Basic knowledge and attitudes towards biostatistics in sixth- and seventh-year medical students

Conocimientos básicos y actitudes frente a la bioestadística en estudiantes de medicina de sexto y séptimo año

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Abstract
Introduction: Biostatistics is essential for evidence-based decision making. **Objective: To** assess basic knowledge and attitudes towards biostatistics in senior medical students and to find correlated factors. **Methods:** Cross-sectional, analytical, observational study. A total of 202 students were surveyed virtually. Attitudes towards biostatistics were measured using the *Survey of Attitudes Toward Statistics-28* and basic knowledge of statistics using the Novack questionnaire. The covariables were sex, age, academic year, medical internship, having taken an extracurricular course in biostatistics, use of statistical software, intention to do a residency, and medical specialty. Correlation coefficients and score differences were found and, for multivariate analysis, adjusted regression coefficients (β) with 95%CI were found, using $p<0.05$ as statistically significant. **Results**: 57.9% of respondents were female and the median age was 25 years. The median and interquartile range of the basic knowledge score was 3 (1-4) and attitude towards biostatistics was 4.6 (4.2-5.0). The factors correlated (adjusted β [95%CI]) to better knowledge consisted of taking an extracurricular biostatistics course (0.65[0.07-1.24]) and higher score on the value subscale (SV) of attitude towards biostatistics (0.33[0.06-0.61]); while for attitude towards biostatistics, older age (0.04[0.01-0.07]) and handling of statistical *software* (0.31[0.12-0.51]). **Conclusions:** The level of basic knowledge of biostatistics is low, and correlates with taking an extracurricular course and SV of attitude towards biostatistics. Attitude was positive and correlated with age and the use of statistical *software.*
Key words: biostatistics, knowledge, attitudes, medical students, internship.

Introduction

The role of biostatistics today is crucial, not only because it allows to analyze and critically evaluate the vast available evidence, but also because of its implication in informed decision making in clinical practice and public health (1,2) based on the close relationship with evidence-based medicine (EBM) (3). The latter invites a proper understanding of biostatistics with respect to the design, processing, analysis and interpretation of data in order to provide optimal patient care (4,5). Therefore, it is necessary a continuous and quality training that provides adequate statistical knowledge for a comprehensive development of future health professionals (6).

Although they are taught at the undergraduate level, there is often no systematic approach focused on the practical aspects that will be useful for the physician in training 9. Therefore, it is essential to know the degree of knowledge about biostatistics and epidemiology (BES) and the related difficulties that could have an impact on a lower understanding and applicability of biostatistics. In this way, these areas can be strengthened by providing them with the minimum capabilities to understand and assertively transmit statistical information not only to the medical community but also to patients (7).

Some authors (8-10) report the importance of investigating cognitive and non-cognitive elements, giving special emphasis to the latter, because among these is the "attitude" (encompassing cognitive, affective and behavioral components) that could influence the acquisition, understanding and optimal performance of statistical skills.

It is considered essential to understand the interaction between the attitude towards biostatistics (AFB) and CBE in students about to graduate, especially in our environment where there is little evidence on this subject. Despite the fact that at the international level, it is even impossible to critically discern and execute medical decisions without a minimum statistical understanding (11). A clear example is the measures taken for the management of patients with COVID-19, where the lack of execution of decisions based on EBM has been exposed, where, even endorsed by regulatory institutions, they have recommended the massive use of drugs with a low level of evidence and poor efficacy, without considering the vital risk or adverse effects, generating other ethical problems and problems of access to those with true indications for these drugs (12). Herein lies the social need of biostatistics for optimal patient care; which, if put to good use, can improve the quality and efficiency of future research (5,6,9), thus avoiding additional mandatory statistical training at the postgraduate level (13). Therefore, the objective of the study was to evaluate the basic knowledge and attitudes towards Biostatistics in sixth- and seventh-year medical students of Human Medicine and to find correlated factors.

Material and methods

Study design and population: Cross-sectional, analytical and observational study. The population is made up of sixth- and seventh-year students of Human Medicine at the Ricardo Palma University between March 2020 and January 2021.

Medical students over 18 years of age who were in their last year (which implies completion of the medical internship) or penultimate academic year and who agreed to take part in the study were included. Prior to their participation, the objective of the study was explained to them in writing and explaining that their participation was voluntary and anonymous.

Two instruments were used: the Novack questionnaire (14) and the SATS 28 (*Survey of Attitudes Toward Statistics-28*) (15). Both tools were loaded to the Google® Forms platform for subsequent delivery to the study population via e-mail and/or personal social networks, supported by a list of contacts provided by the delegates of each URP promotion, requesting their completion and ensuring their anonymity.

The *sampling* was non-probabilistic by convenience. The sample size was calculated to find a correlation coefficient of 0.260 with a power of 80% and a confidence level of 95%, resulting in 113 participants. Due to logistical availability, the entire population was surveyed, which consisted of about 499 participants, of which, 202 students responded, so conforming the study sample.

Instruments and variables

Participants filled out the form, which was divided into three sections: the first section included data on academic and socio-demographic characteristics as sex, age, academic year (internship being the seventh year), being a medical intern, having taken an extracurricular course in biostatistics, handling of statistical *software*, intention to do residency and medical specialty to be followed.

In the second section, ten questions were asked (5 on statistics and 5 on epidemiology) to evaluate the CBE, these questions were taken from the Novack Questionnaire in its validated version and adapted to Spanish (16) *(Annex 1).*

Finally, in the third section, the self-administered SATS-28 survey (15) was used, which was designed in 1990 to assess four components or subscales of the AFB. These were in turn divided into 28 items: "affect" (6 items, assessing positive and negative feelings), "value" (9 items, about the usefulness and relevance of statistics), "cognitive competence" (6 items, about statistical knowledge and skills), and "difficulty" (7 items, about attitudes toward the difficulty of statistics). Medical students responded using a 7-point Likert scale (1 = "Strongly disagree", 4 = "Neither disagree nor agree" or neutral, 7 = "Strongly agree") in an approximate time of ± 10 min. The evaluation of the score translates that the higher the score reflects a more positive attitude towards statistics and vice versa. Some items were reverse scored to control for the problem of acquiescence.

This scale is adequately validated and in the reliability analysis, Cronbach's alpha internal consistency coefficient was used to evaluate the individual factor structure and the total scale. It shows an overall score of 0.907 and for each subscale between 0.716 ("difficulty") - 0.903 ("value") (17). Also, permission was requested from the author by e-mail for the use of the SATS-28 (18) and a validated version in Spanish was also used (19), which is shown in *Annex 2*.

Procedures:

The respective permissions were requested from the Faculty of Human Medicine of the Ricardo Palma University and the Ethics Committee of the same institution. Once these permissions were obtained, in the first instance, the virtual surveys were sent to the personal e-mail addresses of the students belonging to the graduating classes in 2020 and 2021, which were obtained from the student delegates. Subsequently, they were sent to official WhatsApp® groups of each promotion inviting the population to be part of the study voluntarily and anonymously. Of the 499 subjects contacted, only 202 students filled out the survey.

Data analysis

The database was extracted from the data collected in the Google Forms® platform in Microsoft Excel® format, after applying the selection criteria, the data were processed in the STATA v14® statistical package.

For the descriptive analysis of quantitative variables, mean (M) and standard deviation (SD) or median (ME) and interquartile range (IQR) were used, depending on normality, while qualitative variables were analyzed using frequencies and percentages.

For the inferential analysis, the Spearman correlation coefficient of the CBE and AFB scores with each of the quantitative independent variables was found, as well as the Spearman correlation between the CBE and AFB scores; on the other hand, when the independent variables were qualitative, the scores were compared using the Mann-Whitney U or Kruskal-Wallis tests, depending on the number of groups to be compared. In the multivariate analysis, linear regression was used for the adjusted regression coefficients (β), as well as the 95% confidence intervals (95%CI) and worked with a $p<0.05$ as statistically significant. The variables included in the multivariate model for both outcomes considered CBE and for AFB were those that had a value of $p<0.15$ in the bivariate analysis.

Ethical aspects

International guidelines for the correct use of data and research ethics were followed (20). Likewise, permission was requested from the corresponding authorities and from each participant through the virtual completion of an informed consent form. Once this was done, the study population was informed. The study was approved by the Ethics Committee of the Ricardo Palma University.

Results

117 respondents were female (57.9%), the median age was 25 years. Sixty-five percent were medical interns and only 21.8% (44) had taken an extracurricular course in biostatistics. In addition, 68.8% handled some statistical software. And also, almost 98.5% (199) had the intention of doing a residency and of these the great majority would do some other medical specialty, the most frequent being general surgery, followed by pediatrics and gastroenterology. The other characteristics are shown in *Table 1*.

In the bivariate analysis, the factor correlated to the CBE level was age, while having taken an extracurricular course in biostatistics had a value of $p=0.057$, therefore, it was considered in the multivariate analysis as it had $p<0.15$. Among the factors correlated to AFB, age ($p=0.018$) and use of statistical *software* ($p=0.001$) were statistically significant. In addition, the ME and RI of the CBE score was 3 (1-4) and the AFB score was 4.6 (4.2-5.0) (see *Table 2*).

When correlating the AFB subscales with the CBE score, it was found that the value subscale was correlated with a better CBE score in the population studied (see Table 3). It was found that the value subscale was correlated to a better CBE score in the population studied.
In the multivariate analysis, it was found that the factors correlated with CBE were taking an extracurricular course and the AFB value subscale. In addition, according to the adjusted B coefficients it was found that for each increase in taking an extracurricular course, knowledge improved by 0.65 points and as biostatistics value increased, knowledge improved by 0.33 points; whereas, the factors correlated to AFB were age (p=0.013) and handling of statistical software (p=0.001) *(Table 4).*
Figure 1 shows the difference in the CBE score according to having taken an extracurricular course and its correlation with the AFB value subscale; likewise, the difference in AFB scores (according to the SATS-28) between those who handle statistical software and those who do not, as well as its correlation with age, can be observed.

Discussion
Biostatistics as a practical discipline is very useful for medical professionals, because it allows them to make use of the knowledge acquired to use it in health care and also contributes to the construction of skills such as the critical mastery of scientific evidence (21). Despite these advantages stated in the literature, the present study indicates a disturbing reality, that there is a low level of CBE of medical students about to graduate; however, they showed a good AFB when assessing it both in their professional and academic life.

In relation to the level of knowledge, this study found a mean and median well below a score of "6" considered satisfactory, which agrees with Torales et al. (16) where most of the Paraguayan resident physicians of different specialties had a low level of knowledge. This was attributed to the fact that many did not carry out additional studies in the postgraduate program nor did they regularly read scientific articles critically, especially in the first years of residency due to the heavy workload. Different results were found in the study by Santabárbara et al. (22) in postgraduate medical students, where the median CBE score was 8.

Thus, the results reflect the reality of recently graduated physicians, considering that many of them focus their final years of training on their work in health care. Herein lies the importance of further training in BE during undergraduate studies so that they can apply it in future medical practice and correctly interpret the evidence for the benefit of patients.

As mentioned, attitude is one of the non-cognitive elements that would influence knowledge either negatively or positively; therefore, it is relevant to understand other factors that could interfere in its perception and in turn in the CBE. Although the SATS-

28 score was similar to that of the literature (22), the attitude could be accentuated by the context of the COVID-19 pandemic; supported by the need to have at least some understanding of BE to be able to understand the dizzying and changing reality of a disease that is not so well known.

Another substantial finding in this study is that no correlation was found between the level of knowledge and attitude in general, but with the "value" subscale. In contrast to Santabárbara et al. (22), where a higher correlation was obtained between knowledge and the "difficulty" (p=0.031) and "affection" (p=0.048) subscales. In that study, the physicians who studied postgraduate research, although they have high mean scores on the value subscale (5.53±0.76), it is not correlated to greater knowledge (p=0.244) and they consider it a difficult subject to learn and with neutral feelings towards statistics; on the other hand, in the study, medical students obtained few credits in biostatistics courses during their studies, but despite this, at the end of their undergraduate studies they had high value and motivation to learn. This coincides with Daher and Amin(23) where they found that more than 50% of respondents had a positive perception of the value of BE both in the career and to face real health problems.

Therefore, it is evident that students need to be trained in addition to the courses of the curriculum to have more knowledge, supported by the significant correlation found in the present study between taking an extracurricular course and a higher level of CBE. This could be explained by some factors such as the academic weight of the course or by the time in which they take this course; which agrees with the qualitative study of Fielding et al. (24) where medical students considered biostatistics as very relevant within the academic curriculum, mentioning that its premature teaching without a previous base, could not be adequately understood and should be taught from third and then in fifth year pointing out from the first moment the real application in the medical daily life. By means of counseling in small groups, making virtual tools available and not waiting until the pressures of completing the undergraduate degree to learn.

Additionally, in this multivariate analysis, a positive correlation was found between AFB with age and handling statistical software. Regarding age, it was found that the AFB score will improve at a rate of 0.04 points for each year; this differs from some international studies(11,25) including that of Santabárbara et. al. (22) where no significant differences were found either with age (p=0.621) or with having taken an extracurricular course (p=0.211) or using statistical software (p=0.295), whose probable explanation would be the variability of ages or social characteristics of each population surveyed.

However, similar results to Ocakoğlu et al. (26) were obtained about the correlation between AFB and the use of a statistical *software*, where nurses showed a good attitude when using some statistical *software* (SPSS: 84.8%, STATA: 5.4% and SAS: 3.8%) that impacted on the improvement of statistical skills and greater understanding of the subject, in order to translate them into evidence-based research. However, the literature is not conclusive as shown in the Malaysian study (23) where they indicate that there was no significant correlation between statistical attitude and using licensed *software* or owning a personal computer.

Some of the recommendations are to evaluate the way of teaching, counseling time and methodology of undergraduate trainings (24), promote additional research courses (27) using team-based learning strategies (28) and other alternatives necessary to promote greater learning, reaffirm the value of biostatistics given by the students themselves and improve the statistical performance that will impact integrally in these future physicians. An example is that since 2015 the Extracurricular Course of Thesis Degree Workshop has been incorporated in the URP, where through group work, advice is given in biostatistics, discussion of examples of articles published by the advisors themselves, as well as the use of biostatistical tools and packages.

Limitations are recognized within the present study. First, it is not possible to indicate that the assessment of statistics is determined because they have taken some extracurricular course or previously conceived it as very useful for their daily and/or academic-professional life, because the study design is cross-sectional and does not allow us to evaluate causality. Second, the remote access to the surveyed population, which was conducted periodically and there could be other external factors not considered in the present study that influence their responses. And third, because of the non-probability sampling, the results of this sample would not be entirely applicable to a larger population.

Finally, it is concluded that basic knowledge in biostatistics and epidemiology is correlated with the "value" subscale of the attitude towards biostatistics in relation to its usefulness in daily and professional life. In addition, it is shown that this knowledge is low, but improves if they have taken some extracurricular course. Likewise, attitudes towards biostatistics were positively correlated with age and the use of statistical *software*. Therefore, it is important to take measures to generate a positive impact on medical training in biostatistics, which would allow a better evaluation of scientific evidence when making decisions.

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Annexes

Table 1.
Sociodemographic and academic characteristics of sixth- and seventh-year medical students of the Human Medicine course.

	Absolute frequency	Percentage
Sex		
Male	85	42.1%
Female	117	57.9%
Age (years)* Age (years)* Age (years)* Age (years)* Age (years)* Age (years)	25	(24-27)
Medical Intern		
No	70	34.6%
Yes	132	65.4%
Extracurricular course in biostatistics		
No	158	78.2%
Yes	44	21.8%
Statistical software		
No	139	68.8%
Yes	63	31.2%
Intention to take up residence		
No	3	1.5%
Yes	199	98.5%
Will perform medical specialty		
No	91	46.7%
Yes	104	53.3%

Source: Prepared by the authors.

Table 2.
Bivariate analysis of factors correlated to biostatistics and epidemiology knowledge score and Attitudes towards biostatistics in sixth- and seventh-year medical students of Human Medicine.

		Expertise in biostatistics and epidemiology (CBE)		Attitudes towards biostatistics (AFB)*.	
		Spearman's Rho	**Value of *p***	**Spearman's Rho**	**Value of *p***
Age		-0.156	0.025	0.174	0.013
CBE		-	-	0.065	0.356
AFB* AFB* AFB* AFB* AFB* AFB* AFB*		0.065	0.356	-	-

AFB* AFB							
		M±DE	**Me(RI)**	**Value of *p***	**M±DE**	**Me(RI)**	**Value of *p***
Sex	**Male**	3.1±2.1	3(1-5)	0.231	4.5±0.7	4.6(4.2-4.9)	0.644
	Female	2.6±1.5	3(1-4)		4.5±0.6	4.6(4.2-5)	
Becoming a medical intern	**Attends internship**	2.7±1.6	3(1-4)	0.643	4.5±0.7	4.6(4.2-5)	0.950
	6th year	3.0±1.9	3(2-4)		4.5±0.6	4.6(4.2-5)	
Extracurricular course in biostatistics	**Yes**	3.4±2.1	3(2-5)	0.057	4.5±0.8	4.6(3.9-5)	0.563
	No	2.7±1.7	3(1-4)		4.5±0.6	4.6(4.2-5)	
Statistical *software*	**Yes**	3.0±1.8	3(2-4)	0.187	4.7±0.7	4.7(4.5-5.2)	0.001
	No	2.7±1.7	3(1-4)		4.4±0.6	4.5(4.1-4.9)	
Intention to take up residence	**Yes**	2.8±1.8	3(1-4)	0.693	4.5±0.6	4.6(4.2-5)	0.514
	No	3±1	3(2-4)		4.8±0.3	4.9(4.4-4.9)	
Medical Specialty	**Yes**	3±1.9	3(2-4)	0.295	4.5±0.7	4.6(4.1-4.9)	0.358
	No	2.7±1.6	3(1-4)		4.6±0.6	4.6(4.2-5.0)	

CBE: Knowledge in biostatistics and epidemiology. SATS-28: Attitudes towards biostatistics. M: Mean. SD: Standard deviation. Me: Median. IQR: Interquartile range. (*) Measured with the SATS-28 scale.

Source: Prepared by the authors.

Table 3.

Correlation between the subscales of attitudes towards biostatistics and biostatistics and epidemiology knowledge scores of sixth- and seventh-year medical students of Human Medicine.

			Expertise in biostatistics and epidemiology (CBE)	
	M±DE	**Me(RI)**	**Spearman's Rho**	**Value of *p***
Subscale: Affection	4.0±1.1	4.2(3.3-4.7)	-0.021	0.772
Subscale: cognitive competencies	4.7±1.0	4.7(4.2-5.3)	0.050	0.483
Subscale: value	5.5±0.9	5.6(4.9-6.1)	0.231	0.001
Subscale: difficulty	3.7±0.9	3.7(3.1-4.4)	-0.115	0.103
Total	4.5±0.6	4.6(4.2-5.0)	-	-

Source: Prepared by the authors.

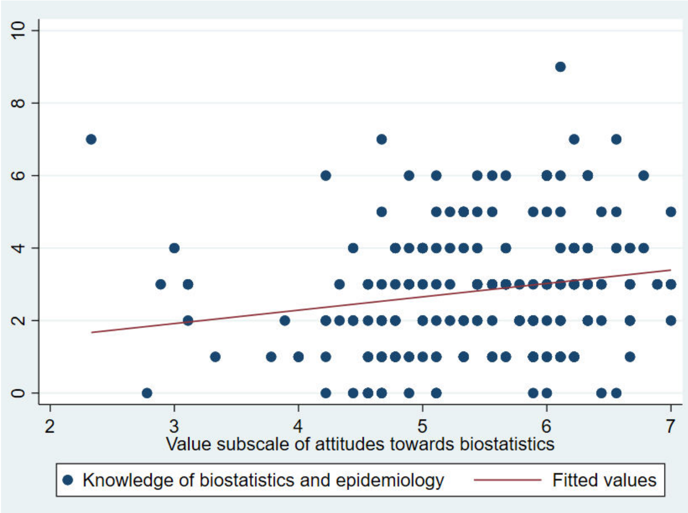
Table 4.
Multivariate analysis of factors correlated to biostatistics and epidemiology knowledge score and attitudes towards biostatistics in sixth- and seventh-year medical students of Human Medicine.

	Expertise in biostatistics and epidemiology (CBE)		**Attitudes towards biostatistics (SATS-28)**	
	β (95% CI)	**Value of *p***	**β (95% CI)**	**Value of *p***
Age	-0.04 (-0.14-0.05)	0.384	0.04 (0.01-0.07)	0.013
Extracurricular course in biostatistics	0.65 (0.07-1.24)	0.028	-	-
Value subscale	0.33 (0.06-0.61)	0.016	-	-
Statistical *software*	-	-	0.31 (0.12-0.51)	0.001

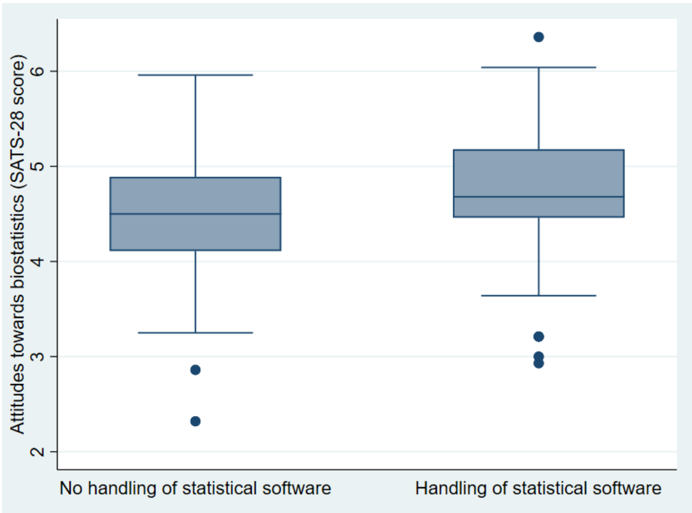
β: Adjusted regression coefficient.
Source: Prepared by the authors.

FIGURE 1.
Correlation between some covariates and knowledge in biostatistics and epidemiology and attitudes towards biostatistics in sixth- and seventh-year medical students of Human Medicine.

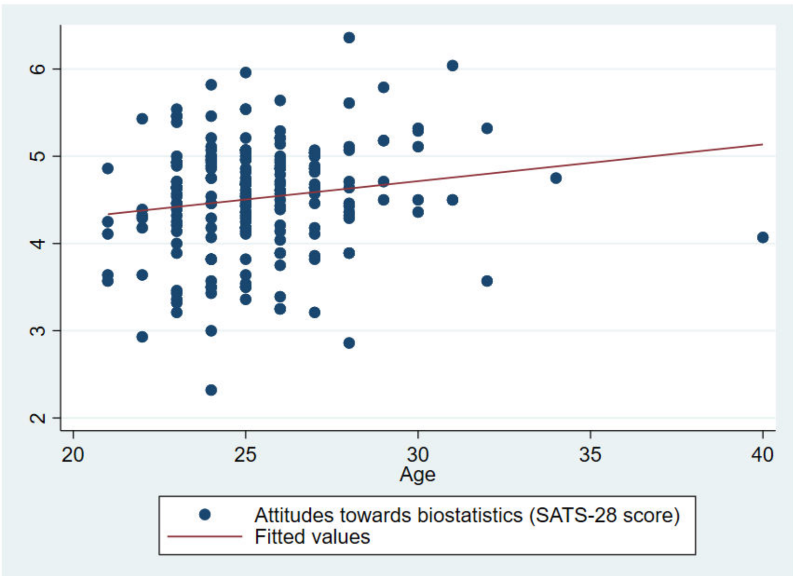
a)


0
2
4
6
8
10
2
3
4
5
6
7
Value subscale of attitudes towards biostatistics
Knowledge of biostatistics and epidemiology
Fitted values

b)


Attitudes towards biostatistics (SATS-28 score)
2
3
4
5
6
No handling of statistical software
Handling of statistical software

c)


2
3
4
5
6
20
25
30
35
40
Age
Attitudes towards biostatistics (SATS-28 score)
Fitted values

d)

A: Difference in biostatistics and epidemiology knowledge scores according to taking an extracurricular biostatistics course. B: Correlation between the biostatistics and epidemiology knowledge score and the biostatistics attitude value subscale. C: Difference in biostatistics attitudes score according to handling statistical software. D: Correlation between biostatistics attitudes score with age.
Source: Own elaboration.

Annex 1.

Questionnaire on basic knowledge in biostatistics and epidemiology (CBE)

You are requested to properly read and answer the following statements using your actual knowledge, as this survey is anonymous and will not be graded, only the results will be used for scientific purposes:

Ask		Alternatives				
1.	Treatment A was found to have a significant effect with p-value =0.05 and the effect of treatment B was found to be significant with p-value =0.002. We can conclude that:	a. The effect of treatment A is greater than that of treatment B.	b. The effect of treatment B is greater than the effect of treatment A.	c. It is impossible to compare the size of the effects	d. Both treatments have significant effects and, therefore, are equally effective.	
2.	In a clinical trial, a series of patients are treated with a new drug to study whether, in a period after administration of that drug, the bilirubin level has decreased. It is accepted that the bilirubin distribution is normal for this design. What is the statistical test of choice:	a. Student's t test for paired data	b. Student's t test for independent data	c. Chi-square	d. Mann-Whitney	e. Fisher's exact test
3.	To study the possible association between maternal rubella and congenital cataracts, a sample of 20 children with this disease and 25 children with similar history and age who do not have the disease are selected. An interview with the mother of each child determines whether or not she had rubella during pregnancy. Which statistical test	a. Student's t test of independent data	b. Student's t test for paired data	c. Chi-square	d. Correlation	e. ANOVA (analysis of variance)

	is the most appropriate to perform this study?					
4.	Which test should be used for comparison of blood pressure values between subjects belonging to three smoking levels?	a. Student's t	b. Student's t test for related samples	c. Correlation	d. ANOVA (analysis of variance).	
5.	In a statistical hypothesis test, if the null hypothesis were true and rejected:	a. A type II error is committed	b. A correct decision is made	c. Statistical power increases	d. A type I error is made	e. The most conservative decision is made
6.	A study investigating a blood pressure-lowering effect of a new drug should be a type study:	a. Retrospective cohort study	b. Prospective case-control study	c. Double-blind, placebo-controlled study	d. Observational cross-sectional study.	
7.	You are investigating risk factors for a very rare disease. Which type of study should you choose in order to obtain results efficiently and quickly?	a. Prospective cohort study	b. Case-control study	c. Clinical trial	d. Observational cross-sectional study	
8.	Researchers compared two weight loss diets, measured at three months after the start of treatment. The study groups included 18 and 10 subjects. A mean weight decrease of 5% in diet group A and 7% in diet group B was observed. The observed difference was not statistically significant ($p > 0.1$). What could be the main reason for refusing to publish these results:	a. The study groups have different sizes	b. Results are not significant	c. Absolute difference in weight loss is very small.	d. The power of the analysis is probably very small	
9.	To try to establish a relationship between valproic acid consumption during pregnancy	a. Cases and controls	b. Cohort study	c. Randomized	d. Ecological	e. Crossover

	and the risk of spina bifida in the newborn, mothers of newborns with spina bifida were selected and compared with mothers of healthy newborns. All mothers of the selected infants have a history of valproic acid consumption. What is the type of study design employed:			clinical trial	study	clinical trial
10.	Australian researchers found that excessive use of sunscreen is associated with the development of skin cancer. This relationship could be explained in part by the presence of a confounding factor. To assess the direct effect of the cream on the development of skin cancer, researchers should perform:	a. Adjustment for sun exposure by multivariate analysis.	b. Adjusting for sun exposure by excluding the variable sun exposure' from multivariate analysis.	c. A new study in less sun-exposed populations.	d. It is impossible to carry out the evaluation of the direct effect of the cream on the development of skin cancer.	
KEYS: B1. c) B2. a) B3. c) B4. d) B5. d) E1. c) E2. b) E3. d) E4. a) E5. a						

Source: Adapted from the Novack questionnaire in its Spanish validated version (16).

Annex 2:

Questionnaire of Attitudes towards Statistics (SATS-28)

(Survey of Attitudes Toward Statistics-28)

In the following statements, read carefully and select the degree of agreement with each of the statements, being 1="Strongly disagree" and 7 ="Strongly agree".

	Item wording	1	2	3	4	5	6	7
1.	I like Statistics.							
2.	I feel insecure when doing Statistics problems.							
3.	I don't understand statistics very much because of my way of thinking.							
4.	Statistical formulas are easy to understand.							
5.	Statistics are useless.							
6.	Statistics is a complicated subject.							

7.	Statistics is a requirement in my training as a professional.							
8.	My statistical skills will facilitate my access to the world of work.							
9.	I have no idea what Statistics is all about.							
10.	Statistics is not useful for the common professional.							
11.	I get frustrated when taking Statistics tests.							
12.	Statistical concepts do not apply outside of work.							
13.	I use statistics in everyday life.							
14.	In Statistics classes I am in tension.							
15.	I enjoy Statistics class.							
16.	Statistical conclusions rarely occur in life.							
17.	Most people learn statistics quickly.							
18.	Learning statistics requires a lot of discipline.							
19.	In my profession I will not use Statistics.							
20.	I make a lot of mathematical mistakes when I do statistics.							
21.	I am afraid of Statistics.							
22.	Statistics involves a lot of computation.							
23.	I can learn Statistics.							
24.	I understand statistical formulas.							
25.	Statistics is not important in my life.							
26.	Statistics is very technical.							
27.	I find it difficult to understand statistical concepts.							
28.	Most people must change their way of thinking to do statistics.							

Source: Adapted from SATS-28 with permission to the author via e-mail for use (18) and use of Spanish validated version (19),

Financing
The authors declare that this work was self-funded.
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Jhony De La Cruz-Vargas:
Dante M. Quiñones-Laveriano:
All authors were involved in the conception, design, development and conclusion of the research work. DMQL had the idea for the research paper. The authors critically reviewed and approved both the drafts and the final submission. In addition, they are responsible for the content described.

Conflict of interest
The authors declare that they have no conflict of interest.