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Validation of a questionnaire for the recognition of dental anxiety in adolescents

Introduction:
In a clinical prospective pilot study, the hierarchic anxiety questionnaire (HAF) by Jöhren was tested for its applicability to identify dental fear in adolescents. Self-disclosure by completing a questionnaire requires certain – age-related – intellectual and cognitive skills. Thus, it gives rise to the question whether the HAF is applicable to adolescents.

Materials and methods:
In order to answer this question, an investigation including 210 adolescent test subjects was conducted. They were distinguished by age (12–14 years, 15–17 years) and sex. The HAF consists of 11 questions, from which the anxiety classifications can be drawn: slightly anxious (≤ 30 points), moderately anxious (31–38 points) and extremely anxious (possibly phobic) (> 38 points). In addition to a review of the internal validity via test and retest (t0, t1), the HAF was externally validated by comparing results of similar tools of self-information and a behavioral evaluation (dental anxiety scale, modified dental anxiety scale and visual analogue scale).

Results:
More than half of all test subjects declared to be slightly anxious (distribution across different survey procedures and points in time: 54–68 %) and 7–12 % said to be extremely anxious. The reliability of the information regarding the level of anxiety was confirmed using Cronbach's α (always > 0.9 = "excellent") for both t0 and t1. Specifically, the answers "moderate" to "good" corresponded to the 11 questions (Cohen's kappa metric). The consistency of HAF-Results and other methods to validate externally provided a high Spearman correlation (at least r > 0.7). Bland-Altman analyses further confirmed, that all techniques determining the subject's degree of fear at t0 and t1 were interchangeable. Moreover, their compliance was substantiated by at least "good" kappa values. The anxiety evaluation that was additionally carried out by the treating dentist and his assistant produced "good" to "very good" Kappa values. Age (correlation coefficient at t0 r = 0.290; at t1 r = 0.285) and sex (bei t0 r = 0.097; bei t1 r = 0.130) had no impact on the applicability of the HAF. However, in the group of the younger adolescents (12–14 years old), the questionnaire was filled out incorrectly in 14 cases.

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Conclusion:
This pilot study has shown that the HAF in its existing form is generally very applicable to adolescents. It is suggested that younger adolescents (12–14 years old) do not fill out the forms without guidance. In addition, further studies on the applicability of the HAF in adolescents are recommended in consideration of their education.

Keywords: adolescents; dental anxiety; hierarchic anxiety questionnaire

1. Introduction

Today, there are multiple options in dentistry to carry out nearly painless dental treatment.

Despite these possibilities, dental fear is a common phenomenon in our society, regardless of social status and level of education of people affected. A visit to the dentist is a burden for every second person in the population, which can lead to psychological, social and dental problems. About 10 % of the population avoid a visit to the dentist completely. Therefore, dental anxiety is one of the greatest obstacles in achieving optimal dental health in the population [3, 7, 11, 20]. From the dentist's perspective, the treatment of anxiety patients leads to an increased burden and stress reactions. Additional costs following appointment cancellations are not uncommon. This phenomenon of dental anxiety impacts the entire health care system: Treatments are delayed, made more difficult or cancelled. If phobic patients are treated psychotherapeutic, additional costs arise due to these interventions [7, 17, 30].

Anxiety before dental treatment can have various different causes (bad experiences, model learning, disposition, etc.) and shows different manifestations, even up to anxiety disorders with pathological significance, for example dental phobia [14, 20]. Usually, the origin of dental phobia can be due to bad experiences in one's childhood or adolescence. Öst [27] asserts the average age for a beginning dental phobia to be 13 years old. The behavior of a child is further modulated by endogenous (constitutional, hereditary) and exogenous (educational, environmental) impacts [16, 32]. But also the development of anxiety during the process of detachment from parents or rather development of the own personality (puberty), a normal phenomenon, is described. Nevertheless, these fears can enhance dental anxiety [31, 33]. Therefore it is important, to give dentists the opportunity to recognize dental anxiety in kids and adolescents, in order to adapt to the situation and adequately prepare the patient [12, 40].

For these reasons, it is important to recognize and classify an existing dental anxiety when compiling the medical history [11, 18, 29], as well as offering appropriate techniques for prevention or reduction [27, 28]. Anxiety questionnaires are popular for patients to assess themselves (e.g. Corah's dental anxiety scale, Jöhren's hierarchic anxiety questionnaire). The visual analogue scale is used as well. These methods are considered to be easily applicable, cost-effective and nevertheless reliable means for a diagnosis of dental anxiety. Especially the hierarchic anxiety questionnaire has proven to be a reliable screening instrument due to its hierarchic design [1, 7, 10, 14].

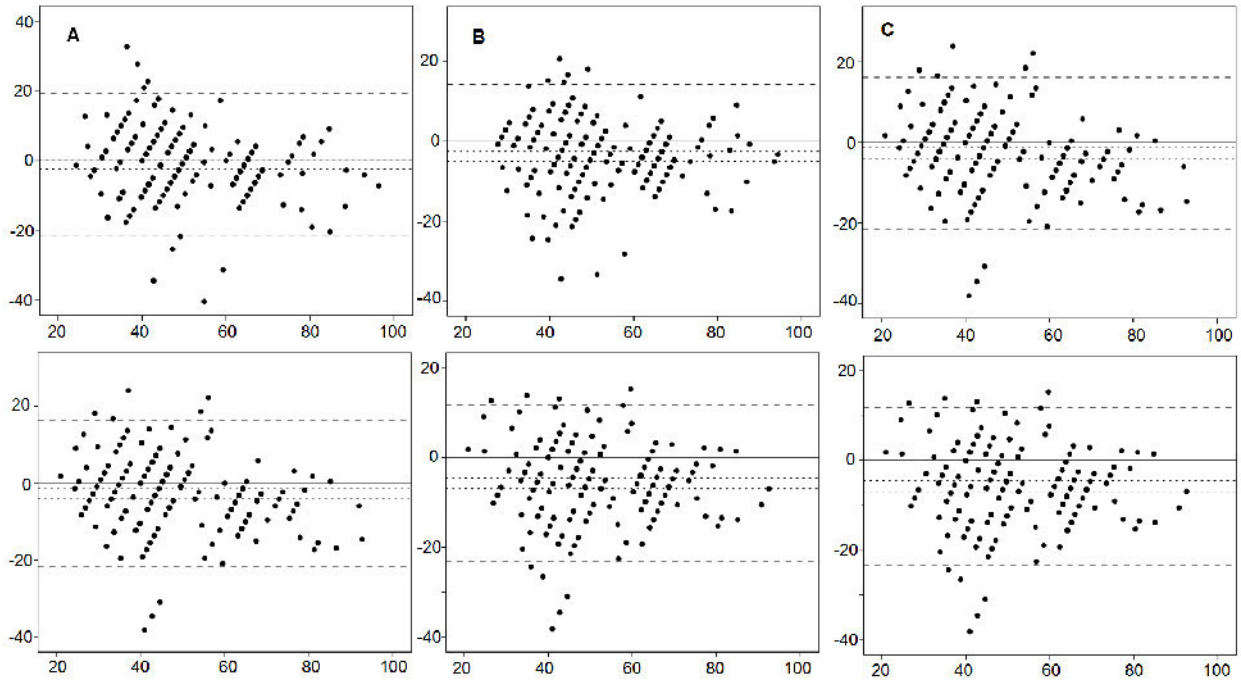
The methods mentioned above were developed empirically and validated in adult subjects. In pediatric dentistry these methods have not been sufficiently investigated and therefore are not applicable. This is because questionnaires and analogue scales require specific intellectual and cognitive skills, which are well-developed in adults and at best in adolescents [24, 40]. For children, the assessment in regard to dental anxiety is done by the treating dentist [4, 39]. For older children up to 13 years old, visual and textually simplified anxiety questionnaires were developed [21]. The question remains unanswered if the method of self-assessment that was used in adults [15] is also suitable for teenage adolescents. Contents of the questionnaire could possibly not be understood fundamentally or extensively. In this content, it is problematic that adolescent imagination is not fully matured and lacking experience. Further, it could lead to false declarations, possibly in consequence of a sense of shame or lack of cooperation due to immaturity [33, 34].

The present pilot study examines the applicability of questionnaires in detecting and determining the extent of dental anxiety in male and female adolescents from ages 12 to just under 18. The investigation is aimed to evaluate the applicability of the HAF (hierarchic anxiety questionnaire) in consideration of a comparison with the DAS (dental anxiety questionnaire as well as the modified form MDAS) and the VAS (visual analogue scale) in adolescents and to validate it via behavioral evaluation.

2. Materials and methods

The present prospective pilot study was conducted between March and September 2012 in a private dental practice in Breckerfeld (Ennepe-Ruhr-Kreis, North Rhine-Westphalia). The study design was previously examined and authorized by the ethics committee of the University Witten/Herdecke (Nr. 05/2012).

The total sample size included 224 students participating voluntarily and was based on earlier comparable studies [e.g. 10, 40]. In 14 cases (6.25 %) the questionnaire was filled out incorrectly (t0 = 9, t1 = 5); all of these 6 male and 8 female participants were under the age of 14. Of the remaining 210 subjects, 94 were male and 116 female. According to the usual classification of development psychology [6], 2 groups were defined: 12–14 year-olds and 15–17 year-olds (meaning



(Fig. 1: N. Weifenbach)

Figure 1 Bland-Altman plots for (A) HAF/DAS, (B) HAF/MDAS and (C) HAF/VAS at different points in time (t0 in the upper row, t1). The X-axis refers to the mean, the Y-axis refers to the difference (see Table 2). The longer, dashed lines mark the limits of agreement, and the short stippled lines mark the 95 % confidence interval of the difference of the total scores.

that the 15th or 18th year has not been completed, respectively). The group mentioned first included 37 males and 50 females, the second group included 57 males and 66 females.

2.1 Utilized survey procedures

Corah's dental anxiety scale (DAS) [2] and its modification (MDAS) [9]: DAS is the most frequently used "anxiety scale" in dentistry internationally [15, 22]. It consists of 4 questions with 5 answer possibilities each. Patients are asked to imagine themselves in different situations and to check the answer possibility that corresponds to their feelings (regarding the specific situation). Patients were asked to imagine themselves in different situations and check response options that represent their current sensation (with regard to the respective situation). The DAS intends the score distribution from 4 to 20 in 3 classifications (12 points: slightly anxious; 13–14: moderately anxious; 15 and higher: extremely anxious) [2, 25]. The MDAS has been extended to include a question on local anaesthesia and has a points distribution from 5–25 (< 16 points: slightly anxious; 16–18: moderately anxious; > 18: extremely anxious) [9].

Jöhren's hierarchic anxiety questionnaire (HAF) [10]: The HAF builds on top of the DAS and in addition contains different treatment situations, which were taken from an anxiety hierarchy of Gale's investigation [5], and that depicts situations causing anxiety in patient treatment [10, 13]. The HAF consists of 11 questions, where 5 different anxiety manifestations can be selected (from "not at all anxious" to "sick with fear"), therefore a points score from 11 to 55 is possible. Thus, the patients can be divided in 3 categories (≤ 30 points: slightly anxious; 31–38 points: moderately anxious; > 38 points: extremely anxious) [10]. The diagnosis dental phobia can be deduced from the HAF, when a point value of more than 38 is reached with simultaneous prevention of dental treatment for more than 2 years in the medical history [10, 14]. The questionnaire was validated and checked on its reliability. It yielded a high correlation to DAS with a coefficient of 0.88 and a good correlation to STAI ("State Trait Anxiety Inventory" of Spielberger et al. [36]) with a coefficient of 0.66 [10].

Self-assessment using the visual analogue scale (VAS) [1]: This test consists of a scale with 2 defined endpoints (0–100 mm). The patients were asked to mark their anxiety with a line on this scale, where 0 corresponds to total fearlessness and the value 100 is maximum anxiety before a treatment. This test is an easy way to determine if dental anxiety exists and how profound it is [14, 15]. Before it was asked if the VAS can serve as an initial screening instrument, it was validated using the HAF. This resulted in the VAS being a suitable, fast and simple (and therefore easily applicable in everyday dental practice) measure of tendency to obtain clarity in what methods in diagnosing anxiety could possibly be applied. However, VAS results alone tempt overinterpretation [1].

The methods presented to self-assess are depicted in Annex 1.

2.2 Study procedure

Test and retest: The questioning of every person was conducted using HAF, MDAS, DAS and VAS (presented in random order). Additionally, all

Anxiety	HAF	DAS	MDAS	VAS	Dentist	Assistant
t0						
Slightly anxious	136 (64.6)	141 (67.14)	144 (68.57)	133 (63.33)	116 (55.24)	115 (54.76)
Moderately anxious	58 (27.62)	50 (23.81)	50 (23.81)	58 (27.62)	70 (33.33)	69 (32.86)
Extremely anxious (possibly phobic)	16 (7.62)	19 (9.05)	16 (7.62)	19 (9.05)	24 (11.43)	26 (12.38)
t1						
Slightly anxious	138 (65.71)	142 (67,62)	140 (66,67)	133 (63.33)	No data was collected	
Moderately anxious	55 (26.19)	49 (23.33)	53 (25.24)	57 (27.14)		
Extremely anxious (possibly phobic)	17 (8.1)	19 (9.05)	17 (8.10)	20 (9.52)		

Table 1 Absolute distribution and (in parentheses) the percentage of anxiety classification of the questionnaires HAF (hierarchic anxiety questionnaire), DAS (dental anxiety scale), MDAS (modified dental anxiety scale), and the VAS (visual analogue scale), as well as the dentist's and assistant's assessment (n = 210). In order to compare the methods, scores were standardized to 100 %.

			t0	t1
HAF–DAS	Mean		–1.073	–2.584
	95 %-mean confidence interval	Minimum	–2.456	–3.875
		Maximum	0.309	–1.294
	Standard deviation		10.162	9.4841
HAF–MDAS	Mittelwert		–3.778	–5.737
	95 %-mean confidence interval	Minimum	–5.013	–6.928
		Maximum	–2.544	–4.545
	Standard deviation		9.076	8.759
HAF–VAS	Mittelwert		12.579	11.596
	95 %-mean confidence interval	Minimum	10.851	9.984
		Maximum	14.307	13.208
	Standard deviation		12.703	11.848

Table 2 Statistical description of data at t0 and t1 used to create Bland-Altman plots (Figure 1) (n = 210).

subjects were assessed regarding their state of anxiety by the dentist and his assistant. The assessment has been carried out based on the behavioral scale of Frankl et al. [4]. Out of the 4 anxiety classifications, the two middle ones were combined so that the subjects could be assessed as: extremely cooperative, conditionally cooperative and slightly cooperative. The 3 anxiety classifications were equated with Corah's anxiety classifications [2]: slightly anxious, moderately anxious and extremely anxious.

	HAF–DAS (t0)	HAF–DAS (t1)	HAF–MDAS (t0)	HAF–MDAS (t1)	HAF–VAS (t0)	HAF–VAS (t1)
Median	–1.136	–3.182	–3.273	–5.818	14.591	12.909
Interquartile range	11.02	11.36	9.82	10.64	15.45	13.59
Minimum	–40.45	–38.18	–34.55	–38.18	–27.09	–26.09
Maximum	32.73	24.09	20.73	15.27	38.55	37.27
p-value	**0.367**	**0.002**	**< 0.001**	**< 0.001**	**< 0.001**	**< 0.001**

Table 3 Results of Bland-Altman analyses for the differences of the total scores and of respective sign tests of HAF and each one of the other dental anxiety methods at t0 and t1 (n = 210). Significant values are bold and in italics.

In order to verify the repeatability of the collected data, all subjects were questioned for a second time (t1) in different intervals, but at least 2 weeks after the first questioning (t0) using HAF, DAS, MDAS and VAS (retest).

Inclusion criteria: The following characteristics were applied for subject selection:

- Boys and girls between 12 and under 18 years of age;
- Full command of the German language;
- Attendance of secondary school;
- Visit to a dental practice with (at least) one parent (or guardian) at time t0 and the voluntary participation in a consultation on the study followed by giving written consent;
- No dental treatment was necessary until retest (t1).

2.3 Statistical analysis

All analyses were conducted using SPSS (Statistical Package for the Social Sciences), Version 19.

Internal validation: In order to determine the test-retest reliability of the HAF, Cronbach's α for time t0 and t1 was calculated. Additionally, it was shown if response items were possibly misunderstood or not kept apart correctly using the Kappa coefficients. With an interval-inclusion test (confidence interval method) the sets of data were tested for equivalence in regard to both points in time. The difference of the total scores (which were previously standardized to 100 %) for t0 and t1 were calculated.

External validation: In order to check the validity of the HAF results using DAS, MDAS and VAS, the scores of mentioned survey methods were standardized to 100 % first to facilitate comparison. Afterwards, a Bland-Altman-analysis was conducted with Bland-Altman-plots for the HAF and for another method mentioned above. In addition to the plot method, sign tests (dependent samples, continuous data) were calculated to detect differences in the calculated total scores of the HAF and DAS, MDAS and VAS, respectively. A statistical difference means, that the subjects would have responded significantly different at both times of investigation. Only after the degree of accordance was determined, it makes sense to investigate how the results of HAF and DAS, MDAS and VAS correlate: a high correlation alone says nothing about the congruence. With the parameter free correlation test by Spearman, the correlation coefficient was calculated for the HAF and each respective method. After this investigation of the correlation in general, the correlation of different survey methods for the 3 classifications of anxiety (slightly anxious, moderately anxious, extremely anxious) was examined separately using kappa values.

Comparison of the HAF results and the assessment of the dentist and his assistant: In order to evaluate the possible difference between HAF results and the personal assessments of competent professionals (only at time t0), the McNermar-Bowker-test was considered along with appropriate cross tables. In addition, the Kappa value was calculated and considered as measure of congruence.

The impacts of age and sex on the applicability of the HAF: In order to determine the impact of age (12–14 years, 15–17 years) and sex (male, female) on the HAF results, Spearman's correlation coefficient was secondarily calculated for these parameters, respectively. Additionally, it was tested on differences using the Wilcoxon-test.

3. Results

With 54 %-68 %, more than half of the 210 subjects declared to be slightly anxious for test and retest and all survey procedures. Subjects stating to be extremely anxious (possibly phobic) made up mostly less than 10 %, with a maximum of 12 % (Table 1). The consideration of the degree of anxiety based on age and sex yields, that younger, female subjects tended to be the most anxious (data not shown).

3.1 Internal Validation

The reliability of the first HAF-interview (t0) was checked using a retest (t1) and the following determination of Cronbach's α. The values were stable over the course of both times of investigation. At t0 and t1, $\alpha = 0.92$ and for t0 + t1, $\alpha = 0.96$, which signified an "excellent" correlation of test and retest. The calculation of kappa coefficients showed a "good" correlation (0.633–0.739) in 4 out of 11 HAF questions, and a

"moderate" correlation (0.460–0.591) at both points in time. The conducted interval-inclusion-test illustrates, that the responses of test and retest were the same and the median difference (50.0–47.27 = –3.63) was within the ± 5 % equivalence range (95 % confidence interval: –3.63; –1.82).

3.2 External Validation

Figure 1A-C depicts Bland-Altman-Plots for the interview via HAF in comparison with DAS, MDAS und VAS for the points in time t0 and t1, based on the values in Table 2.

The plotted values (mean values versus difference of the total scores using two methods) for the most part scatter within the defined limits of agreement, respectively, this also applies for the 95 % confidence interval of difference of total scores. This means that the questionnaires are interchangeable. The 95 % confidence interval excludes a value of zero for HAF/MDAS and HAF/VAS (Figure 1B, C), so that significances of the respective methods differed. The additional sign tests conducted on differences in the total scores of HAF and DAS, MDAS and VAS, respectively, revealed that the intra-individual deviations were low (Table 3).

Calculation of Spearman's correlation coefficient consistently yielded a high correlation of the 3 methods with HAF, respectively: HAF/DAS–r = 0.771 (t0), r = 0.798 (t1); HAF/MDAS–r = 0.780 (t0), r = 0.795 (t1); HAF/VAS–r = 0.829 (t0), r = 0.838 (t1). Table 4 showed a correlation (kappa value) between different survey methods with regard to the frequency of 3 defined anxiety classifications: slightly anxious, moderately anxious and extremely anxious (possibly phobic). The correlations were consistently "good" to "very good". Only in one case (MDAS/dentist's assistant) it was "moderate".

3.3 Differences in classification (dentist, assistant)

Table 5 and 6 compare the HAF results (only at time t0) with the assessment of the dentist and assistant, respectively, regarding the subjects' anxiety. It is shown, that the HAF and competent professionals both classify the anxiety nearly identically. However, McNemar-Bowker-Tests showed, that the HAF results and assessments of the dentist or assistant differed statistically. For HAF/dentist and HAF/assistant the differences were significant ($p < 0.01$), respectively. For dentist/assistant, the difference was not significant ($p = 0.587$). A consistently "good" to "very good" correlation of responses with the respective assessments was shown using Kappa values: HAF/dentist–0.675; HAF/assistant –0.607; dentist/assistant –0.842.

	HAF	DAS	MDAS	VAS
HAF		0.44	0.883	0.896
DAS	0.903		0.961	0.876
MDAS	0.872	0.890		0.915
VAS	0.915	0.895	0.865	
Dentist	0.675	0.665	0.675	0.713
Assistant	0.607	0.605	0.583	0.646

Table 4 Determination of the kappa value regarding the correlation of 2 dental anxiety survey methods at t0 (underlined) and t1 (n = 210). Significant values are bold and in italics.

3.4 Impact of age and sex on the anxiety scale, measured using the HAF

The Spearman correlation coefficient of total scores of the HAF with both age groups yielded a low correlation: t0 r = 0.290; t1 r = 0.285. The same applies for sex: t0 r = 0.097; t1 r = 0.130. Impact of age and sex on the degree of anxiety can therefore not be proven. This is shown by the conducted Wilcoxon test for sex (t0: p = 0.161; t1: p = 0.59), but not for age, where the results were significant (t0; t1: $p < 0.001$).

4. Discussion

4.1 Evaluation of results

The self-assessment of patients on determining the level of anxiety is considered a quick, cost-effective and not-invasive method to recognize and assess dental anxiety. This is with the help of adequate guidelines – for adults in form of the HAF – an appropriate, reliable and widely accepted resource for anxiety diagnosis in the context of dental treatment [8, 15]. Recognizing dental anxiety and determining its level before a dental procedure is crucial for coordinating the dental therapy and the methods calming anxiety [8]. When dental anxiety is suspected, the therapy of choice would be behavioral therapy [38]. Even treatment under general anesthesia can be indicated in individual cases [13, 14]. The described methods regarding diagnosis and therapy of dental anxiety and dental phobia have primarily been investigated in adult patients so far [15]. Dental anxiety with pathological value manifests itself often during the beginning of puberty [27, 33]. In order to avoid bad experiences in the dental practice, it is important to receive reliable information in young patients regarding the level of anxiety before a dental procedure [40]. For children up to 13 years old, customized methods that specifically suit their development were devised, which achieve very good results [40], such as the questionnaire to measure dental anxiety in children (FEZ-Ki) [21]. But what measuring instruments are suitable for older adolescents? Are questionnaires appropriate, that base their complexity on adults and the knowledge/understanding needed in order to answer

			Assessment of dentist regarding degree of anxiety			Total
			Slightly anxious	Moderately anxious	Extremely anxious, phobic	
HAF-Classification regarding degree of anxiety	Slightly anxious	Number	111	24	1	136
		Percentage of total	52.9 %	11.4 %	0.5 %	64.8 %
	Moderately anxious	Number	5	46	7	58
		Percentage of total	2.4 %	21.9 %	3.3 %	27.6 %
	Extremely anxious, phobic	Number	0	0	16	16
		Percentage of total	0 %	0 %	7.6 %	7.6 %
Total		Number	116	70	24	210
		Percentage of total	55.2 %	33.3 %	11.4 %	100 %

Table 5 Quantitative comparison of the answers (cross tables, not shown) of the HAF (Hierarchic anxiety questionnaire) and the assessment of the dentist at t0.

truthfully [10]? This published pilot study investigates this question and examines the suitability of the HAF in adolescents from the age of 12.

In all of the survey methods used in the present study, it was consistently shown that a large part of the adolescent subjects was slightly anxious. The extremely anxious (possibly phobic) subjects made up the lowest percentage, approximately one tenth. The results correspond with those of the investigated adult patients, which show, that increased anxiety with regard to dental treatment constitutes a serious problem for about 10 % of the population [3, 10]. Furthermore, it appears from the collected data, that boys seemed less anxious than girls and that older adolescents (15–17 years old) seemed less anxious than younger adolescents (12–14 years). Even though this is consistent with the socially assigned gender roles and the normal intellectual maturation [e.g. 26], the examination of the effect of age and sex yielded somewhat, that age could play a role. Also, in investigations of dental anxiety in adults, the women declare more anxiety than men [10].

The internal validity, investigated using Cronbach's α through test and retest was "excellent" (> 0.9). Consequently, a high measure of stable relations between the interviews and the different points of time (t0, t1) can be assumed. Despite this very good internal consistency, an item-wise test (McNemar-Bowker-Tests) produced, that the participants' responses of all 11 questions of the HAF at both points in time differed significantly.

These differences were consistently not highly significant. In accordance with this, the kappa values showed an item-wise comparison of test and retest, so that the correlation of the 1st and 2nd interview was at least "moderate", in 4 out of 11 questions even "good". The results of the interval-inclusion-test suggest an equivalent significance at t0 and t1 (95 % confidence interval within the defined area of equivalence) and therefore support the interval validity. The lack of experience of young subjects could possibly have an impact, because it can be assumed, that examined adolescents have little experience in general visiting a dental practice. At least the first test conducted in this research project solely took place during a dental check-up; even following this no dental procedure was carried out (until the retest).

For the external HAD-validity using Spearman's correlation test, the data was examined using Bland-Altman-analyses. These showed, that the HAF results strongly correlated with the DAS, MAS and VAS.

However, it must be noted, that the other questionnaires used for external validity for adolescents was not examined and validated expressis verbis, let alone translated from English into German for this group and checked appropriately. Such investigations exist for diagnosing anxiety in adults, for example for the DAS [37]. Most international studies deal with dental anxiety in adults and include adolescents of 15 years or older from time to time, without pointing this out separately or discussing it. So far, it was always rather differentiated between children and adults. In this study, it is investigated explicitly, if the HAF is a suitable instrument in 12–14 year old adolescents. The results of the present investigation show that in spite of all previous scepticism, the HAF is a suitable instrument to diagnose anxiety in adolescents.

Although adolescents are considered "uncooperative", especially

			Assessment of assistant regarding degree of anxiety			Total
			Slightly anxious	Moderately anxious	Extremely anxious, phobic	
HAF- Classification regarding degree of anxiety	Slightly anxious	Number	107	27	2	136
		Percentage of total	51.0 %	12.9 %	1.0 %	64.8 %
	Moderately anxious	Number	8	42	8	58
		Percentage of total	3.8 %	20 %	3.8 %	27.6 %
	Extremely anxious, phobic	Number	0	0	16	16
		Percentage of total	0 %	0 %	7.6 %	7.6 %
Total		Number	115	69	26	210
		Percentage of total	54.8 %	32.9 %	12.4 %	100 %

Table 6 Quantitative comparison of the answers (cross table, not shown) of the HAF (hierarchic anxiety questionnaire) and the assessment of the dentist's assistant at t0. (Tab. 1–6: N. Weifenbach)

when transitioning to puberty, and possibly tend to make false statements due to a sense of shame [6, 33, 34, 40], these results show that adolescents had no difficulties handling the questionnaire. This is particularly true for older adolescents, which is in line with the fact that questionnaires filled out incorrectly solely occured in the group of 12–14 year old subjects. In order to achieve clear results and recognize uncertainties in younger adolescents handling the questionnaires, it is recommended that a follow-up study examines the completion of the HAF questionnaire under the guidance of competent staff.

4.2 Methodological critique

The study presented exhibits pilot character because the sample size is based on the HAF study in adults from 1999 [10] and other diagnostic studies [1, 40]. Follow-up studies with larger number of participants are in the planning stage. Additionally, the social, cultural and spatial distribution of participating students were not taken into account. They attended different types of schools, which could have an impact given the expected variation in level of education [cf. 23]. The same applies for possible effects of cultural barriers such as effects, that potentially result from time or length of study, even though this cannot be expected according to the authors' assessment. Furthermore, in this pilot study, the participants' origins were not subjected to any geographic dispersion with regard to the entire country of Germany, and all participants of this investigation visited the same dental practice. Unlike Margraf and Poldrack [19], who explicitly compared East and West Germany, the present pilot study only reproduces a selective situation. However, regardless of degree of education and individual level of development, no questionnaire was filled out incorrectly in the group of 15–17 year olds.

Although the results presented contribute to closing the knowledge gaps in dentistry and are important for the clinical approach, it must not be overlooked, that a comprehensive and final evaluation at the current degree of the knowledge process has not been given.

5. Conclusion

This pilot study shows, that the HAF in its existing form is applicable in adolescents of both sexes between the ages of 15 and 18. Regarding the applicability of younger adolescents between 12 and 14 years old, difficulties in dealing with the questionnaire emerged. Further studies have to show the impact of social, cultural and regional aspects and how adolescents can be supported most appropriately in filling out this anxiety questionnaire, so that the HAF can be justified for this target group in the daily dental practice.

Conflicts of interest:
Authors state, that there is no conflict of interest within the meaning of the International Committee of Medical Editors.

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Annex 1

Hierarchic anxiety questionnaire (HAF)

Please imagine yourself in the following situations and specify:

	Relaxed (1 Point)	Uneasy (2 Points)	Tense (3 Points)	Anxious (4 Points)	Sick with fear (5 Points)
How do you feel at the thought of having to go see the dentist tomorrow?					
You are sitting in the waiting room and waiting to be called up. How do you feel?					
Imagine entering the treatment room and smelling the typical odor.					
You are in the dentist's chair and the dentist enters the room.					
You take a look at the X-Ray image together and discuss what has to be done.					
How do you feel when it is explained to you, that tartar is about to be removed?					
The dentist explains that you have a cavity, and that he wants to treat it right now.					
He adjusts the position of the chair and prepares a syringe.					
Imagine hearing the typical noise of the drill, how do you feel?					
The dentist explains to you, that the caries is too deep and that the tooth has to be extracted.					
A wisdom tooth has to be removed and the injection was already given. The dentist picks up the scalpel.					

Patient questions on DAS (Questions 1 to 4)

1. Imaging having to go see a dentist tomorrow. How do you feel right now?

I quite enjoy going to the dentist.	1
I don't mind, it doesn't bother me.	2
I feel a little uneasy.	3
I am worried, that it will be painful and uncomfortable	4
I am very afraid and am very worried what the dentist is going to do with me.	5

2. Imagine sitting in the waiting room at the dentist. How do you feel?

relaxed	1
a little uncomfortable	2
tense	3
anxious	4
so anxious, that I am sweating and feeling downright sick	5

3. Imagine sitting in the dentists' chair. The dentist prepares the drill to work on your teeth. How do you feel?

relaxed	1
a little uncomfortable	2
tense	3
anxious	4
so anxious, that I am sweating and feeling downright sick	5

4. Imagine sitting in the dentists' chair to have tartar removed. While you wait, the dentist prepares the instruments he will use to scrape off tartar in the gingival area. How do you feel?

relaxed	1
a little uncomfortable	2
tense	3
anxious	4
so anxious, that I am sweating and feeling downright sick	5

MDAS: Extension of DAS by 1 question

5. Imagine having to receive an injection into your gums above a posterior molar. How do you feel?

relaxed	1
a little uncomfortable	2
tense	3
anxious	4
so anxious, that I am sweating and feeling downright sick	5

Self-evaluation on a visual analogue scale (VAS) by the patient

How do you evaluate the strength of the anxiety? Please mark the subjective feeling with a vertical line on the scale.

0	10
No fear	Such intense fear, that one believes one must die