Readability assessment of Turkish orthorexia nervosa scales with confirmed reliability and validity

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ABSTRACT

Objective: This study aimed to assessment the readability levels of Turkish adapted orthorexia nervosa self-report scales with confirmed reliability and validity. While psychometric properties of these scales have been previously examined, their linguistic accessibility and readability which affect user comprehension and data quality have been largely overlooked.

Methods: A descriptive document analysis was conducted by collecting Turkish versions of nine orthorexia nervosa scales validated for adult individuals. These scales were identified through a comprehensive literature search performed in widely used academic databases. The readability of scale items was assessed using two formulas appropriate for Turkish texts: the Ateşman Readability Formula and the Çetinkaya-Uzun Readability Formula. Textual features such as total word count, sentence count, average word length, and average sentence length were calculated. Readability scores were then classified according to established educational level benchmarks for each formula.

Results: The nine scales evaluated in this study were the Barcelona Orthorexia Scale (BOS), Düsseldorf Orthorexia Scale (DOS), Eating Habits Questionnaire (EHQ), Orthorexia Nervosa Inventory (ONI), Orthorexia Nervosa Scale (ONS), ORTO-11, ORTO-R, Test of Orthorexia Nervosa (TON-17), and Teruel Orthorexia Scale (TOS). According to the Ateşman formula, all scales except ORTO-R were categorized as "somewhat difficulty", corresponding approximately to comprehension at the high school level (11th-12th grade). ORTO-R required a university level reading ability and was classified as "difficult". Using the Çetinkaya-Uzun formula, all scales were classified within the "educational reading" category, indicating an 8th-9th grade comprehension level.

Conclusion: Overall, the Turkish-adapted orthorexia nervosa scales demonstrated moderate readability suitable for individuals with high school education. However, their applicability may be limited among populations with lower education and health literacy levels. Future adaptation studies should include readability analyses and pilot testing across diverse educational backgrounds to ensure inclusivity and accurate assessment.

Keywords: orthorexia nervosa, readability, reliability, validity

Introduction

Orthorexia nervosa (ON), which has been extensively researched in recent years, is derived from the Greek words "ortho" (correct) and "orexia" (appetite) and was first defined by Steven Bratman in 1997 as an obsessive and compulsive preoccupation with healthy eating.[1]

Initially described as a disorder unrelated to weight and body shape concerns, focusing solely on food quality and purity, ON has since been recognized by researchers as a complex condition that may also include weight and body shape concerns.[2,3] Individuals with ON tend to prioritize the quality of food over its quantity, fixating intensely on aspects such as food purity, quality, preparation,

and packaging.[4] This pathological preoccupation can dominate their daily lives and scauses difficulties in social relationships, family life, and work performance.[3] Whether ON should be classified as a distinct eating disorder or considered within the broader spectrum of mental health disorders remains a topic of ongoing debate. Although general diagnostic criteria have been proposed, ON is not currently included in official psychiatric classification systems such as International Classification of Diseases (ICD-11) or Diagnostic and Statistical Manual of Mental Disorders (DSM-5).[5] This lack of consensus hinders the standardization of its definition and diagnosis. Nevertheless, especially in today's world where healthy eating trends are on the rise, preclinical disordered eating behaviors, including ON and other unhealthy preoccupations with body image, have increased at an alarming rate. Various studies have shown that the prevalence of ON varies widely across different populations, ranging from 6.9% to 90.6%.[6-8] Additionally, the identification of ON symptoms in approximately one-third of participants in a recent large scale meta-analysis highlights the serious public health concern posed by this condition.[9] In light of these concerns, the development of valid and reliable assessment instruments to detect ON early and guide interventions has become increasingly critical. Although no original ON scale has yet been developed in Türkiye, nine different ON scales have been adapted into Turkish. However, despite the emphasis on psychometric validation, the readability of these scales -the extent to which they are understandable to users- is often overlooked.[10]

Readability refers to how easily and accurately a text can be comprehended by its intended audience.[11] It is a parameter that is objectively measured using mathematical formulas based on quantitative characteristics such as the syntactic complexity, sentence length, and word length of texts.[12] In English texts, formulas such as the Flesch Reading Ease Formula, Flesch-Kinkaid Reading Grade Level, Gunning Frequency of Gobbledygook, and SMOG Index are commonly used.[13,14] In Turkish texts, the formulas developed by Ateşman,[15] Çetinkaya-Uzun,[16] and Bezirci-Yılmaz[17] are used. This study aims to evaluate the readability levels of Turkish adapted ON scales with confirmed reliability and validity, using the Ateşman and Çetinkaya-Uzun readability formulas. By doing so, it seeks to assess how comprehensible ON-related self-report scales are to users and to highlight the importance of integrating readability analyses into validation processes in order to enhance the quality and accessibility of such tools in both research and clinical contexts.

Material and Method

Study design and data collection

This research is a descriptive document analysis study. A comprehensive literature search was conducted in July 2025 across the PubMed, Scopus, Web of Science, and Google Scholar databases. The search strategy included keywords such as "Orthorexia nervosa", "Orthorexia", "Orthorexic behavior", "Healthy eating obsession", "Screening tool", "Assessment tool", "Diagnostic tool", "Self-report scale", "Psychometric properties", "Measurement instrument", "Questionnaire", "Validation", "Reliability", and "Validity". Through this process, nine ON scales adapted into Turkish were identified. All of these scales are self-report measurement scales that have undergone validity and reliability studies in adult populations. Necessary permissions for use were obtained from the original researchers who adapted these scales. The identified scales and the researchers who adapted them into Turkish are listed in Table 1.

Ethical approval

As this study involved document analysis of published materials and did not include human subjects or interventions, ethical committee approval was not required. Similar studies in the literature have also been conducted without the need for ethical approval.[10,25]

Readability analysis

In this study, the readability levels of the scale items were assessed using the Ateşman[15] and Çetinkaya-Uzun[16] readability formulas. These two indices were used because they are the most widely applied and

> ### Main Points
>
> - This study evaluated the readability of nine Turkish adapted ON scales using objective formulas.
> - Most scales showed moderate readability, suitable for individuals with a high school education level.
> - Future scale adaptation studies should integrate readability analyses and pilot testing to ensure broader applicability and comprehension across diverse populations.

Table 1. Turkish adapted orthorexia nervosa scales

Scales	Authors adapted into Turkish	Year	Number of Items
Barcelona Orthorexia Scale (BOS)	Bilekli-Bilger and Dağ[18]	2023	50
Düsseldorf Orthorexia Scale (DOS)	Yılmaz, Demirkol, Tamam, Özdemir-Yılmaz, Yeşiloğlu[19]	2024	10
Eating Habits Questionnaire (EHQ)	Bilekli-Bilger and Dağ[18]	2023	18
Orthorexia Nervosa Inventory (ONI)	Kaya, Uzdil, Çakıroğlu[20]	2022	24
Orthorexia Nervosa Scale (ONS)	Bilekli-Bilger and Dağ[18]	2023	15
ORTO-11	Arusoğlu, Kabakçı, Köksal, Kutluay-Merdol[21]	2008	11
ORTO-R	Kaya, Asil, Çakıroğlu, Sertdemir, Can, Muradoğlu[22]	2024	6
Test of Orthorexia Nervosa (TON-17)	Yassıbaş and Aydıldız[23]	2023	17
Teruel Orthorexia Scale (TOS)	Asarkaya and Arcan[24]	2023	16

cited Turkish readability formulas, with simple and comparable structures that facilitate the consistency and interpretability of results.[15,26,27] The Ateşman Readability Formula was developed based on the Flesch Reading Ease Formula, taking into account the unique structure of the Turkish language.[15,28] This formula calculates the readability level of a text based on the variables of average word length (number of syllables) and average sentence length (number of words).

Ateşman Readability Formula = 198.825 − (40.175 × average word length) − (2.610 × average sentence length)

The resulting score ranges from 0 to 100; with higher scores indicating easier readability.[15] The corresponding educational levels associated with score ranges are presented in Table 2. The readability scores were calculated based on the formulas described above.

The study also used the Çetinkaya-Uzun Readability Formula, which was developed specifically for Turkish texts.[16,26] It is similarly based on average word and sentence lengths but uses a different mathematical structure.

Çetinkaya-Uzun Readability Formula = 118.823 − (25.987 × average word length) − (0.971 × average sentence length)

Unlike the Ateşman formula, lower scores on the Çetinkaya-Uzun Formula indicate higher readability demands,[16] with corresponding educational level classifications detailed in Table 2.

During the analysis process, the total number of syllables, words, and sentences in each scale text was calculated and transferred to Microsoft Excel. Then, scores were calculated according to the Çetinkaya-Uzun Readability Formula and compared with the evaluation scales.

The statistical analyses are descriptive in nature. Since the study aims to summarize and compare inter scale readability scores rather than test specific hypotheses, inferential statistical tests or multiple comparison adjustments have not been applied.

Results

Descriptive statistics regarding the linguistic characteristics of the Turkish versions of the ON scales are presented in Table 3. Among the scales, the BOS contains the greatest number of words and sentences, as well as the highest total character count (4125) and total word count (491). In contrast, the ORTO-R scale, comprising only 6 items, features the shortest text length. Similarly, the DOS exhibits a concise language structure with a relatively short text. Regarding average word length, all scales maintain the typical Turkish three-syllable word structure. The highest average word length was observed in the ONS (3.09 syllables), while the lowest was in the ONI (2.85 syllables). For average sentence length, the ONI again had the highest value (12.4 words per sentence), whereas the EHQ had the shortest average sentence length (7.3 words).

Table 2. Readability and education levels according to Ateşman and Çetinkaya-Uzun readability formulas

Score	Readability Level	Education Level
Ateşman Readability Formula Score[15]		
90–100	Very easy	4th grade
80–89	Easy	5th–6th grade
70–79	Fairly easy	7th–8th grade
60–69	Moderate difficulty	9th–10th grade
50–59	Somewhat difficulty	11th–12th grade
30–49	Difficult	University level
1–29	Very difficult	Postgraduate level
Çetinkaya-Uzun Readability Formula Score[16]		
0–34	Assisted reading level	10th–12th grade
35–50	Educational reading	8th–9th grade
51 and above	Independent reading	5th–7th grade

Figure 1 shows the scores obtained from the Ateşman and Çetinkaya-Uzun readability formulas for the ON scales, which have been adapted in Turkish, while Table 4 shows the readability and education levels corresponding to these scores.
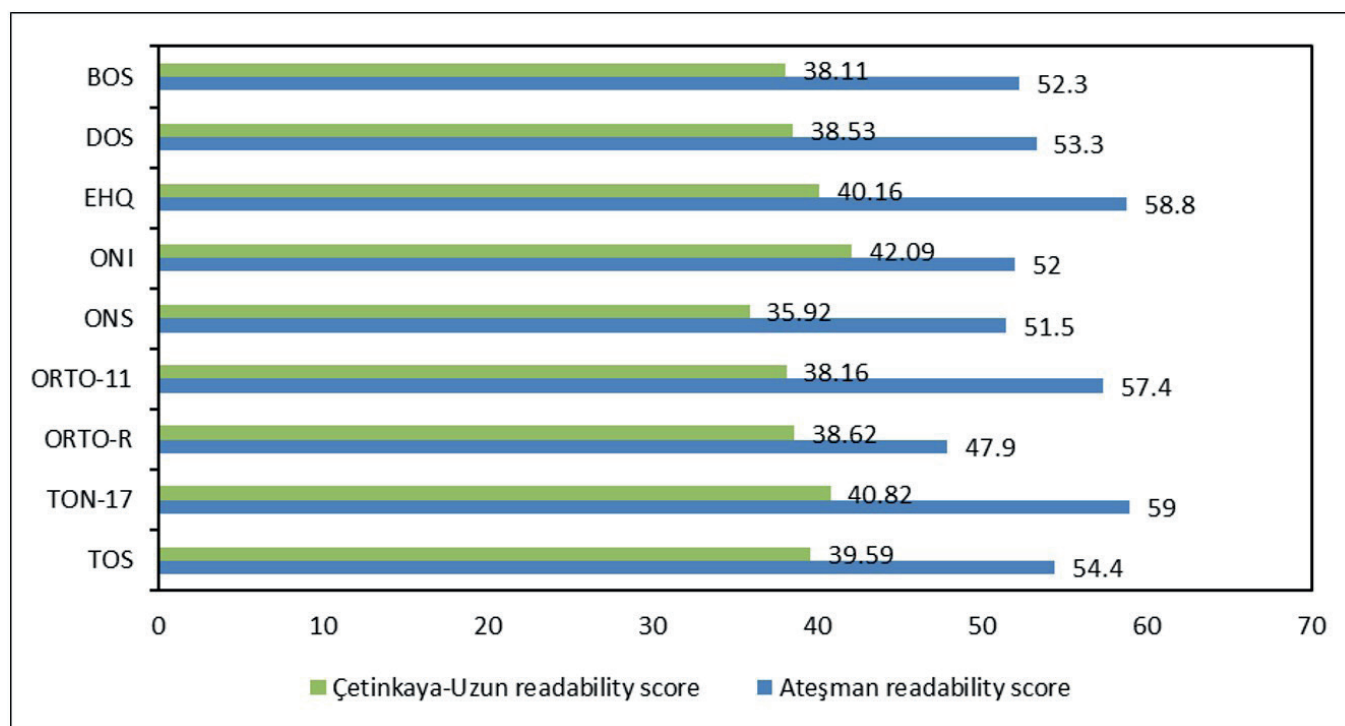
According to Ateşman readability scores, all scales except ORTO-R were determined to be in the "somewhat difficulty" category, indicating that they are generally comprehensible to individuals at the 11th to 12th grade (high school senior) education level (Table 4). The highest readability score belongs to the TON-17 scale (59.0), while the lowest score was found in the ORTO-R scale (47.9) (Figure 1). The ORTO-R scale was classified as "difficult" according to the Ateşman Readability Formula, implying that it requires a university level reading ability (Table 4). According to the Çetinkaya-Uzun Readability Formula, all scales are categorized as requiring "educational reading" ability, corresponding to an 8th to 9th grade educational level. Within this classification, the ONI had the highest readability score (42.09), while the ONS had the lowest (35.92) (Table 4).

Table 3. Descriptive linguistic statistics of the scales

Scales	Total Word Count	Total Character Count	Sentence Count	Difficult Word Count	Average Word Length	Average Sentence Length
BOS	491	4125	50	489	3.01	9.8
DOS	88	751	10	88	3.05	8.8
EHQ	131	1098	18	130	3.01	7.3
ONI	299	2382	24	296	2.85	12.4
ONS	134	1149	15	134	3.09	8.9
ORTO-11	100	822	11	99	2.93	9.1
ORTO-R	69	581	6	68	3.01	11.5
TON-17	155	1254	17	154	2.89	9.1
TOS	154	1280	16	154	2.97	9.6

BOS: Barcelona Orthorexia Scale, DOS: Düsseldorf Orthorexia Scale, EHQ: Eating Habits Questionnaire, ONI: Orthorexia Nervosa Inventory, ONS: Orthorexia Nervosa Scale, TON-17: Test of Orthorexia Nervosa, TOS: Teruel Orthorexia Scale

Figure 1. Readability score of the scales according to Ateşman and Çetinkaya-Uzun readability formulas

Table 4. Readability values of the scales

Scales	Ateşman Readability Level	Ateşman Education Level	Çetinkaya-Uzun Readability Level	Çetinkaya-Uzun Education Level
BOS	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade
DOS	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade
EHQ	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade
ONI	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade
ONS	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade
ORTO-11	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade
ORTO-R	Difficult	University level	Educational reading	8th–9th grade
TON-17	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade
TOS	Moderate difficulty	11th–12th grade	Educational reading	8th–9th grade

BOS: Barcelona Orthorexia Scale, DOS: Düsseldorf Orthorexia Scale, EHQ: Eating Habits Questionnaire, ONI: Orthorexia Nervosa Inventory, ONS: Orthorexia Nervosa Scale, TON-17: Test of Orthorexia Nervosa, TOS: Teruel Orthorexia Scale

Discussion

This study is one of the pioneering studies that examines the readability levels of Turkish adapted ON scales using objective criteria. The findings reveal that all scales examined have a generally "somewhat difficulty" readability level and are understandable by individuals with a high school education. However, when the average literacy level in Türkiye is considered the practical implication of these findings becomes particularly significant. The scales categorized as being of "moderate difficulty" may not be sufficiently comprehensible for

individuals with lower literacy levels, which could restrict their usability in community-based or clinical settings involving diverse educational backgrounds. This concern is further underscored by the close relationship between general literacy and health literacy, both of which are known to affect individuals' capacity to accurately interpret and respond to health related materials. A study conducted in Türkiye on the national health literacy level showed that three-quarters of individuals over the age of 18 have limited (insufficient or problematic) health literacy levels.[29] In conclusion, the moderate level of readability identified in this study may make it difficult to accurately assess orthorexic behaviors, particularly among individuals with low educational attainment and limited health literacy.

The differences in readability levels observed among the ON scales can be attributed to the methods used to develop these scales, the cultural contexts from which they originate, and strategic choices made during the translation process. For example, the ORTO-R scale, which has the lowest readability score, consists of short sentences but contains a language structure that is conceptually dense and loaded with technical terms. This situation may reduce the comprehensibility of the scale, especially for individuals with low educational levels and health literacy. Similarly, scales such as the BOS, which have a large number of words and sentences, may require more cognitive effort despite providing content richness. In contrast, scales such as the TON-17 and EHQ, which are structured with simpler and clearer expressions, increase comprehensibility. These results emphasize that the readability level of a scale is determined not only by the number of items but also by sentence structure, word choice, and conceptual clarity. Therefore, in the development of measurement tools, not only the content but also the linguistic presentation form should be considered. A similar pattern has been observed in various self-report instruments, particularly within the field of mental health, where readability analyses have shown that many commonly used scales demand literacy levels above the population average.[30] McHugh and Behar (2010) noted that the accessibility of such tools is often reduced due to the frequent use of technical terminology and complex sentence structures, potentially limiting their effectiveness among individuals with lower reading proficiency.[31]

When reviewing the validity and reliability studies of the Turkish adaptations of the ON scales, it is observed that these studies were largely conducted on university students or individuals with higher education.

This situation has led to the samples consisting of individuals with generally high language proficiency, thereby limiting the generalizability of the evaluations of the scales' comprehensibility levels. For example, the Turkish adaptation studies of the EHQ, BOS, and ONS were conducted with university students; the average age of the participants was reported to be 21.26.[18] The TON-17 was tested on a sample with an average age of 30.2, 95% of whom were individuals with graduate or undergraduate education.[23] Similarly, the ONI was evaluated with a sample consisting of individuals with an average age of 30.15, 91.1% of whom had graduate and undergraduate education.[20] In the ORTO-R scale study, participants with an average age of 24 and 88% of whom had higher education were used.[22] It is noteworthy that in the adaptations of scales such as TOS, the majority of the samples consisted of individuals with a high level of education.[24] Although some studies have conducted comprehensibility tests and pilot applications, it is observed that these processes have not been systematically carried out for all scales and that they contain differences in terms of surface validity.[19-23] This situation highlights critical concerns regarding the functional applicability of existing scales, particularly for individuals with lower levels of education. In countries like Türkiye, where approximately 60% of the population are secondary school graduates,[32] scales validated predominantly on highly educated samples may not adequately represent or serve the broader population. As a result, the generalizability and inclusiveness of these scales are brought into question. The findings of the current study, which reveal moderate to difficult readability levels across scales, underscore the potential risk that these instruments may not be equally comprehensible to individuals with varying educational backgrounds. This disparity poses a threat to the early detection and proper assessment of ON, potentially leading to misinterpretations, omitted responses, or inaccurate self-reporting.

Readability is not only a linguistic concern but also a core determinant of a tool's effectiveness in accurately capturing user responses. In self-report psychological assessments, the clarity and accessibility of language directly influence the reliability and validity of the collected data. Scales with low readability are more likely to be misunderstood, improperly completed, or partially skipped, compromising both data quality and diagnostic accuracy. Moreover, when research tools are misaligned with the education level of their intended audience, they risk becoming exclusionary, thereby limiting both participation and the generalizability of findings.[30,33,34]

In clinical settings, such misalignments can result in diagnostic errors or delays, especially for emerging psychological conditions like ON, which lack standardized criteria yet demonstrate increasing prevalence. Therefore, it is essential that readability is systematically integrated into the scale development and adaptation process, alongside traditional psychometric evaluations. Doing so would enhance the inclusivity, clarity, and overall utility of assessment tools across diverse populations.

Limitations

This study has several limitations that should be acknowledged. First, the analysis was limited to nine self-report ON scales that have been adapted into Turkish and validated for adult individuals. Therefore, the results may not be generalizable to other scales that have not been included or to newly developed instruments. Additionally, the study focused solely on textual readability using two objective formulas (Ateşman and Çetinkaya-Uzun), without incorporating participant-based assessments such as user comprehension testing or qualitative feedback. Moreover, this study did not evaluate the readability of accompanying materials such as instructions, response formats, or scale administration procedures, which may also influence comprehension and usability. This study was conducted purely as a document-based analysis, and the scales were not pilot tested with participants from varying educational levels, which may limit the generalizability of the results. Finally, it is thought that the translation and adaptation processes of the scales evaluated differed and that not all of them followed a standard methodology, and that this situation may have indirectly affected the readability levels observed in the Turkish versions.

Conclusion

In this study, the readability levels of nine self-report scales adapted into Turkish for ON were evaluated using the Ateşman and Çetinkaya-Uzun Readability Formulas. The results obtained showed that most scales had a readability level suitable for high school students and were of moderate difficulty. Readability is as important a criterion as psychometric validity and reliability and should be considered for the proper and effective use of measurement tools. Low readability can negatively affect data quality by preventing participants from correctly understanding the scales and may lead to disruptions in the diagnostic process. Therefore, it is recommended that user focused criteria such as linguistic accessibility and readability be systematically evaluated in future scale development and adaptation studies. Furthermore, future research should prioritize conducting pilot testing and comprehensibility assessments with participants representing different educational levels to ensure that the scales are accessible and interpretable across diverse population groups. Additionally, the comprehensibility of scales should be tested through pilot applications and qualitative studies with participants from different educational and socio-cultural backgrounds. Ensuring that assessment tools for ON used in clinical practice and research are adequate from both psychometric and linguistic perspectives will enhance the effectiveness of early diagnosis and intervention processes. In conclusion, this study aims to contribute to future research and clinical practice by filling an important gap in the applicability of ON measurement tools.

Ethical approval

As this study involved document analysis of published materials and did not include human subjects or interventions, ethical committee approval was not required.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: SK; data collection: SK; analysis and interpretation of results: SK; draft manuscript preparation: SK. The author reviewed the results and approved the final manuscript.

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Conflict of interest

The author declares no conflict of interest.

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