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Perceptions of Dentists Towards Artificial Intelligence: Validation of a New Scale

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ABSTRACT

Objective: To enhance the effectiveness and efficiency of using artificial intelligence (AI) in healthcare, it is crucial to comprehend the perceptions of healthcare professionals and individuals regarding AI. This study aimed to: (i) develop and conduct psychometric analyses of a new measurement tool, the AI Perceptions Scale (AIPS); and (ii) identify and compare sub-dimensions of perceptions of AI and its sub-dimensions, specifically in the dental profession.

Materials and Methods: The study used a cross-sectional and correlational design involving 543 dentists. The data collection tools used were a socio-demographic form, the AIPS, and the Dental Profession Perceptions Scale (DPPS). Construct validity was assessed using exploratory and confirmatory factor analysis. Multivariate analysis of variance was utilized to test the difference between AIPS scores among groups.

Results: The AIPS contained 26 items measured on a 5-point Likert response scale and demonstrated excellent internal and test-retest reliability. Exploratory and confirmatory factor analyses of the AIPS identified six factors that categorized perceptions of AI, including 'Human', 'Security', 'Accessibility', 'Vocational', 'Technology', and 'Cost'. The six-factor solution of the AIPS model demonstrated a good fit for the data. AIPS scores varied depending on gender, working place, occupational experience, the need to use AI, and the frequency of AI use in dental practice. The total AIPS score had the strongest correlation with the "human" factor and the weakest correlation with the "accessibility" factor. Statistically significant correlations were observed between the AIPS score and DPPS total, as well as each of its three sub-scales.

Conclusions: This study developed a new scale, the AI Perceptions Scale (AIPS), to evaluate perceptions of AI in healthcare. The perceptions of dentists towards AI were categorized into six distinct factors. The AIPS scale was found to be a reliable and valid measurement tool, indicating that it can be effectively used in future research.

Keywords: Artificial Intelligence, Attitude of Health Personnel, Dentists, Occupational Dentistry, Perception.

Diş Hekimlerinin Yapay Zekâya İlişkin Algıları: Yeni Bir Ölçeğin Geliştirilmesi ve Geçerliliği

Süreç

Geliş: 29/12/2023
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ÖZ

Amaç: Yapay zekanın (yz) sağlık hizmetlerinde kullanımının etkinliğini ve verimliliğini artırmak için, sağlık profesyonellerinin ve bireylerin YZ ile ilgili algılarını anlamak çok önemlidir. Bu çalışmanın amacı: (i) yeni bir ölçüm aracı olan YZ Algılama Ölçeği'nin (YZPS) psikometrik analizlerini geliştirmek ve yürütmek; ve (ii) YZ algılarının alt boyutlarını ve alt boyutlarını, özellikle dişhekimliği mesleğinde belirlemek ve karşılaştırmaktır.

Gereç ve Yöntem: Çalışmada, 543 diş hekimini içeren kesitsel ve korelasyonel bir tasarım kullanıldı. Kullanılan veri toplama araçları sosyo-demografik bir form, YZPS ve Diş Hekimliği Mesleği Algı Ölçeği'dir (DPPS). Yapı geçerliliği açımlayıcı ve doğrulayıcı faktör analizi kullanılarak değerlendirildi. Gruplar arasında YZPS puanları arasındaki farkı test etmek için çok değişkenli varyans analizi kullanıldı.

Bulgular: YZPS, 5 noktalı Likert yanıt ölçeğinde ölçülen 26 madde içeriyordu ve mükemmel dahili ve test-tekrar test güvenilirliği gösterdi. PS'nin açıklayıcı ve doğrulayıcı faktör analizleri, "İnsan", "Güvenlik", "Erişilebilirlik", "Mesleki", "Teknoloji" ve "Maliyet" dahil olmak üzere yapay zeka algılarını kategorize eden altı faktör belirledi. YZPS modelinin altı faktörlü çözümü, veriler için iyi bir uyum gösterdi. YZPS puanları cinsiyete, çalışma yerine, mesleki deneyime, YZ kullanma ihtiyacına ve dişhekimliği pratiğinde YZ kullanım sıklığına bağlı olarak değişti. Toplam YZPS puanı, "insan" faktörü ile en güçlü korelasyona ve "erişilebilirlik" faktörü ile en zayıf korelasyona sahipti. YZPS puanı ile DPPS toplamı ve üç alt ölçeğinin her biri arasında istatistiksel olarak anlamlı korelasyonlar gözlendi.

Sonuçlar: Bu çalışma, sağlık hizmetlerinde yapay zeka algılarını değerlendirmek için yeni bir ölçek olan YZ Algılama Ölçeği (YZPS) geliştirdi. Diş hekimlerinin yapay zekaya yönelik algıları altı farklı faktöre ayrılmıştır. YZPS ölçeğinin güvenilir ve geçerli bir ölçme aracı olması, gelecekte yapılacak araştırmalarda etkin bir şekilde kullanılabileceğini göstermektedir.

Anahtar Kelimeler: Yapay Zeka, Sağlık Personelinin Tutumu, Diş Hekimleri, Işyeri Diş Hekimliği, Algı.

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Introduction

Artificial intelligence (AI) systems have the ability to perceive and respond to events, phenomena, and objects in a manner similar to human intelligence.[1] As AI continues to permeate every aspect of daily life, it has become increasingly important to understand how it is perceived and utilized.[2,3]

The use of AI in dentistry is widespread, particularly in areas such as x-ray and diagnostics[4-6], caries detection[7,8], implantology[9], practice management[10,11], teledentistry[12], and clinical prediction.[13] However, dentists' attitudes toward the use of AI in their profession, as well as the factors that contribute to their willingness or reluctance to use it, are critical to the development of AI algorithms that can enhance the quality of dental practice.[14] The effective implementation of AI tools can significantly improve patient care and optimize daily workflow.[15, 16] However, many dentists are still skeptical about the use of AI in dentistry and view it as a potentially exaggerated trend.[17] This skepticism may be due to negative perceptions of AI, which can lead to negative behavior. Perception and behavior are closely linked, and people's behavior is often influenced by their perceptions.[18]

Understanding the concerns of individuals and the public regarding AI is crucial since these concerns can lead to regulatory activities with potentially severe consequences.[19] While previous literature has primarily focused on future uses of AI, there has been limited research aimed at developing a reliable and valid tool for measuring people's perceptions of AI. However, to the best of our knowledge, no study has examined the sub-components of AI and their relationship with various concomitant factors in dentistry. Given these reasons, developing a measurement tool that assesses people's perceptions of AI and its sub-dimensions can have a significant impact on both clinical and academic aspects.

There are numerous sub-dimensions related to human[20], occupational[21], technological[22], economic[23], security[24,25], accessibility[26], and social factors[27] that can have a positive or negative impact on the use of AI. To enhance the understanding of AI solutions and assess their value, it is crucial to consider these factors. A conceptual model that examines these sub-dimensions together can facilitate the analysis of the factors that may influence them.

The primary objectives of this study were twofold: (i) to develop and conduct psychometric analyses of a novel measurement tool, the AI Perceptions Scale (AIPS); and (ii) to compare and identify sub-dimensions of perceptions of AI with those of the dental profession and its sub-dimensions. The study aimed to answer the following research questions: (i) how do dentists perceive AI; and (ii) do perceptions of AI differ based on factors such as age, gender, education level, working place, occupational experience, income, previous AI education, self-efficacy, necessity to use AI, and frequency of using AI in both daily life and dental practice?

Materials and Methods

Ethical Considerations

This study was conducted in accordance with the ethical standards outlined in the Helsinki Declaration of 1964 and its subsequent amendments. The researchers informed participants that the results would only be used for scientific purposes and that personal data would be kept confidential. Written consent was obtained from all participants.

Study design and participants

This study utilized a cross-sectional and correlational design and was conducted in a province. A convenience sample of 460 practitioners and specialist dentists from various dental specialties who were working in public hospitals, dental faculties, and private clinics were recruited. The study group consisted of dentists working in the city center since most dental patients seek treatment in this area. Additionally, dentists working in the surrounding areas generally prefer not to treat their dental patients. The data collection period took place between July 2022 and September 2022. The participating dentists graduated from different faculties and had varying years of professional experience. Volunteers who were fluent in Turkish were recruited for the study. To assess test-retest reliability, 50 randomly selected participants completed the measurement one month after the initial assessment.

Measurements

The data collection tools that were utilized included three main components: the socio-demographic form, the Artificial Intelligence Perceptions Scale (AIPS), and the Dental Profession Perceptions Scale.

The socio-demographic form

The socio-demographic form contained questions that sought to elicit personal information about the participants, such as their age, gender, education level, monthly income, working experience, working place, previous AI education, and self-efficacy, necessity, and frequency of using AI systems.

The Dental Profession Perceptions Scale

The Dental Profession Perceptions Scale (DPPS) consisted of 17 items, which were measured on a 5-point Likert scale (1=strongly disagree and 5=strongly agree). The DPSS was originally developed in Turkish and English and had good reliability and validity.[28] It addresses participants' perceptions of the dental profession and was built on solid theoretical and psychological bases. The 'Status' factor of the DPPS comprised six items, while the 'Human' factor included seven items, and the 'Scientific' factor consisted of four items. Participants were scored on a scale ranging from 17 to 85.

Artificial Intelligence Perceptions Scale

The development of the Artificial Intelligence Perceptions Scale (AIPS) followed a rigorous methodology

based on existing literature. Initially, a comprehensive literature review was conducted to identify perceptions towards AI. The search was conducted on PubMed, ISI WOS, and Google Scholar databases, using the search terms "artificial intelligence" and "perceptions of artificial intelligence," and limited to English-language peer-reviewed journals. This process resulted in a 44-item draft scale, where each item was rated on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). The theoretical model was based on previous AI studies and models, and included sub-dimensions such as "human," "vocational," "technological," "accessibility," "security," and "cost." To ensure face validity, the 44-item scale design was reviewed by an expert team, consisting of a computer engineer, a lecturer from the department of artificial intelligence, and a statistician. The experts provided feedback on the appropriateness of each item for the established conceptual framework, and whether they contained any non-theoretical items. Group discussions with ten participants were also conducted to assess the comprehensibility of the questions and answer options. Based on feedback from the experts and group discussions, seven items were removed from the scale. Finally, two Turkish experts verified the scale, and the final article pool was established.

Statistical Analysis

The data were analyzed using two software programs, SPSS 22.0 (Statistical Package for the Social Sciences) and LISREL 8.51 (Scientific Software International, Lincolnwood, IL USA), with various descriptive statistics calculated. Construct validity was assessed using exploratory factor analysis (EFA) with principal components analysis (PCA) and varimax rotation, and internal reliability was assessed with Cronbach's alpha. Test-retest reliability was assessed with intra-class correlation coefficients (ICCs). The factor structure was then tested using confirmatory factor analysis (CFA) with various fit indexes used to assess the validity of the model. Correlations between different variables were evaluated using Pearson product-moment correlation coefficients. Multivariate analysis of variance (MANOVA) was used to test differences between AIPS scores and socio-demographic and personal characteristics, while independent samples t-tests were used to determine gender differences. The statistical significance level was set at 0.05.[29]

Results

Participants' characteristics

Out of the total 460 participants, 294 (63.9%) were female and 166 (36.1%) were male. The participants were categorized into two groups based on their education level: undergraduate (n=247, 53.7%) and post-graduate (n=213, 46.3%).

Exploratory factor analysis and scale structure

To determine the suitability of the AIPS for factor analysis using PCA, the Kaiser-Meyer-Olkin (KMO) coefficient and Bartlett's sphericity test were used. The data were found to be appropriate for factor analysis, as indicated by the statistically significant KMO value of 0.931 and Bartlett's sphericity test value of $X^2 = 6917.83$, $P<0.01$. After varimax rotation, 11 items were excluded from the scale because their loading factors were shared across two or more factors and/or the loading factor difference was less than 0.10. The final AIPS consisted of 26 items divided into six factors with an Eigenvalue higher than 1. These factors were named as the 'Human', 'Security', 'Accessibility', 'Vocational', 'Technology', and 'Cost' aspects of AI. The 'Human' factor had the highest value (Eigenvalue = 6.44, Cronbach's a = 0.94, % variance explained=24.74) and consisted of nine items examining the characteristics of the human and AI relationship. The 'Security' factor (Eigenvalue=3.23, Cronbach's a = 0.71, % variance explained= 12.42) consisted of three items examining concerns regarding the security of AI. The 'Accessibility' factor (Eigenvalue = 2.26, Cronbach's a = 0.72, % variance explained = 8.70) comprised three items examining sub-dimensions of AI accessibility. The 'Vocational' factor (Eigenvalue = 2.01, Cronbach's a = 0.87, % variance explained = 7.75) comprised five items examining sub-dimensions and characteristics of the vocation and AI relationship. The 'Technology' factor (Eigenvalue = 2.00, Cronbach's a = 0.85, % variance explained = 7.74) consisted of three items examining the technological and scientific sub-dimensions of AI. The final 'Cost' factor (Eigenvalue = 1.86, Cronbach's a = 0.67, % variance explained = 7.17) comprised three items examining the financial aspect of AI. The total variance explained was 68.53%. Table 1 presents the descriptive statistics for each item and the findings of the EFA and reliability analyses. Table 2 shows the final AIPS items and their corresponding factors.

Confirmatory factor analysis

The findings of the Confirmatory Factor Analysis (CFA) conducted on the six-factor model derived from the Exploratory Factor Analysis (EFA) of the AIPS are presented in Figure 1. The analysis indicates that the model fits the data well, with all indices exceeding the recommended value (>0.90), and $\chi 2/df$ values within acceptable limits (<5). The findings demonstrate that the six-factor solution of the AIPS model is a good fit for the data. Figure 1 also displays the path diagram of the six-factor AIPS.

The internal reliability coefficient for the AIPS full scale was determined to be 0.92 using Cronbach's method, which indicates that the scale has a high degree of internal consistency. The corrected item-total correlations for the scale ranged from 0.34 to 0.76, indicating that the items in the AIPS are homogenous. Additionally, the test-retest reliability was also high with an ICC value of 0.91.

Tables 1 and 2 depict the mean scores of each item as well as the distribution of responses from the participants. The item with the highest average score (4.02) on both the AIPS full scale and the Human factor was Item 19, with 84.4% of the participants either strongly agreeing or

agreeing that AI would increase scientific curiosity. On the Security factor, Item 16 received the highest average score (3.40), with 48.0% of respondents either strongly agreeing or agreeing that the use of AI could lead to decision-making problems. The highest average score (2.90) for the items loaded on the Accessibility factor was obtained by Item 17, with 29.3% of participants either strongly agreeing or agreeing that AI could be used in underdeveloped regions. Among the items loaded on the Vocational factor, Item 23 had the highest average score (3.90), with 78.2% of participants either strongly agreeing or agreeing that AI could shorten working hours. For the Technology factor, Item 7 had the highest average score (3.80), with 73.2% of participants either strongly agreeing or agreeing that AI development requires a long time. Finally, among the items loaded on the Cost factor, Item 2 had the highest average score (3.87), with 78.7% of participants strongly or strongly agreeing that AI development needs a long time.

Table 3 displays the Pearson r correlations between the AIPS and its sub-scales with DPPS. The AIPS total score had the strongest correlation with the "human" factor (r = 0.88) and the weakest correlation with the "accessibility" factor (r = 0.44). The Pearson r correlations between the AIPS score and DPPS total and each of its three sub-scales were 0.42, 0.31, 0.41, and 0.40 for the total, status, human, and scientific sub-scales, respectively. All of the Pearson r correlations were statistically significant (P < 0.01).

Table 4 presents a comparison of the sub-scale and total scores of AIPS based on the tested variables. The AIPS scores differed according to variables such as gender, working place, occupational experience, necessity to use AI, and frequency of using AI in dental practice, but there were no significant differences among the other tested variables.

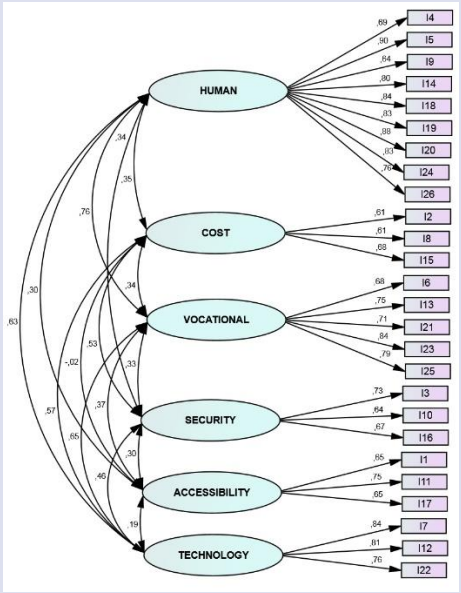

Figure 1: Path diagram of the Confirmatory Factor Analysis (CFA) of the six-factor Artificial Intelligence Perception Scale (AIPS). The fit indices values were as follows: χ2 = 840.20; degrees of freedom (df) = 284; χ2/df = 2.95; p<0.001; Root mean square error of approximation (RMSEA) = 0.0065; Normed fit index (NFI) = 0.88; Non-normed fit index = 0.89; Root mean square residual (RMR) = 0.061; Standardized root mean square residual (SRMR) = 0.066; Comparative fit index (CFI) = 0.91; Relative fit index (RFI) = 0.86; Incremental fit index (IFI) = 0.91.

Table 1. Outcome of the Exploratory Factor Analysis and reliability analyses

Factor and item	Mean	SD	Alpha if item deleted	CITC	Factor loading
Factor 1: Human					
I4 – Alternative to human power	3.78	0.96	0.91	0.62	0.580
I5 – Usability in industry	4.01	0.80	0.91	0.76	0.815
I9 – Human control	3.67	0.91	0.92	0.59	0.481
I14 – Usability in agriculture and livestock	3.79	0.86	0.91	0.69	0.718
I18 – Usability in transportation	3.89	0.86	0.91	0.69	0.746
I19 – Scientific curiosity	4.02	0.83	0.91	0.72	0.720
I20 – Usability in health	3.99	0.80	0.91	0.72	0.801
I24 – Usability in education	3.95	0.84	0.91	0.71	0.722

I26 – Maintaining the ecological balance	3.75	0.84	0.91	0.68	0.647
Factor 2: Security					
I3 – Data security	3.03	0.97	0.92	0.34	0.682
I10 – Ethical concerns	2.46	0.99	0.92	0.34	0.703
I16 – Decision responsibility	3.40	0.92	0.91	0.53	0.630
Factor 3: Accessibility					
I1 – Easily accessibility	2.64	0.93	0.92	0.31	0.663
I11 – Usability with(out) internet	2.89	0.99	0.92	0.38	0.590
I17 – Usability in underdeveloped regions	2.90	1.02	0.92	0.38	0.722
Factor 4: Vocational					
I6 – New job opportunities	3.76	0.86	0.92	0.60	0.579
I13 – Reputation of profession	3.55	0.92	0.81	0.60	0.683
I21 – Customer satisfaction	3.69	0.84	0.91	0.60	0.628
I23– Working hours	3.90	0.80	0.91	0.67	0.728
I25 – Financial income	3.77	0.82	0.91	0.73	0.675
Factor 5: Technology					
I7 – Development process	3.80	0.87	0.91	0.65	0.795
I12 – Large teams	3.71	0.92	0.92	0.57	0.796
I22 –Need for high energy	3.56	0.91	0.92	0.56	0.761
Factor 6: Cost					
I2 – Expensive products	3.87	0.91	0.91	0.37	0.652
I8 – Costly using	3.07	1.00	0.92	0.32	0.725
I15 –Requiring expensive hardware	3.51	0.94	0.91	0.37	0.607

Table 2. Responses to the Artificial Intelligence Perceptions Scale (AIPS) items

How much do you agree with the following statements?	Strongly	Disagree	Neither	Agree	Strongly
	n (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)
1) Artificial intelligence-based products are easily accessible.	45 (9.8)	168 (36.5)	162 (35.2)	77 (16.7)	8 (1.7)
2) Artificial intelligence-based products can be expensive.	15 (3.3)	25 (5.4)	58 (12.6)	266 (57.8)	96 (20.9)
3) Using artificial intelligence can endanger data and information	27 (5.9)	101 (22.0)	187 (40.7)	117 (25.4)	28 (6.1)
4) Artificial intelligence-based systems can be an alternative to	18 (3.9)	28 (6.1)	82 (17.8)	241 (52.4)	91 (19.8)
5) Artificial intelligence can be used in industry.	7 (1.5)	18 (3.9)	49 (10.7)	274 (59.6)	112 (24.3)
6) Using artificial intelligence can create new job opportunities.	14 (3.0)	53 (11.5)	172 (37.4)	175 (38.0)	46 (10.0)
7) The development process of artificial intelligence can take a long	9 (2.0)	31 (6.7)	83 (18.0)	255 (55.4)	82 (17.8)
8) Using artificial intelligence-based products can be costly and	23 (5.0)	125 (27.2)	129 (28.0)	161 (35.0)	22 (4.8)
9) Human control and oversight of artificial intelligence can make	15 (3.3)	29 (6.3)	109 (23.7)	243 (52.8)	64 (13.9)
10) Using artificial intelligence in professional life may be unethical.	80 (17.4)	166 (36.1)	145 (31.5)	58 (12.6)	11 (2.4)
11) Artificial intelligence can also be used without an internet	36 (7.8)	126 (27.4)	171 (37.2)	105 (22.8)	2 (4.8)
12) Large teams may be needed for the development of artificial	12 (2.6)	35 (7.6)	103 (22.4)	234 (50.9)	76 (16.5)
13) Using artificial intelligence can increase the reputation of the	13 (2.8)	44 (9.6)	134 (29.1)	213 (46.3)	56 (12.2)
14) Artificial intelligence can be a solution to problems in	12 (2.6)	21 (4.6)	95 (20.7)	255 (55.4)	77 (16.7)
15) High-level and costly hardware may be required to use artificial	13 (2.8)	56 (12.2)	123 (26.7)	217 (47.2)	51 (11.1)
16) The use of artificial intelligence can create problems about the	14 (3.0)	53 (11.5)	172 (37.4)	175 (38.0)	46 (10.0)
17) Artificial intelligence can also be used in underdeveloped or	41 (8.9)	125 (27.2)	153 (33.3)	121 (26.3)	20 (4.3)
18) Artificial intelligence can be a solution to the problems that	10 (2.2)	24 (5.2)	66 (14.3)	265 (57.6)	95 (20.7)
19) Artificial intelligence can increase scientific curiosity.	8 (1.7)	20 (4.3)	44 (9.6)	269 (58.5)	119 (25.9)
20) Artificial intelligence can be used in the field of health.	6 (1.3)	20 (4.3)	53 (11.5)	272 (59.1)	109 (23.7)
21) Artificial intelligence can improve the quality of relationships	8 (1.7)	32 (7.0)	114 (24.8)	246 (53.5)	60 (13.0)
22) Artificial intelligence-based products can use high energy.	11 (2.4)	47 (10.2)	125 (27.2)	223 (48.5)	54 (11.7)
23) Using artificial intelligence can shorten working hours or	6 (1.3)	22 (4.8)	72 (15.7)	271 (58.9)	89 (19.3)
24) Artificial intelligence can be used in the field of education.	11 (2.4)	18 (3.9)	55 (12.0)	269 (58.5)	119 (25.9)
25) Using artificial intelligence can increase financial income.	4 (0.9)	30 (6.5)	104 (22.6)	248 (53.9)	74 (16.1)
26) Using artificial intelligence can be beneficial in maintaining the	11 (2.4)	18 (3.9)	113 (24.6)	249 (54.1)	69 (15.0)

Table 3. Correlations between the AIPS scale score with sub-factor scores and DPPS scale score with sub-factor scores

Measure	1	2	3	4	5	6	7	8	9	10	11
1. AIPS – Total	-	0.88	0.54	0.44	0.81	0.73	049	0.42	0.31	0.41	0.40
2. AIPS – Human		-	0.29	0.26	0.70	0.55	0.27	0.41	0.23	0.43	0.44
3. DPPS – Security			-	0.23	0.26	.37	0.38	0.17	0.18	0.16	0.09
4. DPPS – Accessibility				-	0.31	0.16	0.01	0.09	0.16	0.03	0.02
5. AIPS – Vocational					-	0.54	0.25	0.34	0.23	0.33	0.34
6. AIPS – Technology						-	0.43	0.33	0.26	0.31	0.29
7. AIPS – Cost							-	0.28	0.23	0.26	0.23
8. DPPS -Total								-	0.83	0.90	0.88
9. DPPS – Status									-	0.56	0.58
10. DPPS – Human										-	0.79
11. DPPS – Scientific											-

Table 4. Comparison of sub-scale and total scores of AIPS according to tested variables

		Human	Vocational	Technology	Cost	Accessibility	Security	Total
Age (year)	*n*	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
<25	96	3.9 (3.7 - 4.0)	3.6 (3.5 - 3.8)	3.8 (3.6 - 3.9)	3.5 (3.4 - 3.7)	2.9 (2.8 -3.1)	3.1 (2.9 - 3.3)	3.6 (3.5 - 3.7)
25-35	134	4.0 (3.8 - 4.1)	3.8 (3.7 - 4.0)	3.6 (3.5 - 3.8)	3.4 (3.2 - 3.5)	2.9 (2.7 - 3.0)	2.9 (2.8 - 3.0)	3.6 (3.5 - 3.7)
36-45	86	3.7 (3.6 - 3.8)	3.6 (3.5 - 3.7)	3.6 (3.5 - 3.7)	3.5 (3.4 - 3.7)	2.6 (2.4 - 2.8)	2.9 (2.7 - 3.1)	3.4 (3.3 - 3.5)
46-55	73	3.8 (3.6 - 3.9)	3.7 (3.5 - 3.8)	3.7 (3.5 - 3.8)	3.5 (3.3 - 37)	2.6 (2.4 - 2.8)	2.8 (2.7 - 3.0)	3.5 (3.4 - 3.6)
>55	71	3.8 (3.6 - 3.9)	3.6 (3.4 - 37)	3.6 (3.4 - 3.8)	3.3 (3.2 - 3.5)	2.7 (2.5 -2.9)	2.8 (2.6 -3.0)	3.4 (3.3 - 3.5)
		P = 0.054	*P = 0.051*	*P = 0.094*	*P = 0.204*	*P = 0.017*	*P = 0.094*	*P = 0.069*
Gender								
Women	294	3.8 (3.8 - 3.9)	3.6 (3.6 - 3.7)	3.6 (3.5 - 3.7)	3.5 (3.4 - 3.6)	2.7 (2.6 - 2.8)	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)
Men	166	3.8 (3.7 - 3.9)	3.8 (3.7 - 3.9)	3.7 (3.6 -3.8)	3.4 (3.3 - 3.5)	2.8 (2.7 -3.0)	2.9 (2.8 -3.1)	3.5 (3.5 - 3.6)
		P = 0.883	***P = 0.035***	*P = 0.093*	*P = 0.134*	*P = 0.142*	*P = 0.553*	*P = 0.382*
Education level								
Undergraduate	247	3.8 (3.8 - 3.9)	3.7 (3.6 - 3.8)	3.7 (3.6 - 3.8)	3.4 (3.4 - 3.5)	2.8 (2.7 -2.9)	2.9 (2.8 - 3.0)	3.5 (3.5 - 3.6)
Post-graduate	213	3.8 (3.7 - 3.9)	3.7 (3.6 - 3.8)	3.6 (3.5 -3.7)	3.4 (3.3 - 3.5)	2.7 (2.6 - 2.8)	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)
		P = 0.675	*P = 0.823*	*P = 0.384*	*P = 0.830*	*P = 0.592*	*P = 0.613*	*P = 0.612*
Working place								
Public	130	3.9 (3.8 - 4.1)a	3.7 (3.6 - 3.9)	3.7 (3.6 -3.9)	3.6 (3.4 -3.7)	2.7 (2.6 -2.9)	3.0 (2.9 - 3.1)	3.6 (3.5 - 3.7)
University	207	3.8 (3.7 - 3.9)	3.7 (3.6 - 3.8)	3.6 (3.5 -3.7)	3.4 (3.3 -3.5)	2.8 (2.7 - 2.9)	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)
Private Clinic	123	3.7 (3.6 -3.9)a	3.7 (3.5 -3.7)	3.6 (3.4 -3.7)	3.4 (3.3 -3.5)	2.7 (2.6 - 2.9)	2.8 (2.7 - 2.9)	3.4 (3.3 - 3.5)
		P = 0.042	*P = 0.669*	*P = 0.286*	*P = 0.085*	*P = 0.631*	*P = 0.060*	*P = 0.062*
Occupational experience(yr)								
1-5	127	3.9 (3.8 - 4.0)	3.8 (3.6 -3.8)	3.7 (3.6 - 3.8)	3.4 (3.3 - 3.6)	2.8 (2.7 - 2.9)	3.0 (2.9 - 3.1)	3.6 (3.5 - 3.7)
6-10	116	3.8 (3.7 - 4.0)	3.7 (3.6 - 3.8)	3.6 (3.4 - 3.7)	3.4 (3.2 - 3.5)	2.9 (2.7 - 3.0)	2.8 (2.7 - 3.0)	3.5 (3.4 - 3.6)
11-15	120	3.7 (3.6 - 3.8)	3.6 (3.4 - 3.7)	3.5 (3.4 -3.6)a	3.4 (3.3 - 3.6)	2.6 (2.5 - 2.8)	2.8 (2.6 - 2.9)a	3.4 (3.3 - 3.5)
>16	97	3.9 (3.7 -4.0)	3.7 (3.6 - 3.9)	3.8 (3.7 - 4.0)b	3.6 (3.4 - 3.7)	2.7 (2.6 - 2.9)	3.1 (3.0 -3.3)b	3.6 (3.5 - 3.7)
		P = 0.120	*P = 0.174*	***P = 0.010***	*P = 0.266*	*P = 0.077*	***P = 0.003***	*P = 0.019*
Monthly income (TL)								
<10,000	98	3.8 (3.7 - 3.9)	3.6 (3.5 - 3.8)	3.7 (3.6 - 3.9)	3.6 (3.4 - 3.7)	2.8 (2.6 - 3.0)	2.9 (2.8 - 3.1)	3.5 (3.4 - 3.6)
10,001-20,000	123	3.8 (3.7 - 3.9)	3.7 (3.6 -3.8)	3.6 (3.4 -3.7)	3.5 (3.3 - 3.6)	2.8 (2.6 - 2.9)	2.9 (2.7 - 3.0)	3.5 (3.4 - 3.6
20,001 - 30,000	115	3.9 (3.8 - 4.0)	3.8 (3.7 - 3.9)	3.6 (3.5 - 3.8)	3.4 (3.3 - 3.5)	2.8 (2.6 - 2.9)	3.0 (2.8 - 3.1)	3.6 (3.5 - 3.7)
30,001 - 40,000	82	3.8 (3.7 - 4.0)	3.6 (3.5 -3.8)	3.6 (3.5 -3.8)	3.4 (3.2 - 3.5)	2.6 (2.4 - 2.8)	2.9 (2.7 - 3.1)	3.5 (3.3 - 3.6)
>40,000	42	3.8 (3.6 - 4.0)	3.7 (3.5 - 3.9)	3.8 (3.5 - 4.0)	3.3 (3.1 - 3.5)	2.8 (2.6 - 3.1)	3.0 (2.8 - 3.3)	3.5 (3.4 - 3.7)
		P = 0.714	*P = 0.338*	*P = 0.517*	*P = 0.196*	*P = 0.428*	*P = 0.798*	*P = 0.692*
Previous AI education								
Yes	10	3.9 (3.4 - 4.3)	3.9 (3.5 - 4.4)	3.7 (3.2 - 4.2)	3.4 (2.9 - 3.8)	2.7 (2.2 - 3.1)	3.2 (2.7 - 3.7)	3.6 (3.3 - 3.9)
No	450	3.8 (3.8 - 3.9)	3.7 (3.6 - 3.7)	3.6 (3.6 - 3.7)	3.4 (3.4 - 3.5)	2.8 (2.7 - 2.8)	2.9 (2.8 - 3.0)	3.5 (3.5 - 3.6)
		P = 0.797	*P = 0.264*	*P = 0.772*	*P = 0.812*	*P = 0.652*	*P = 0.275*	*P = 0.600*
Self-efficacy to use AI								
Yes	76	3.9 (3.7 - 4.0)	3.7 (3.6 - 3.9)	3.6 (3.4 - 3.8)	3.3 (3.1 - 3.4)	2.9 (2.7 - 3.1)	2.8 (2.6 - 3.0)	3.5 (3.4 - 3.6)

No	210	3.8 (3.7 - 3.9)	3.7 (3.6 - 3.8)	3.7 (3.6 - 3.8)	3.6 (3.5 - 3.7)	2.7 (2.6 - 2.8)	3.0 (2.9 - 3.1)	3.5 (3.5 - 3.6)
Neutral	174	3.8 (3.7 - 3.9)	3.7 (3.5 - 3.8)	3.6 (3.5 - 3.7)	3.4 (3.3 - 3.5)	2.8 (2.7 - 2.9)	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)
		P = 0.846	*P = 0.587*	*P = 0.139*	*P = 0.003*	*P = 0.054*	*P = 0.136*	*P = 0.629*
Necessity to use AI								
Yes	245	3.9 (3.8 - 4.0)a	3.8 (3.7 - 3.9)a	3.7 (3.6 - 3.8)	3.4 (3.4 - 3.5)	2.9 (2.8 - 3.0)a	2.9 (2.8 - 3.0)	3.6 (3.5 - 3.6)a
No	52	3.4 (3.2 - 3.6)b	3.3 (3.1 - 3.5)b	3.5 (3.3 - 3.7)	3.5 (3.3 - 3.7)	2.5 (2.2 - 2.7)b	3.1 (2.9 - 3.4)	3.3 (3.1 - 3.4)b
Neutral	163	3.8 (3.7 - 3.9)a	3.6 (3.5 - 3.7)c	3.6 (3.5 - 3.7)	3.4 (3.3 - 3.5)	2.7 (2.6 - 2.8)	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)a
		P = 0.001	***P = 0.001***	*P = 0.482*	*P = 0.532*	***P = 0.002***	*P = 0.053*	***P = 0.001***
Frequency of using AI in daily life								
Never	100	3.7 (3.5 - 3.8)	3.6 (3.4 - 3.7)	3.5 (3.4 - 3.7)	3.6 (3.4 - 3.7)	2.6 (2.4 - 2.8)	2.9 (2.8 - 3.19	3.4 (3.3 - 3.5)
Rarely	132	3.8 (3.7 - 4.0)	3.7 (3.6 - 3.8)	3.7 (3.6 - 3.9)	3.5 (3.3 - 3.6)	2.8 (2.7 - 2.9)	3.0 (2.9 - 3.1)	3.5 (3.5 - 3.6)
Sometimes	164	3.8 (3.7 - 4.0)	3.7 (3.6 - 3.8)	3.7 (3.5 - 3.8)	3.4 (3.3 - 3.5)	2.8 (2.7 - 2.9)	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)
Often	54	4.0 (3.8 - 4.2)	3.9 (3.7 - 4.0)	3.6 (3.4 - 3.9)	3.3 (3.1 - 3.5)	2.8 (2.6 - 3.1)	2.8 (2.6 - 3.0)	3.6 (3.4 - 3.7)
Always	10	4.1 (3.6 - 4.5)	4.1 (3.7 - 4.6)	3.9 (3.4 - 4.3)	3.3 (2.8 - 3.7)	3.0 (2.5 - 3.4)	3.0 (2.5 - 3.5)	3.7 (3.4 - 4.0)
		P = 0.058	*P = 0.056*	*P = 0.323*	*P = 0.189*	*P = 0.193*	*P = 0.738*	*P = 0.119*
Frequency of using AI in dental practice								
Never	238	3.8 (3.7 - 3.9)	3.7 (3.6 - 3.8)	3.7 (3.6 - 3.8)	3.5 (3.4 - 3.8)	2.6 (2.8 - 3.0)c	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)
Rarely	135	3.8 (3.7 - 4.0)	3.7 (3.6 - 3.8)	36 (3.4 - 3.7)	3.3 (3.2 - 3.4)	2.9 (2.8 - 3.1)c	2.9 (2.8 - 3.0)	3.5 (3.4 - 3.6)
Sometimes	62	3.8 (3.7 - 4.0)	3.7 (3.5 - 3.8)	3.7 (3.5 - 3.9)	3.4 (3.2 - 3.6)	2.9 (2.7 - 3.1)c	3.0 (2.8 - 3.2)	3.5 (3.4 - 3.7)
Often	14	3.9 (3.5 - 4.3)	4.0 (3.6 - 4.4)	3.7 (3.3 - 4.1)	3.3 (2.9 - 3.6)	3.3 (2.9 - 3.7)a	2.5 (2.1 - 2.9)	3.6 (3.3 - 3.9)
Always	10	2.7 (1.3 - 4.1)	3.0 (1.6-4.3)	3.0 (1.4 - 4.5)	4.3 (2.8 - 4.7)	4.0 (2.4 - 4.5)b	3.3 (1.8 - 4.8)	3.2 (2.2 - 4.2)
		P = 0.574	*P = 0.369*	*P = 0.690*	*P = 0.052*	***P = 0.001***	*P = 0.251*	*P = 0.900*

Discussion

The primary objective of this research was to create and evaluate the psychometric properties of the Artificial Intelligence Perceptions Scale (AIPS) in a Turkish dentist population. The study examined both the reliability and validity of the AIPS. The results indicated that the AIPS exhibited high internal consistency and test-retest reliability. The AIPS items also demonstrated good validity in terms of test score interpretations and correlations with perceptions of the dental profession. In general, the participants viewed AI as having higher scores in the human, vocational, technology, and cost components, while scoring lower in the accessibility and security components.

This research paper outlines the creation of a new scale using recommended scale development techniques from the literature. The study includes analyses of explanatory and confirmatory factor analysis, as well as validity and reliability of the scale. The findings suggest that the AIPS, which is based on a six-factor structure derived from previous literature, is a valid and reliable research tool for measuring perceptions of AI. The internal reliability coefficient of the AIPS exceeded the recommended values. While research on AI perception and related factors has been limited, to the authors' knowledge, there is currently no valid and reliable scale available for assessing perceptions of AI. Therefore, the AIPS can be used to evaluate professional perceptions of AI in relation to their field and/or to determine personal, professional, or public perceptions of AI.

This research paper makes several important contributions. Firstly, the AIPS can be used as a measurement tool in future studies and in different cultural contexts. Secondly, the scale is psychometrically robust, demonstrating both reliability and validity. In previous studies[30,31] that examined perceptions of AI, validity and reliability were not tested or the scales used were too long, making them impractical measurement tools. Some studies[19,32] also had low construct validity and did not directly measure perceptions of AI. In contrast, the AIPS can be used in future studies due to its advantages, such as the possibility of conducting detailed factor analysis and investigating psychometric properties, as well as being a short and simple tool that can be easily completed by participants.

The study was conducted only among dentists in a province, which limits the generalizability of the findings to other healthcare professionals or to different cultural contexts. Furthermore, the study relied on self-report measures, which may be subject to response bias or social desirability bias. Finally, the study did not assess the actual use of AI in dental practice, which could provide valuable insights into how perceptions of AI relate to its practical implementation in the field.

Understanding the multidimensional nature of AI perception is indeed crucial, as the perception of AI can impact its adoption and integration in various fields. The factors identified in this study, such as human, security, accessibility, vocational, technology, and cost, are consistent with previous literature[2,5,6,10,11,13,17,33], indicating the robustness of the findings. However, as mentioned earlier, further research is needed to examine the impact of psychological factors and independent professional or personal variables on AI perception. Innovations, including technological, political, demographic, and economic trends, have the potential to change perceptions of AI.[34] Over time, this relationship between AI and personal, vocational, and social orientation and mobility has varied. Therefore, understanding the multidimensional nature of AI perception and determining it with a valid and reliable measurement tool with appropriate factors is crucial and critical. Additionally, future studies could

explore the potential changes in AI perception due to ongoing technological, political, demographic, and economic trends.

It is important to note that the lower agreement scores in the accessibility and security factors do not necessarily mean that the participants have negative perceptions of AI in these aspects. Rather, it may reflect the uncertainty or lack of knowledge about these aspects[35], which could be addressed through education and training. As the use of AI in healthcare continues to grow, it is crucial for healthcare professionals to have a clear understanding of its benefits and potential risks in order to provide safe and effective care to their patients. Therefore, further research and education efforts are needed to better understand and address the concerns and perceptions of healthcare professionals regarding AI.

Although there was no variation in the results of other tested factors, AIPS scores were found to be influenced by certain variables such as gender, place of work, vocational experience, the need to use AI, and the frequency of AI usage in dental practice. The results indicate that men scored significantly higher in the "vocational" category compared to women. This may be associated with the fact that men tend to use technology more frequently than women, both in dental practice and in their daily lives, and are more inclined towards technology.[36] It is possible that dentists working in public settings obtained higher scores in the "human" factor compared to other groups due to their increased exposure to patients and greater interaction with people. Individuals with over 15 years of work experience had higher scores on the "safety" factor in comparison to other groups, as they were concerned about potential security issues related to the use of AI. One possible explanation for this could be that younger dentists use technological products more frequently, but the frequency of usage decreases with age. Dentists who did not perceive the use of AI as necessary had lower scores on the "human", "vocational", and "accessibility" factors, which is in line with the existing literature.

Conclusions

This study developed a new scale, the AI Perceptions Scale (AIPS), to evaluate perceptions of AI in healthcare. The perceptions of dentists towards AI were categorized into six distinct factors. The AIPS scale was found to be a reliable and valid measurement tool, indicating that it can be effectively used in future research. It can also aid in assessing whether these perceptions have an impact on the behavior of professionals.

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References

1. Kok J N, Boers E J, Kosters W A, et al. Artificial intelligence: definition, trends, techniques, and cases. Artif Intell 2009;1:270-299.
2. Eli-Chukwu N C. Applications of artificial intelligence in agriculture: A review. Eng Appl Sci Res 2019;9:4377-4383.
3. Poola I. How artificial intelligence in impacting real life everyday. Int J Adv Res Dev 2017;2:96-100.
4. Pethani F. Promises and perils of artificial intelligence in dentistry. Aust Dent J 2021;66:124-135.
5. Schwendicke F a, Samek W, and Krois J. Artificial intelligence in dentistry: chances and challenges. J Dent Res 2020;99:769-774.
6. Shan T, Tay F, and Gu L. Application of artificial intelligence in dentistry. J Dent Res 2021;100:232-244.
7. Kühnisch J, Meyer O, Hesenius M, et al. Caries detection on intraoral images using artificial intelligence. J Dent Res 2022;101:158-165.
8. Schwendicke F, Rossi J, Göstemeyer G, et al. Cost-effectiveness of artificial intelligence for proximal caries detection. J Dent Res 2021;100:369-376.
9. Mohammad-Rahimi H, Motamedian S R, Pirayesh Z, et al. Deep learning in periodontology and oral implantology: A scoping review. J Periodontal Res 2022;57:942-951.
10. Chen Y-w, Stanley K, and Att W. Artificial intelligence in dentistry: current applications and future perspectives. Quintessence Int 2020;51:248-257.
11. Khanagar S B, Al-Ehaideb A, Maganur P C, et al. Developments, application, and performance of artificial intelligence in dentistry–A systematic review. J Dent Sci 2021;16:508-522.
12. Joda T, Yeung A, Hung K, et al. Disruptive innovation in dentistry: what it is and what could be next. J Dent Res 2021;100:448-453.
13. Nguyen T T, Larrivée N, Lee A, et al. Use of artificial intelligence in dentistry. Current clinical trends and research advances. J Can Dent Assoc 2021;7:17.
14. Schwendicke F, Singh T, Lee J-H, et al. Artificial intelligence in dental research: Checklist for authors, reviewers, readers. J Dent 2021;107:103610.
15. Ahmed N, Abbasi M S, Zuberi F, et al. Artificial Intelligence Techniques: Analysis, Application, and Outcome in Dentistry—A Systematic Review. Biomed Res Int 2021;2021:e9751564.
16. Hsu L-P, Huang Y-K, and Chang Y-C. The implementation of artificial intelligence in dentistry could enhance environmental sustainability. J Dent Sci 2022;17:1081.
17. Pauwels R and Del Rey Y C. Attitude of Brazilian dentists and dental students regarding the future role of artificial intelligence in oral radiology: a multicenter survey. Dentomaxillofac Radiol 2021;50:20200461.
18. Gaube S, Lermer E, and Fischer P. The concept of risk perception in health-related behavior theory and behavior change. Perceived safety 2019;101-118.
19. Stai B, Heller N, McSweeney S, et al. Public perceptions of artificial intelligence and robotics in medicine. J Endourol 2020;34:1041-1048.
20. Asan O and Choudhury A. Research trends in artificial intelligence applications in human factors health care: mapping review. JMIR Hum Factors 2021;8:e28236.
21. Pishgar M, Issa S F, Sietsema M, et al. REDECA: a novel framework to review artificial intelligence and its applications in occupational safety and health. Int J Environ Res Public Health 2021;18:6705.
22. Sohn K and Kwon O. Technology acceptance theories and factors influencing artificial Intelligence-based intelligent products. Telemat Inform 2020;47:101324.
23. Wolff J, Pauling J, Keck A, et al. The economic impact of artificial intelligence in health care: systematic review. J Med Internet Res 2020;22:e16866.
24. Mörch C, Atsu S, Cai W, et al. Artificial intelligence and ethics in dentistry: a scoping review. J Dent Res 2021;100:1452-1460.
25. Zhang Z, Ning H, Shi F, et al. Artificial intelligence in cyber security: research advances, challenges, and opportunities. Artif Intell Rev 2022;55:1029-1053.
26. Li Z, Keel S, and He M. Can artificial intelligence make screening faster, more accurate, and more accessible? Asia Pac J Ophthalmol 2018;7:436-441.
27. Miller T. Explanation in artificial intelligence: Insights from the social sciences. Artif Intell 2019;267:1-38.

28. Buldur B and Armfield J M. Perceptions of the dental profession: a comparative analysis through scale development. Eur J Oral Sci 2018;126:46-52.

29. Hair J F, Anderson R E, Babin B J, et al., *Multivariate data analysis: A global perspective (Vol. 7)*. 2010, Upper Saddle River, NJ: Pearson.

30. Brougham D and Haar J. Smart technology, artificial intelligence, robotics, and algorithms (STARA): Employees' perceptions of our future workplace. J Manage Organ 2018;24:239-257.

31. Laï M-C, Brian M, and Mamzer M-F. Perceptions of artificial intelligence in healthcare: findings from a qualitative survey study among actors in France. J Transl Med 2020;18:1-13.

32. Chounta I-A, Bardone E, Raudsep A, et al. Exploring teachers' perceptions of Artificial Intelligence as a tool to support their practice in Estonian K-12 education. Int J Artif Intell Educ 2022;32:725-755.

33. Tandon D, Rajawat J, and Banerjee M. Present and future of artificial intelligence in dentistry. J Oral Biol Craniofac Res 2020;10:391-396.

34. Tang K-Y, Chang C-Y, and Hwang G-J. Trends in artificial intelligence-supported e-learning: A systematic review and co-citation network analysis (1998–2019). Interact Learn Environ 2021;1-19.

35. Müller A, Mertens S M, Göstemeyer G, et al. Barriers and enablers for artificial intelligence in dental diagnostics: a qualitative study. J Clin Med 2021;10:1612.

36. Yau H K and Cheng A L F. Gender difference of confidence in using technology for learning. J Technol Res 2012;38:74-79.