340.02 ± 132.11 (30.00 - 900.00)		362.80 ± 123.41 (80.00 - 650.00)		339.03 ± 132.47 (30.00 - 900.00)		0.327
e-HDL total score		28.63 ± 5.85 (13.00 - 51.00)		33.20 ± 8.36 (13.00 - 51.00)		28.43 ± 5.64 (13.00 - 48.00)		0.004**
e-HDL Finding		6.93 ± 2.29 (3.00 - 15.00)		8.74 ± 3.25 (3.00 - 15.00)		6.85 ± 2.21 (3.00 - 15.00)		0.003**
e-HDL Understanding		10.41 ± 4.05 (4.00 - 20.00)		12.90 ± 4.81 (4.00 - 20.00)		10.31 ± 3.99 (4.00 - 20.00)		<0.001**
e-HDL Judging		7.56 ± 1.84 (2.00 - 10.00)		7.03 ± 2.36 (2.00 - 10.00)		7.59 ± 1.82 (2.00 - 10.00)		0.103
e-HDL Applying		3.72 ± 1.65 (2.00 - 10.00)		4.52 ± 1.99 (2.00 - 10.00)		3.68 ± 1.62 (2.00 - 10.00)		0.006**
TON-17 total score		45.12 ± 9.42 (20.00 - 78.00)		-		-		N.A.
TON-17 CFQ		15.78 ± 4.47 (6.00 - 30.00)		23.55 ± 2.73 (20.00 – 30.00)		15.45 ± 4.22 (6.00 – 29.00)		<0.001**
TON-17 FHD		16.14 ± 3.23 (5.00 - 25.00)		20.90 ± 2.44 (16.00 – 25.00)		15.93 ± 3.10 (5.00 – 25.00)		<0.001**

TON-17 DS	13.19 ± 4.37 (6.00 - 30.00)	21.81 ± 3.65 (15.00 – 30.00)	12.82 ± 4.00 (6.00 – 25.00)	<0.001**

S.D., standard deviation; Min, minimum; Max. maximum; ON, Ortorexia Nervosa; e-HDL, electronic-healthy diet literacy; TON-17, Test of Orthorexia Nervosa; CFQ, control of food quality; FHD, fixation on health and a healthy diet; DS, disorder symptoms;

[a] Chi-square test; [b] Mann Whitney U test; * $p < 0.05$; ** $p < 0.01$

Table 2 presents the mean total scores across all scales by sex. On the e-HDL scale, women scored significantly higher on all total and sub-factor scores ($p < 0.05$), except for “understanding” and “applying” ($p > 0.05$). Contrary to this, no statistically significant differences were observed between sexes regarding TON-17 total score and TON-17 CFQ ($p > 0.05$). However, women scored higher when it comes to TON-17 FHD and TON-17 DS ($p < 0.05$). Moreover, time spent on screen was quite similar between the sexes and did not pose any statistical significance ($p > 0.05$).

Table 2
Scale scores of participants regarding sexes

	Men	Women	
	Mean ± S.D. (Min. - Max.)	Mean ± S.D. (Min. - Max.)	Significance p value [a]
e-HDL total score	27.86 ± 5.84 (13.00–46.00)	29.01 ± 5.81 (14.00–51.00)	0.005**
e-HDL Finding	6.46 ± 2.41 (3.00–15.00)	7.12 ± 2.21 (3.00–15.00)	0.000**
e-HDL Understanding	10.45 ± 3.92 (4.00–20.00)	10.40 ± 4.11 (4.00–20.00)	0.893
e-HDL Judging	7.15 ± 1.88 (2.00–10.00)	7.73 ± 1.81 (2.00–10.00)	0.000**
e-HDL Applying	3.62 ± 1.59 (2.00–10.00)	3.76 ± 1.67 (2.00–10.00)	0.297
TON-17 total score	44.88 ± 9.15 (22.00–70.00)	45.22 ± 9.54 (20.00–78.00)	0.663
TON-17 CFQ	15.69 ± 4.34 (6.00–29.00)	15.82 ± 4.53 (6.00–30.00)	0.732
TON-17 FHD	16.50 ± 3.31 (6.00–25.00)	15.99 ± 3.19 (5.00–25.00)	0.048*
TON-17 DS	12.68 ± 4.36 (6.00–26.00)	13.40 ± 4.36 (6.00–30.00)	0.040*
Screen Time	328.66 ± 136.68 (30.00–770.00)	344.62 ± 130.14 (60.00–900.00)	0.136

S.D., standard deviation; Min, minimum; Max. maximum; e-HDL, electronic-healthy diet literacy; TON-17, Test of Orthorexia Nervosa; CFQ, control of food quality; FHD, fixation on health and a healthy diet; DS, disorder symptoms

[a] independent sample *t*-test; * $p < 0.05$; ** $p < 0.01$

According to the findings, the TON-17 FG and its sub-factors have a positive, weak but significant correlation with the e-HDL total score, its subscales of “Finding,” “Understanding,” and “Applying,” as well as with the FNS FG ($p < 0.01$). It should be highlighted that the only variable correlated with screen time was the “Disorder Symptoms” sub-factor of the TON-17, reflecting the pathological dimension of orthorexia. Accordingly, as screen time increased, pathological orthorexia tendency also increased ($p < 0.05$) (Table 3).

Table 3
Correlation coefficients table of TON-17 scale scores

	TON-17 total score	TON-17 CFQ	TON-17 FHD	TON-17 DS
	Correlation Coefficients			
e-HDL total score	0.319**	0.265**	0.266**	0.219**
e-HDL Finding	0.341**	0.257**	0.316**	0.239**
e-HDL Understanding	0.168**	0.142**	0.131**	0.120**
e-HDL Judging	− 0.014	0.007	0.013	− 0.046
e-HDL Applying	0.260**	0.227**	0.170**	0.202**
Age (years)[a]	0.070	0.052	0.081*	0.040
Screen time (minutes)	0.003	− 0.035	− 0.066	0.091*

e-HDL, e-healthy diet literacy; TON-17, Test of Orthorexia Nervosa; CFQ, control of food quality; FHD, fixation on health and a healthy diet; DS, disorder symptoms

[a] Spearman's rho; * $p < 0.05$; ** $p < 0.01$

The relationship between the TON-17 total score (ON-risk (≥ 61) and non-ON-risk (< 61)) and the e-HDL total score is displayed in Table 4, showing that 6.2% of participants with an e-HDL total score > 28 were significantly more likely to be in the ON-risk group, whereas this proportion was only 2.3% among those with an e-HDL score ≤ 28 ($\chi^2 = 6.727$, p = 0.009). Moreover, the odds ratio (OR) = 2.735 (95% CI = 1.242–6.023) indicates that individuals with higher e-HDL scores were approximately 2.7 times more likely to be at ON-risk score than those with lower e-HDL scores.

Table 4
Risk evaluation between the TON-17 score and the e-HDL total score

			TON-17 total score							
	Overall		≥ 61 (n = 31)		< 61 (n = 712)		Significance		Risk	
	n	%	n	%	n	%	χ^2	*p*	OR	95% CI
e-HDL total score ≤ 28	385	51.8	9	2.3	376	97.7	6.727	0.009**	2.735	1.242–6.023
e-HDL total score > 28	358	48.2	22	6.2	336	93.8				

TON-17, Test of Orthorexia Nervosa; e-HDL, e-healthy diet literacy; OR, Odds Ratio; CI, Confidence Interval

* $p < 0.05$. ** $p < 0.01$

According to linear regression plots presented in Fig. 1, e-HDL total scores were found to be a statistically significant contributor to the TON-17 total and its three sub-factor scores ($p < 0.001$ for all). The standardized beta coefficients (β) indicated that higher e-HDL was associated with increased orthorexia tendencies. The overall regression model was statistically significant ($p < 0.001$) and accounted for 10.0% of the variance (Adjusted $R^2 = 0.102$) in the TON-17 total score, with a correlation ($R = 0.319$) between the predictor and the outcome variable. Moreover, as presented in Fig. 1, e-HDL score contributed to TON-17 sub-factor scores with R^2 values ranging between 0.048 and 0.071 ($p < 0.000$).

Discussion

This study investigated the possible association between risk of developing orthorexia nervosa and digital health literacy levels of undergraduate students. Nutrition and dietetics students were deliberately excluded from the study sample because a higher susceptibility to orthorexia nervosa in this group has been indicated in the literature (28, 29).

As orthorexia nervosa is not officially listed in DSM-5-TR, its prevalence depends not only on the variation between populations, but also on the tool used to measure it and the diagnostic threshold criteria (29–31). Therefore, the prevalence of ON observed in this study is in line with the literature, as recent studies reported that the prevalence among undergraduate students fluctuates over a fairly wide range from 1.5% to 88.7% (28, 32–38). In accordance with the findings of this study, a recent review of systematic reviews related to ON has declared that there is no sex disparity regarding ON prevalence (39), while controversial findings have also been reported (17, 26). Moreover, according to the findings of the original study that developed the TON-17 scale, women had higher scores compared to men for all factors except DS (26). This is also evident in our study for the factors FHD and DS, although it should be emphasized that women were represented in a higher proportion in this study.

While examining orthorexia nervosa, it is crucial to take into account the social norms, the role of technological developments as means of meeting individuals' health and well-being needs, and the complex interplay among these factors (19). There are studies indicated the association between ON and internet -social media- use (17, 35, 38), which has even been linked to eating disorders and obsessive-compulsive behaviors (17, 40, 41). However, the results will vary depending on the level of objectivity of the methods used to determine individuals' internet use, and particularly self-reported inquiries about internet usage time, as done in this study; a margin of error must be taken into consideration. Despite the findings of this study indicating no difference in mean screen time between those at ON-risk and those not at risk, the presence of a significant positive correlation between the disorder symptom subscale of TON-17 and screen time, as well as an increase in ON risk in accordance with digital healthy diet literacy levels, has led to controversial questions regarding the protective effect of digital literacy.

Although numerous studies reported positive contributions of high health literacy to favorable health outcomes (4, 23, 25, 42), it is accurate to emphasize that the relationship between the use of virtual resources and health outcomes is complex and multifaceted. A recent meta-analysis indicated that e-health literacy might not always positively affect health behaviors —vaccine-hesitant individuals have a higher tendency to seek online health information—so this influence requires deeper analysis. Although a positive correlational trend is observed as a general effect between e-health literacy and health-related behaviors, this relationship weakens among young adults and remains moderate among older adults, suggesting the presence of certain mediating factors in this relationship (4). In line with our findings, there are also studies suggesting that individuals with higher e-health literacy may be more prone to make online investigations for reassurance and, in doing so, they may perform these searches excessively (1, 4, 43). However, it should be highlighted that high e-health literacy does not always reduce the urge to seek out excessive online health information; in fact, it may even trigger the emergence of anxiety symptoms that might lead to cyberchondria (1, 43). Recent literature includes reports highlighting the association between cyberchondria- the most common subclinical condition characterized by persistent or repetitive health-related internet searching along with anxiety about one's own health – and negative health outcomes including internet addiction, health anxiety, anxiety susceptibility, and even transdiagnostic compulsive behavioral syndrome (1, 9, 11, 17, 43). A scoping review of 42 studies reported a prevalence of cyberchondria ranging from 30.7% to 55.6% (1), and moreover, an inverse relationship was reported in the literature suggesting that someone can suffer cyberchondria irrespective of their level of e-health literacy and that higher e-health literacy does not necessarily be protective against cyberchondria (7, 13, 43). Furthermore, a recent study that reported a potential connection between obsessive beliefs and cyberchondria provides intriguing insights into how this could be a potential mediator of orthorexia nervosa (44). Another study reported an increased risk of orthorexia nervosa as cyberchondria increases, which suggests that the interaction between these two conditions needs to be addressed as a significant public health issue in the future (45).

The dominance of women participants, the fact that screen time data was collected depending on individuals' self-reports, and the cross-sectional design are considered significant limitations of this study. It is recommended that future studies should include not only these factors, but also cyberchondria, as this would be beneficial in identifying the aforementioned potential risk.

Conclusions

In conclusion, somewhat unexpectedly, this study observed that the tendency towards orthorexia nervosa increased when individuals' levels of healthy eating literacy rose above a certain level. This finding was an important indication that the potential consequences of excessive internet use should be considered. It is obvious that the ability to research online that comes with digital literacy may not always yield the desired results; in fact, it can unknowingly lead individuals to become overly obsessive, highly anxious, and excessively search for health-related issues. Therefore, it is crucial to use targeted and audience-oriented content and appropriate methods in efforts to promote digital health literacy.

Declarations

Clinical trial number: not applicable.

Ethics approval and consent to participate

The study described in this paper is covered by the ethics approval obtained from the Yeditepe University Non-Interventional Clinical Research Ethics Committee with the date and number E.83321821-805.02.03-497, in accordance with the Helsinki Declaration. Prior to participation, all participants read and signed an informed consent form describing the study's objectives, procedures, confidentiality, and voluntary participation basis. For illiterate participants, in accordance with ethical guidelines, verbal informed consent was obtained in a language they understood after a full explanation of the study.

Consent for publication

All authors accept responsibility to submit for publication.

Competing Interest

The authors declare no competing interests.

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Author Contribution

All authors contributed equally to designing the study. İKC conceptualized the study, designed the methodology, conducted the statistical analysis, and wrote the original draft. GDB contributed as the co-supervisor and assisted with data interpretation, literature review, and manuscript revision. SŞ, ÇGK, and SD contributed to data collection and wrote the initial draft of the manuscript. GDB, SŞ, ÇGK, and SD reviewed the article for critically important content and approved the final version. The corresponding author confirms that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Data Availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

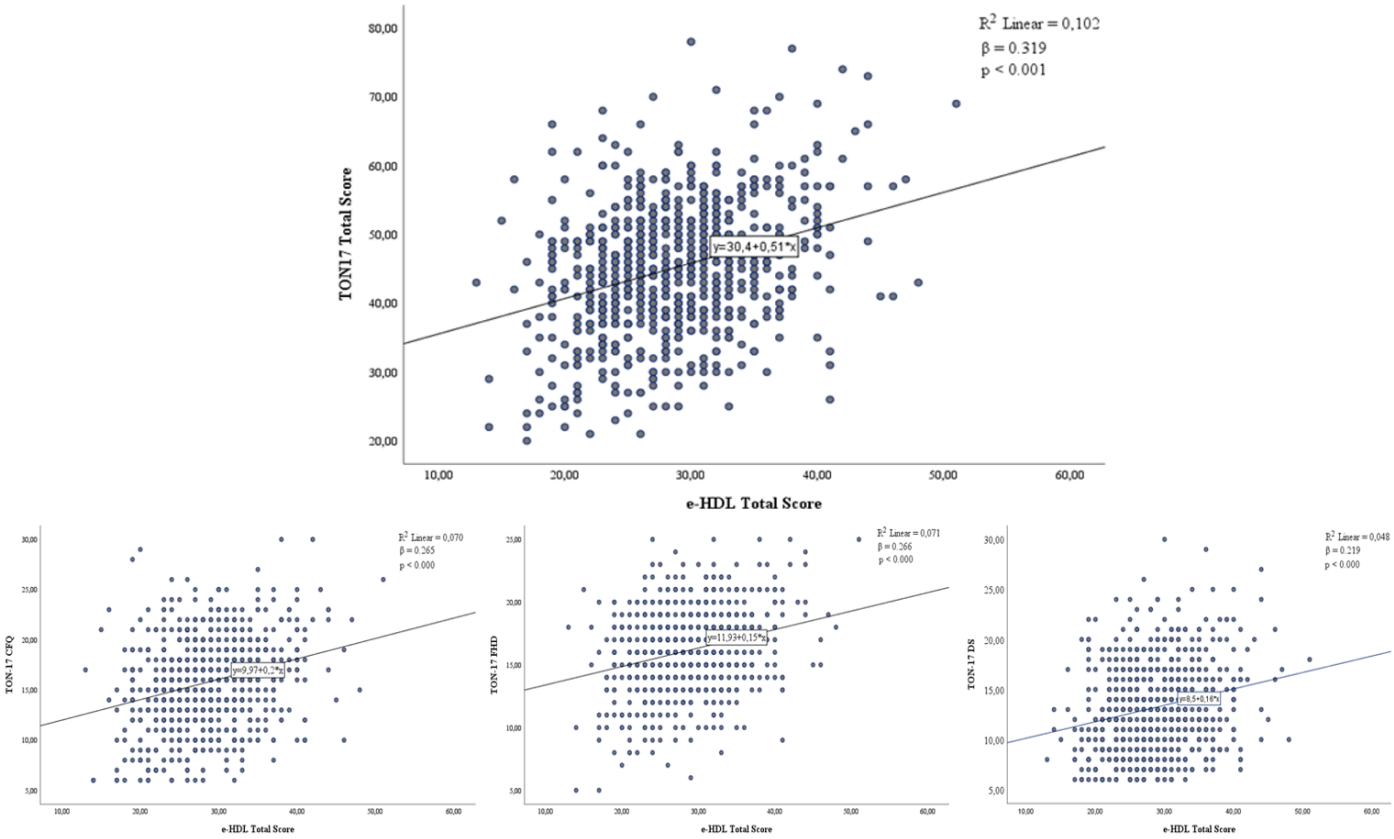


Figure 1

Associations between TON-17 total and sub-factor scores and e-HDL total score

β, coefficient for the constant; SE. Standard Error; df. degree of freedom; CI. Confidence Interval; TON-17, Test of Ortorexia Nervosa-17; e-HDL, electronic-healthy diet literacy; CFQ, control of food quality; FHD, fixation on health and a healthy diet; DS, disorder symptoms; * $p < 0.05$; ** $p < 0.01$