Ann Med Res 2021;28(8):1508-14

Annals of Medical Research

DOI: 10.5455/annalsmedres.2020.09.914

Original Article

2D/4D proportion and preoperative anxiety: Is there an association?

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Abstract

Aim: The proportion of an individual's index finger to their ring finger, their 2D/4D proportion, is influenced by prenatal sex hormones and is known to be higher in women. It has been related to certain psychological, behavioral and physiological characteristics. Therefore, we aimed to discover whether 2D/4D proportion is related to preoperative anxiety.

Materials and Methods: We included 108 ASA I or II patients with an age range of 18 to 65 years who were to undergo elective surgery. The APAIS-A and APAIS-B tests were used to determine the patients' anxiety levels and their desire to obtain information regarding the preoperation. Digit lengths were quantified via a digital caliper with 0.01 mm sensitivity. 2D/4D proportions were measured bilaterally, allowing us to determine the differences between the fingers of both hands. Patients were grouped according to their 2D/4D proportions as ≥1 mm and <1 mm.

Results: We found no statistical relation in 2D/4D proportions of either hand (p=0.190 for right and p=0.677 for left).Also, neither right-hand nor left-hand proportions were statistically associated with APAIS scores (p=0.155 and p=0.533, respectively). In terms of differences in length, neither hand revealed any correlation to APAIS scores (right-hand: p=0.821 for <1 mm and p=0.233 for ≥1 mm; left-hand: p=0.388 for <1 mm and p=0.604 for ≥1 mm).

Conclusion: Although simple and easy anthropometric measurements, 2D/4D proportions and 2D-4D sizes were found to be unrelated to preoperative anxiety. Our results can be of aid to future multicentered research with larger and more homogenized patient samples.

Keywords: 2D/4D proportion; APAIS scale; preoperative anxiety

INTRODUCTION

Patients experience preoperative anxiety at differing degrees and for various reasons. These include all concerns regarding anesthesia and fear of negative postoperative outcomes such as not waking up, permanent disability, severe pain, inability to work, loss of control over one's body and loss of sexual function. Mainly caused by uncertainty, preoperative anxiety has been reported to have an incidence of 60 to 80% (1-4).Research suggests that reducing patients' anxiety helps to reduce release of corticosteroid hormones and shortens the time before vital signs turn to normal, aiding quick recovery (4,5).

Second digit (2D) length is known to be directly proportional to testosterone levels in males and estrogen levels in females. The proportion of this finger's length to that of the fourth digit (4D) is defined as 2D/4D proportion. This proportion is influenced by antenatal sex hormones (6).It is higher in women all around the globe (6-8).Research suggests that it is also correlated with certain psychological, behavioral and physiological characteristics (7).In addition, starting from the 14th prenatal week, it remains unchanged throughout life (9). However, considering the literature on the matter, this proportion has not yet been investigated in relation to anxiety prior to surgery.

One of the tools we used here was the Amsterdam Preoperative Anxiety and Information Scale (APAIS), measuring anxiety levels and desire to obtain information on anesthesia and surgery (10). Developed by Moerman et al. (11), it proved to be quicker and easier compared to the previously used scale, State-Trait Anxiety Inventory (STAI). With its short structure and quantitative evaluation, the APAIS has been material to many researches on the subject (11,12).Moreover, studies comparing the APAIS and the STAI have revealed that it is as feasible as the STAI (13,14).

Received: 05.09.2020 **Accepted:** 19.10.2020 **Available online:** 18.08.2021
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Here, we aimed to determine patients' anxiety levels regarding anesthesia and evaluate the correlation between APAIS scores and 2D/4D proportions.

MATERIALS and METHODS

Ethical approval for the study was given by the Clinical Research Ethics Committee of Ordu University (Dated 12.03.2020, No. 2020/36).

Our sample consisted of 108 patients aged 18-65 years in the anesthesia clinic of the Training and Research Hospital in Ordu University. Our study was conducted between April 2020 and August 2020. The cases who applied to Ordu University Training and Research Hospital for preoperative examination were included in the study. All patients were classified as ASA I or II and were to undergo elective surgery. Our cases were selected among patients without systemic disease or with stable systemic disease. This study designed as one unblinded study. The patients were enrolled on a participatory basis, with a written informed consent form by each. Patients with hand injury, osteoarthritis, structural deformity, trauma, fracture, congenital deficiency of perception, deficiency of hearing, speech disorder , mental or cognitive disorder and those aged under 18 years or could not speak Turkish were excluded. Cases in ASA III and ASA IV risk class were excluded from the study. Cases with severe systemic disease (eg uncontrolled diabetes, advanced stage lung disease, unstable angina etc..) were excluded from the study. We recorded the demographic information of the participants. Finger length measurements were done by a digital caliper with 0.01 mm sensitivity (Mitutoyo, Japan).The APAIS-A and APAIS-B tests were used to determine preoperative anxiety levels and desire to receive information, distributing or reading the forms to the patients. The APAIS-A is a 5-point Likert-type questionnaire with 4 items that measures preoperative anxiety. On the other hand, the APAIS-B is a 5-point Likert-type scale that has 2 items and measures desire to receive information. The items in each form can be found below.

APAIS-A

1. I am worried about anesthesia.

2. I always think about anesthesia.

3. I am worried about the surgical procedure.

4. I always think about the surgical procedure to be applied.

APAIS-B

1. I would like to get as much information as possible about anesthesia.

2. I would like to get as much information as possible about the surgical procedure.

The sum of the scores to each item made up the APAIS-A and APAIS-B scores. For APAIS-A, scores below 16 were considered as low anxiety, and scores 16 and above indicated high anxiety (15). For APAIS-B, scores below 8 considered as a low desire for information,while scores 8 and above 8 indicated a high desire (15).

We also determined the length differences between index and ring fingers.Digit length was taken as the distance between the central point of the proximal line separating the finger root from the palm to the fingertip (17).

2D/4D proportion is defined as the ratio of the length of the extent of the index finger to that of the ring finger (17).2D/4D proportions were calculated bilaterally, allowing us to determine the differences between the fingers of both hands. Patients were grouped according to their 2D/4D proportions as ≥1 mm and <1 mm (18).

Statistical Analysis

We used the IBM SPSS Statistics 23.0 software to analyze our data. Whether the data was normally distributed was checked using the Kolmogorov-Smirnov test and the Shapiro-Wilk test. Comparison of age and gender parameters with APAIS scores was done by t-test.The data not following with normal distribution were analyzed by Spearman's correlation coefficient. Quantitative data are given as mean±standard deviation and median (minimum-maximum).Categorical data are indicated as frequency and percentage. $p<0.05$ was taken as the level of significance.

RESULTS

The flow chart of the study participants is shown in Figure 1.

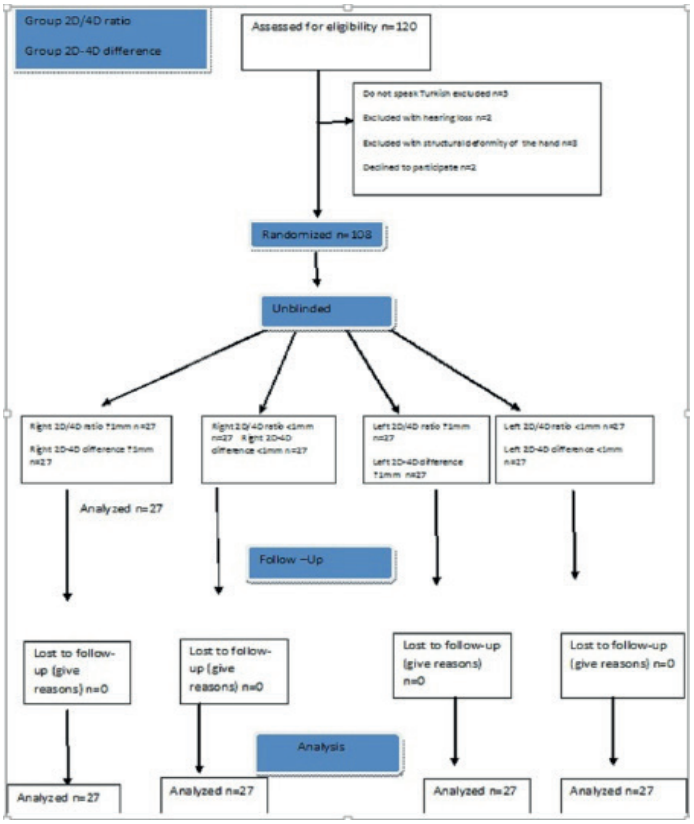

Figure 1. Participant flow diagram

Table 1 below shows the frequency distribution of categorical data.

Table 1. Frequency distribution of categorical data

	Frequency (n)	Percentage (%)
ASA		
ASA I	49	45.4
ASA II	59	54.6
Educational background		
Illiterate	8	7.4
Primary school	61	56.5
High school	28	25.9
University graduate	11	10.2
Marital status		
Married	102	94.4
Single	6	5.6
Sex		
Female	75	69.4
Male	33	30.6
Right- or left-handed		
Right-handed	107	99.1
Left-handed	1	0.9
APAIS-A Status		
i)Low Anxiety	102	94.4
ii)High Anxiety	6	5.6
APAIS-B Status		
i)Low desire for receiving information	95	88
ii)High desire for receiving information	13	12
Anxiety according to the proportion in the right hand		
Low Anxiety	35	32.4
High Anxiety	73	67.6
Anxiety according to the proportion in the left hand		
Low Anxiety	50	46.3
High Anxiety	58	53.7
Difference in the right hand		
<1 mm	70	64.8
≥1 mm	38	35.2
Difference in the left hand		
<1 mm	83	76.9
≥1 mm	25	23.1

54.6% of the participants were classified as ASA II, 56.5% had primary school education, 94.4% were married, 69.4% were female, and 99.1% were right-handed. APAIS results revealed that 5.6% had high anxiety, while 12% had a high desire for information. In comparison, high preoperative anxiety was seen in 67.6% of right-side measurements and 53.7% of left-side measurements. In terms of length comparisons, 2D-4D difference was ≥1 mm in 35.2% of right-hand measurements and 23.1% of left-hand measurements. There was no statistically significant difference between the 2D / 4D ratios (for both right and left hand) between female and male cases (p=0.06). When the age parameter was compared in terms of APAIS scores, no significant relationship was found between age and APAIS scores (p=0.089).

Table 2 below shows the descriptive statistics for quantitative data.

Table 2. Descriptive statistics of quantitative data

	Mean±SD	Mean (Min-Max)
Age	38.71 ± 11.39	38.5 (18 - 77)
Number of children	2 ± 1.42	2 (0 - 6)
Right 2D length	67.45 ± 8.13	68.2 (30.58 - 84.85)
Right 4D length	67.58 ± 8.77	68.57 (20.77 - 83.5)
Left 2D length	67.34 ± 7.99	67.91 (30.68 - 81.44)
Left 4D length	68.18 ± 8.82	68.81 (20.76 - 83.69)
APAIS total	12.38 ± 5.54	11 (6 - 27)
APAIS-A	8.11 ± 3.76	7 (4 - 18)
APAIS-B	4.27 ± 2.06	4 (2 - 9)
Right 2D/4D	1 ± 0.06	1 (0.9 - 1.47)
Left 2D/4D	0.99 ± 0.06	0.99 (0.89 - 1.48)
Right 2D-4D	-0.13 ± 3.06	-0.12 (-7.56 - 9.81)
Left 2D-4D	-0.84 ± 3.09	-0.88 (-7.99 - 9.92)

The patients included in the study had a mean age of 38.71 (range 18 to 77) years and a mean number of children of 2 (range 0 to 6).Mean 2D lengths were 67.45 for right-hand measurements (range 30.58 to 84.85) and 67.34 for left-hand measurements (range 30.68 to 81.44), while mean 4D lengths were 67.58 for right-hand measurements (range 20.77 to 83.5) and 68.18 for left-hand measurements (range 20.76 to 83.69). The mean 2D/4D proportions were 1 (range 0.9 to 1.47) for right-hand measurements and 0.99 (range 0.89 to 1.48) for left-hand measurements. Mean 2D-4D differenceswere-0.13 (range -7.56 to 9.81) for right-hand measurements and -0.84 (range -7.99 to 9.92) for left-hand measurements. Considering anxiety levels and desire for information, the patients had a mean APAIS score of 12.38 (range 6-27). The mean subscale scores were 8.11 (range 4-18) for APAIS-A and 4.27 (range 2-9) for APAIS-B.

Table 3 below shows the associations between 2D/4D proportions and APAIS and subscale scores for right-hand measurements.

Patients with low anxiety according to right-hand 2D/4D proportions had a positive correlation between each of their overall and subscale scores (p<0.001 for all; r=0.697 for APAIS-A and APAIS-B; r=0.955 for APAIS-A and APAIS; r=0.868 for APAIS-B and APAIS). However, the right-side 2D/4D proportion was not correlated with APAIS scores (p>0.050).

Patients with high anxiety according to right-hand 2D/4D proportions had a positive correlation between each of their overall and subscale scores (p<0.001 for all; r=0.791 for APAIS-A and APAIS-B; r=0.965 for APAIS-A and APAIS; r=0.915 for APAIS-B and APAIS). Right-hand 2D/4D proportions and APAIS scores were not correlated for this group either (p>0.050).

Table 3. The correlation between 2D/4D proportions and APAIS and subscale scores, right-hand

Anxiety according to the proportion in the right-hand			Right-hand 2D/4D Proportion	APAIS-A	APAIS-B
Low anxiety	APAIS-A	r	0.153		
		p	0.382		
	APAIS-B	r	0.295	**0.697**	
		p	0.085	**<0.001**	
	APAIS	r	0.227	**0.955**	**0.868**
		p	0.190	**<0.001**	**<0.001**
High anxiety	APAIS-A	r	-0.065		
		p	0.586		
	APAIS-B	r	-0.029	**0.791**	
		p	0.809	**<0.001**	
	APAIS	r	-0.050	**0.965**	**0.915**
		p	0.677	**<0.001**	**<0.001**

r: Spearman's Rho correlation coefficient

Table 4. The correlation between 2D/4D proportions and APAIS and subscale scores, left-hand

Anxiety according to left-side proportion			Left-side 2D/4D	APAIS-A	APAIS-B
Low anxiety	APAIS-A	r	0.202		
		p	0.160		
	APAIS-B	r	0.190	**0.740**	
		p	0.187	**<0.001**	
	APAIS	r	0.204	**0.965**	**0.882**
		p	0.155	**<0.001**	**<0.001**
High anxiety	APAIS-A	r	-0.104		
		p	0.437		
	APAIS-B	r	-0.031	**0.796**	
		p	0.817	**<0.001**	
	APAIS	r	-0.083	**0.965**	**0.921**
		p	0.533	**<0.001**	**<0.001**

r: Spearman's Rho Correlation Coefficient

Table 5. The relation between 2D-4D differences and APAIS scores, right-hand

Right-side 2D-4D			Right-side 2D-4D	APAIS-A	APAIS-B
<1 mm	APAIS-A	r	-0.066		
		p	0.589		
	APAIS-B	r	0.020	**0.721**	
		p	0.869	**<0.001**	
	APAIS	r	-0.028	**0.961**	**0.876**
		p	0.821	**<0.001**	**<0.001**
≥1 mm	APAIS-A	r	-0.235		
		p	0.156		
	APAIS-B	r	-0.144	**0.826**	
		p	0.388	**<0.001**	
	APAIS	r	-0.198	**0.968**	**0.935**
		p	0.233	**<0.001**	**<0.001**

r: Spearman's Rho Correlation Coefficient

Table 4 below shows the relation between 2D/4D proportions and APAIS scores for left-hand measurements.

Patients with low anxiety according to left-hand 2D/4D proportions had a positive correlation between each of their overall and subscale scores (p<0.001 for all; r=0.74 for APAIS-A and APAIS-B; r=0.965 for APAIS-A and APAIS; r=0.882 for APAIS-B and APAIS). However, the left-side 2D/4D proportion was not correlated with APAIS scores (p>0.050).

Patients with high anxiety according to left-hand 2D/4D proportions had a positive relationship among each of their overall and subscale scores (p<0.001 for all; r=0.796 for APAIS-A and APAIS-B; r=0.965 for APAIS-A and APAIS; r=0.921 for APAIS-B and APAIS). Left-side 2D/4D proportions and APAIS scores were not related in this group either (p>0.050).

Table 5 below shows the relationship among 2D-4D differences and APAIS scores for right-hand measurements.

Patients with <1 mm of right-hand 2D-4D difference had a positive correlation between each of their overall and subscale scores (p<0.001 for all; r=0.721 for APAIS-A and APAIS-B; r=0.961 for APAIS-A and APAIS; r=0.876 for APAIS-B and APAIS). However, right-hand 2D-4D differences and APAIS scores were not significantly correlated (p>0.050).

Patients with ≥1 mm of right-hand 2D-4D difference had a positive correlation between each of their overall and subscale scores (p<0.001 for all; r=0.826 for APAIS-A and APAIS-B; r=0.968 for APAIS-A and APAIS; r=0.935 for APAIS-B and APAIS). Right-hand 2D-4D differences and APAIS scores were not correlated for this group either (p>0.050).

Table 6 below shows the relation between 2D-4D differences and APAIS and subscale scores for left-hand measurements.

Patients with <1 mm of left-hand 2D-4D difference had a positive correlation between each of their overall and subscale scores (p<0.001 for all; r=0.763 for APAIS-A and APAIS-B; r=0.967 for APAIS-A and APAIS; r=0.898 for APAIS-B and APAIS). However, left-hand 2D-4D differences and APAIS scores were not significantly correlated (p>0.050).

Patients with ≥1 mm of left-hand 2D-4D difference had a positive correlation between each of their overall and subscale scores (p<0.001 for all; r=0.774 for APAIS-A and APAIS-B; r=0.957 for APAIS-A and APAIS; r=0.9 for APAIS-B and APAIS). Left-hand 2D-4D differences and APAIS scores were not correlated for this group either (p>0.050).

Table 6. The relation between 2D-4D differences and APAIS and subscale scores, left-hand

Left-side 2D-4D			Left-side 2D-4D	APAIS-A	APAIS-B
<1 mm	**APAIS-A**	r	0.056		
		p	0.616		
	APAIS-B	r	0.157	**0.763**	
		p	0.157	**<0.001**	
	APAIS	r	0.096	**0.967**	**0.898**
		p	0.388	**<0.001**	**<0.001**
≥1 mm	**APAIS-A**	r	0.029		
		p	0.891		
	APAIS-B	r	0.121	**0.774**	
		p	0.564	**<0.001**	
	APAIS	r	0.109	**0.957**	**0.900**
		p	0.604	**<0.001**	**<0.001**

r: Spearman's Rho Correlation Coefficient

DISCUSSION

Our findings suggest that proportions or differences in 2D and 4D lengths have no impact on preoperative anxiety regardless of the measured hand. Although, patients with a 2D-4D difference of ≥1 mm in both hands appeared to have higher APAIS scores, with a marked association between their APAIS and APAIS-A scores (p<0.001, r=0.957).

Seeking a correlation between Type 2 diabetes and 2D/4D proportion in 400 participants, Ozkan et al. (19) had some interesting findings. They observed their male participants to have 2D/4D proportions above the normal values, while the females had proportions below normal (0.96 mm for men and 0.98 mm for women). Moreover, they were able to reveal differences between healthy volunteers and diabetes patients in terms of 2D/4D proportions, which differ from our findings. Though, this could be attributed to their sample being larger and more homogeneous.

In another research, Tatar et al. (18) observed the personality traits of 321 young women in comparison to their 2D-4D

differences using the Five-Factor Personality Inventory. They divided the women into 3 groups according to their 2D-4D differences (estrogen-dominant if >1 mm, middle group if =1 mm and testosterone-dominant if <1 mm). Accordingly, the former group had gentler, more sensitive, more tolerant and more emotional personality traits, along with higher anxiety sensitivity and predisposition to anxiety. In comparison, we observed our patients to have positive correlations between each of their APAIS and subscale scores and 2D-4D differences for both hands. The two findings are consistent in the context that estrogen-dominant women have higher predisposition to anxiety.

Oztasan et al.(20) sought the association of 2D/4D proportions with non-verbal intelligence, hand preference, cerebral lateralization, motor skills and visual, auditory and verbal skills. The only statistical correlation they found was between right-hand 2D/4D proportions and nonverbal intelligence, similar to our lack of any other relevant findings.

Karadağ Arlı (15) measured preoperative anxiety levels in 189 patients who were scheduled for various types of surgerical procedure using both APAIS and STAI and found that most of the participants had moderate to high preoperative anxiety. The findings measured with the two scales were similar. However, using only the APAIS, we marked much lower anxiety levels in our patients compared to the literature, with high levels being observed in only 5.6% of participants. This could be attributed to differences in culture, as in the more courageous and assertive nature of people living in and around Ordu (the Black Sea region), and to the established trust of patients in our physicians, as our hospital is the only university hospital in the city.

Evardone and Alexander (21) examined the correlation between anxiety and gender-related behavior models and 2D/4D proportions using 8 scales, one of which was the STAI. They reported that the only significant difference was in the anxiety levels of men with a 2D/4D proportion of >0.98. They also could not find any association with the evaluated hormone levels including estradiol and testosterone in either males or females. In our study, there was no statistically significant difference between the 2D / 4D ratios (for both right and left hand) between female and male cases. Considering that our sample consisted largely of women, it could be stated that our findings are in parallel.

A validity study of the APAIS scale for the Turkish population was conducted to determine the level of preoperative anxiety. Cetinkaya et al. (22) conducted a validity and reliability study of APAIS for Turkey and found the scale to be quite reliable. Therefore, APAIS scoring was used in our study.

Looking at research on preoperative anxiety and its influence on postoperative recovery, it is known that high levels of anxiety are to be avoided as they can negatively affect recovery. Anxiety is widely accepted as a subjective experience based on patient perception (23). The adverse effects that preoperative anxiety may have on postoperative outcomes have been well defined in the literature, including delayed wound healing, longer hospitalization and reduced patient satisfaction (24-26). In addition, research suggests preoperative anxiety to be a predictive marker for hemodynamic changes in anesthesia for older patients (24).

LIMITATIONS

Some limitations of the current study are listed as small sample size of study and having data from a single center. Further research can alleviate such limitations by focusing on more homogeneous groups of patients.

CONCLUSION

In conclusion, considering its adverse postoperative effects, preoperative anxiety is an indication well worth focusing on, as quicker recovery and shorter hospitalization will have plenty of benefits, including economic advantages. Being simple and easy anthropometric measurements, 2D/4D proportion and 2D-4D difference have no statistical bearing on determining preoperative anxiety. However, our findings can aid future multicenter research on larger and more homogenized groups of patients.

Competing Interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical Approval: Clinical Studies Ethics Committee of Ordu University, Faculty of Medicine , (Date 12.03.2020 Decision no: 2020/36).

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