



Effect of Varied Response Alternatives and Sample Size on Reliability of an Attitude Scale Physical Activity Among Female Students in College of Basic Education

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Abstract

Objectives: To investigate differences in the reliability coefficients of a psychological scale according to the number of response alternatives and sample size. The study also sought to identify the most appropriate response format and minimum sample size for estimating the reliability of psychological scales in physical education and sport sciences.

Materials and Methods: A descriptive research design combining survey and comparative approaches was employed. The sample comprised 150 third-year female students, representing 13.63% of the study population. The Attitudes Toward Physical and Sports Activity Scale was administered using three response formats: three, four, and five alternatives. Reliability coefficients were calculated and compared across the response formats and different sample sizes.

Results: The three-, four-, and five-alternative response formats produced similar reliability coefficients when the sample size exceeded 30 participants. Reliability estimates increasingly converged as the sample size increased, regardless of the number of response alternatives. These findings suggest that sample size has a greater influence on the stability of reliability estimates than the use of three, four, or five response alternatives.

Conclusions: Psychological scales employing three, four, or five response alternatives can yield comparable reliability coefficients when administered to samples larger than 30 participants. Researchers in physical education and sport sciences are therefore advised to use more than 30 participants when estimating scale reliability to obtain stable and dependable results.

Keywords: Response Alternatives, Reliability, Physical Activity Scale.



Introduction

Psychological scales are among essential tools in psychological and educational scientific research, as researchers rely on them to measure various psychological traits, attitudes, and abilities. This makes accuracy and reliability of these scales a fundamental condition for validity of results obtained from them. Reliability is one of the most important psychometric properties that determines quality of psychological scale and its ability to represent trait to be measured in an accurate scientific manner.

Psychometric properties of a psychological scale are influenced by several methodological factors, most notably the number of response alternatives used in scale items, such as in two-tail or multi-tail scales. A relatively large number of alternatives can increase accuracy of discrimination between individuals, while it may also increase cognitive load on test-takers. Sample size is also a factor that directly affects reliability coefficients, as these coefficients vary depending on sample size used in statistical analysis, number of response alternatives affects psychometric properties of scales; literature reviews have shown that increasing number of alternatives in Likert-type scales can lead to a higher reliability rate. It is often associated with a rise in validity and reliability coefficients up to a certain point, while usefulness decreases after a certain point (e.g., from 4 to 7 alternatives), which reinforces the researcher's decision regarding selection of an appropriate number of options in a single item (Kusmaryono & et al, 2022: 628).

Despite great importance of these two variables, results of previous studies have not definitively agreed on best number of alternatives or optimal sample size that ensures the highest levels of reliability. Few studies have addressed interaction effect between number of alternatives and sample size on psychometric properties of psychological scales, as “sample size affects estimates of reliability coefficients such as split-half and test-retest methods, and very small samples (less than 50) produce unstable estimates, while larger samples (100 and above) provide more reliable estimates” (Al-Qarni, 2025: 413). Need arises for a systematic scientific study that contributes to clarifying this effect, which helps researchers to make informed decisions when constructing and applying psychological scales.

Importance of the current research lies in studying effect of difference in number of alternatives (tripartite, quadruple, quintuple) as well as sample size used in extracting reliability of one of psychological scales (attitudes towards physical sports activity) and identifying optimal number of alternatives and sample size for measuring reliability of psychological scales in physical education and sports science.

Research problem lies in clear discrepancy in results of previous studies regarding effect of number of response alternatives and sample size on reliability of psychological scales, as well as absence of clear criteria that can be relied upon when choosing appropriate number of alternatives or determining sufficient sample size to obtain accurate estimates of psychometric properties, problem is defined in answering following question: Does difference in sample size and number of alternatives affect estimation of reliability coefficients for scale of attitudes towards physical activity among female students?



Research objectives to identifying reliability coefficients of scale of attitudes towards physical activity among several alternatives (tripartite, quadruple, quintuple), Identifying reliability coefficients of scale of attitudes towards physical activity in case of different sample sizes (30 female students, 50 female students, 80 female students, 100 female students, 150 female students), Identifying differences in reliability coefficients of scale according to number of alternatives and sample sizes. Research assumption there are statistically significant differences between reliability coefficients according to number of alternatives and different sample sizes.

Research Methodology

The researcher used descriptive approach with both survey and comparative methods because they are suitable for nature of current research. Research community included female students of Faculty of Basic Education at University of Mosul in four academic stages for academic year 2025/2026 in 10 departments, totaling 1100 female students. Sample was represented, according to research idea, by female students whom the researcher was able to reach to distribute scale during application period, number of individuals in research sample amounted to 150 female students from third stage, as they were present at time of distributing scale, sample represented 13.63% of total research community.

Scale of attitudes towards physical activity

The researcher used (Al-Anzi, 2019) scale, as the scale in its final form consists of 52 items, of which 31 are positive items, which are the items with the sequences (1, 3, 4, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 24, 27, 29, 30, 39, 40, 44, 46, 47, 48, 50, 51, 52), and 21 are negative items, which are items with sequences (2, 5, 11, 13, 23, 25, 26, 28, 31, 32, 33, 34, 35, 36, 37, 38, 41, 42, 43, 45, 49) in final scale, and answer to them is according to five alternatives which are (Strongly agree, Agree, Neutral, Disagree, Strongly disagree). Weights of scores (5, 4, 3, 2, 1) are given respectively for positive items and opposite for negative items, thus final value of the scale is limited to 52 - 310 points.

Scientific coefficients of the scale

Given that scale was built on same sample earlier and had high scientific coefficients and a reliability coefficient by split-half method and its equation by Spearman-Brown method amounting to (0.92) on a sample size of 325 female students to build scale, as well as scale obtaining face validity amounting to (0.82), the researcher decided to use it as is for purpose of achieving research idea, after he distributed it 3 times at different times a month between one application and another to same sample members, once by adopting 3 alternatives, which are (Agree, Neutral, Disagree), once by adopting 4 alternatives, which are (Strongly agree, Agree, Disagree, Strongly disagree), and once by adopting same five alternatives adopted in original research.



Scale final application

The researcher distributed scale to sample of 150 female students as follows: First application during the period 1/10/2025 until 15/10/2025 by adopting 3 alternatives for scale, thus final score of scale is limited to 52 - 156 degrees. Second application during period 15/11/2025 until 1/12/2025 by adopting 4 alternatives for scale, thus final score of scale is limited to 52 - 208 degrees. Third application during period 2/1/2026 until 16/1/2026 by adopting 5 alternatives for scale, thus final score of scale is limited to 52 - 260 degrees. This is to extract reliability of scale using split-half method for proposed sample sizes 30 students, 50 students, 80 students, 100 students, 150 students to achieve research idea and extract differences in reliability between sample sizes and number of alternatives proposed by the researcher.

Statistical Methods

Percentage, Arithmetic mean, Standard deviation, Simple correlation coefficient, Coefficient of variation, Spearman-Brown equation, Williams' equation for comparing stability coefficients, Fisher Transform (Z values).

Results

After the researcher distributed scale with its proposed alternatives, as previously explained, to same sample of 150 female students, extracted statistical parameters of scale for sample according to number of proposed alternatives and according to sample sizes proposed by the researcher, results were as shown in tables below.

Table 1. Statistical features of attitudes towards physical activity scale of 150 female students

No.	Scale	Total degree	Sample	Mean	St.d	Coefficient of variation
1	3 alternatives	156	150	92.32	6.33	6.85%
2	4 alternatives	208	150	161.42	8.25	5.11%
3	5 alternatives	260	150	200.15	9.49	4.74%

Table (1) shows that coefficients of variation for scale for total sample of 150 female students all ranged (4.74% - 6.85%) and all of them are less than (30%), which indicates homogeneity of sample on scale, as Al-Tikriti and Al-Ubaidi, 1999, state: "Sample is considered homogeneous if coefficient of variation reaches 30% or less" (Al-Tikriti and Al-Ubaidi, 1999: 210).

Table 2. Statistical features of attitudes towards physical activity scale of 100 female students

No.	Scale	Total degree	Sample	Mean	St.d	Coefficient of variation
1	3 alternatives	156	100	91.54	6.14	6.70%
2	4 alternatives	208	100	159.22	7.78	4.88%
3	5 alternatives	260	100	198.53	9.40	4.73%



Table (2) shows that coefficients of variation for scale for a sample of 100 female students all ranged (4.73% - 6.70%) and all of them are less than (30%), which indicates homogeneity of sample on scale.

Table 3. Statistical features of attitudes towards physical activity scale of 80 female students

No.	Scale	Total degree	Sample	Mean	St.d	Coefficient of variation
1	3 alternatives	156	80	89.48	6.10	6.81%
2	4 alternatives	208	80	155.35	8.10	5.21%
3	5 alternatives	260	80	195.22	9.41	4.82%

Table (3) shows that coefficients of variation for scale for a sample of 80 female students all ranged (4.82% - 6.81%) and all of them are less than (30%), which indicates homogeneity of sample on scale.

Table 4. Statistical features of attitudes towards physical activity scale of 50 female students

No.	Scale	Total degree	Sample	Mean	St.d	Coefficient of variation
1	3 alternatives	156	50	91.23	5.12	5.61%
2	4 alternatives	208	50	158.84	7.54	4.74%
3	5 alternatives	260	50	196.33	10.12	5.15%

Table (4) shows that coefficients of variation for scale for a sample of (50) female students all ranged (4.74% - 5.61%) and all of them are less than (30%), which indicates homogeneity of sample on scale.

Table 5. Statistical features of attitudes towards physical activity scale of 30 female students

No.	Scale	Total degree	Sample	Mean	St.d	Coefficient of variation
1	3 alternatives	156	50	91.23	5.12	5.61%
2	4 alternatives	208	50	158.84	7.54	4.74%



3	5 alternatives	260	50	196.33	10.12	5.15%
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Table (5) shows that coefficients of variation for scale for a sample of (30) female students all ranged (5.53% - 6.12%) and all of them are less than (30%), which indicates homogeneity of sample on scale. After that, in order to achieve research objective and verify hypothesis, the researcher extracted reliability coefficients of scale using split-half method and equated them using Spearman-Brown equation, according to number of proposed alternatives and according to proposed sample sizes, as shown in tables below:

Table 6. Reliability coefficients of scale for a sample of 150 female students

No.	Scale	Sample	Reliability coefficient	Adjusted Reliability coefficient	Sig.
1	3 alternatives	150	0.79	0.88	0.001
2	4 alternatives	150	0.77	0.87	0.001
3	5 alternatives	150	0.81	0.89	0.001

Table 7. Reliability coefficients of scale for a sample of 100 female students

No.	Scale	Sample	Reliability coefficient	Adjusted Reliability coefficient	Sig.
1	3 alternatives	100	0.75	0.85	0.001
2	4 alternatives	100	0.78	0.87	0.001
3	5 alternatives	100	0.82	0.90	0.001

Table 8. Reliability coefficients of scale for a sample of 80 female students

No.	Scale	Sample	Reliability coefficient	Adjusted Reliability coefficient	Sig.
1	3 alternatives	80	0.71	0.83	0.001
2	4 alternatives	80	0.75	0.85	0.001
3	5 alternatives	80	0.84	0.91	0.001

Table 9. Reliability coefficients of scale for a sample of 50 female students

No.	Scale	Sample	Reliability coefficient	Adjusted Reliability coefficient	Sig.
1	3 alternatives	50	0.70	0.82	0.001
2	4 alternatives	50	0.74	0.85	0.001



3	5 alternatives	50	0.84	0.91	0.001
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Table 10. Reliability coefficients of scale for a sample of 30 female students

No.	Scale	Sample	Reliability coefficient	Adjusted Reliability coefficient	Sig.
1	3 alternatives	30	0.68	0.80	0.001
2	4 alternatives	30	0.72	0.83	0.001
3	5 alternatives	30	0.81	0.89	0.001

Table below shows reliability coefficients according to number of alternatives based on proposed sample sizes, for purpose of comparing them.

Table 11. Reliability coefficients of scale according to number of alternatives based on sample sizes

No.	Sample sizes	3 Alternatives	4 Alternatives	5 Alternatives
1	30 female students	0.80	0.83	0.89
2	50 female students	0.82	0.85	0.89
3	80 female students	0.83	0.85	0.91
4	100 female students	0.85	0.87	0.90
5	150 female students	0.88	0.87	0.89

Table (11) shows closeness of reliability coefficients horizontally and vertically between different categories of number of alternatives, as well as between proposed sample sizes. The researcher will conduct horizontal comparisons between reliability coefficients according to number of alternatives for each sample size, as well as vertical comparisons between reliability coefficients for each number of alternatives according to sample sizes, as shown below.

First: Conduct horizontal comparisons between reliability coefficients of proposed sample sizes among three alternatives according to Williams' equation, as shown in Table (12).

Table 12. Williams equation values show differences between reliability coefficients according to sample size

No.	Sample sizes	Calculated (t) value	Tabular (t) value
1	30 female students	1.421	2.052
2	50 female students	1.012	2.012



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3	80 female students	1.624	1.991
4	100 female students	1.417	1.984
5	150 female students	1.524	1.976

Significant at a level of (0.05) and freedom degrees of (n-3)

Table (12) shows that there are no statistically significant differences between reliability coefficients between three alternatives for all proposed sample sizes. Thus, null hypothesis of research is accepted and alternative hypothesis is rejected.

Second: Vertical comparisons are made between reliability coefficients of proposed sample sizes in three alternatives using Fisher's Z -transform , as shown in Table (13).

Table 13. Z- values and standard error for vertical comparisons

No.	Sample sizes	3 Alternatives		4 Alternatives		5 Alternatives	
		Z values	Standard error	Z values	Standard error	Z values	Standard error
1	30 female students	1.099	0.192	1.188	0.192	1.422	0.192
2	50 female students	1.157	0.146	1.256	0.146	1.422	0.146
3	80 female students	1.188	0.114	1.256	0.114	1.527	0.114
4	100 female students	1.256	0.102	1.333	0.102	1.472	0.102
5	150 female students	1.376	0.083	1.333	0.083	1.422	0.083

Z- value (2.08)

The researcher then made comparisons between each pair of correlation coefficients to determine whether there were differences between reliability coefficients for each of proposed sample sizes for three alternatives, as shown in tables below.

Table 14. Comparisons are shown between correlation coefficients between sample sizes for three alternatives

Correlation transactions	Z value	Significance
0.80 × 0.82	0.24	Insig.
0.80 × 0.83	0.38	Insig.
0.80 × 0.85	0.67	Insig.
0.80 × 0.88	1.29	Insig.
0.82 × 0.83	0.17	Insig.
0.82 × 0.85	0.53	Insig.
0.82 × 0.88	1.16	Insig.
0.83 × 0.85	0.46	Insig.
0.83 × 0.88	1.06	Insig.
0.85 × 0.88	0.96	Insig.



Table 15. Comparisons are shown between correlation coefficients between sample sizes for four-way alternatives

Correlation transactions	Z value	Significance
0.83×0.85 (30×50)	0.29	Insig.
0.83×0.85 (30×80)	0.32	Insig.
0.83×0.87 (30×100)	0.54	Insig.
0.83×0.87 (30×150)	0.66	Insig.
0.85×0.85 (50×80)	0.00	Insig.
0.85×0.87 (50×100)	0.40	Insig.
0.85×0.87 (50×150)	0.52	Insig.
0.85×0.87 (80×100)	0.49	Insig.
0.85×0.87 (80×150)	0.63	Insig.
0.87×0.87 (100×150)	0.00	Insig.

Table 16. Comparisons are shown between correlation coefficients between sample sizes for five alternatives

Correlation transactions	Z value	Significance
0.89×0.89 (30×50)	0.00	Insig.
0.89×0.91 (30×80)	0.44	Insig.
0.89×0.90 (30×100)	0.23	Insig.
0.89×0.89 (30×150)	0.00	Insig.
0.89×0.91 (50×80)	0.53	Insig.
0.89×0.90 (50×100)	0.31	Insig.
0.89×0.89 (50×150)	0.00	Insig.
0.91×0.90 (80×100)	0.36	Insig.
0.91×0.89 (80×150)	0.57	Insig.
0.90×0.89 (100×150)	0.35	Insig.

As shown in Tables (14) three alternatives, (15) four alternatives and (16) five alternatives, there are no statistically significant differences between reliability coefficients between sample sizes proposed by the researcher, values of reliability coefficients are close between five sample sizes to extract their reliability according to number of alternatives. Thus, null hypothesis of research is accepted and alternative hypothesis is rejected.

Discussion

From Tables (12-16), it becomes clear to the researcher that there are no statistically significant differences between reliability coefficients of scale of attitudes towards physical activity for female students of Faculty of Basic Education in case of a difference



in number of alternatives (three, four, five) as well as in difference in sample size (30, 50, 80, 100, 150) students. The researcher attributes appearance of these results to several reasons, including: A small number of response alternatives reduces large differences in correlation coefficients, as increasing number of alternatives leads to an improvement in psychometric properties of scale, and an improvement in its ability to distinguish between different scores of responses i.e., an increase in variance within categories compared to scales with few alternatives. Also, a small number of alternatives reduces discriminatory power of scale and distribution of responses is more clustered around middle of scale, which reduces apparent differences in data and in turn reduces effect of number of alternatives on apparent magnitude of correlation coefficient or reliability (Abdul Rahman, 2015).

In very small sample sizes (e.g., 30), there may not be sufficient power to detect small differences in correlation or reliability coefficients because statistical power is insufficient to test for differences in reliability coefficients across different groups. Consequently, even if there are small actual differences, no significant differences may be found. In larger samples (80, 100, 150), there is greater power, but if differences in reliability or correlation coefficients resulting from changing number of alternatives are relatively small compared to variance of data within sample, these differences may remain statistically insignificant. That is correlation coefficients converge relatively regardless of number of response alternatives due to effect of latent variance in data and fact that number of alternatives does not significantly affect mean or standard deviation of scores. This limits ability of statistical tests to demonstrate significant differences (Lozano et al., 2008: 75).

Correlations in reliability depend on underlying variance and not just number of alternatives. Correlation coefficients depend mainly on shared variance between items and internal consistency of measure, not on a small number of response alternatives alone. Also, if items are highly homogeneous within measure, relationship between items will appear relatively strong regardless of whether there are 3, 4, or 5 alternatives, especially if distribution of scores is similar in each model (typical data conditions).

Conclusions

Reliability coefficients are similar when using three, four or five alternatives in case of using sample sizes larger than 30 individuals. Reliability coefficients converge when using large sample sizes (greater than 30) in case of any number of alternatives to psychological scale.

Recommendations

Using a sample size greater than 30 individuals to extract reliability coefficients for psychological scales is necessary for the researcher to obtain a reliable and dependable



reliability coefficient. It is preferable for number of alternatives to psychological scale to be (five) in order for the researcher to obtain the highest possible reliability coefficient.

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Appendix 1. The scale in its final form

No.	Paragraphs	Strongly agree	Agree	neutral	Disagree	Strongly disagree
1	I love sports and I always want to practice them in the designated place and in regular sportswear.					



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2	I am afraid of practicing physical education because of the injuries that may befall me.					
3	If I were asked to choose, I would prefer to practice sports at university on a regular weekly basis.					
4	I would like to participate in women's sports clubs and teams in various sporting events.					
5	I believe that sports are for people who specialize in practicing them, and not everyone has the ability to do them.					
6	I believe it is very necessary to add a structured physical education course in colleges.					
7	I feel extremely happy when I do sports activities with my colleagues.					
8	He considered practicing sports at the university to be one of the most important means of relaxation and clearing the mind.					
9	I release my pent-up energies and inner potential through participation in physical sports activity.					
10	It is best to participate in sports activities that promote health and general physical fitness,					



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	which is essential for every human being.					
11	It is better to do sports activities at home than at university.					
12	I gained friendships and serious relationships through my participation in sports activities at university.					
13	Physical sports activities are not of utmost importance to female university students.					
14	I give a lot of my time and attention to sports activities that require beauty, artistry, and agility in their performance.					
15	What I like most about physical education classes is the focus on the beauty of the movements.					
16	Physical education and sports increase mutual respect among female students.					
17	Physical education and sports develop self-confidence and a love for teamwork.					
18	Physical education helps improve the behavior of female university students.					
19	Physical education works to develop good physical and moral qualities in female students.					



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20	Physical education develops the mental skills and intelligence of the university student in a way that serves the theoretical study.					
21	Sports foster serious cooperation and understanding among female students.					
22	Physical education focuses on building muscle in the body without paying attention to the rest of the body.					
23	Sports in general are not important in our daily lives.					
24	Sports make our bodies more beautiful, our movements more graceful, and our posture more balanced.					
25	The reason I distanced myself from physical education is that it is not based on sound scientific principles.					
26	The reason I don't participate in physical activity is the lack of a physical education class or women's sports activity at the university.					
27	My only way to get rid of daily problems is to exercise with minimal effort.					
28	The lack of genuine motivation to engage in					



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	physical activity makes me shy away from it.					
29	The social relationships I form while practicing sports are the reason for my participation in sports.					
30	My extensive social network is the reason I participate in sports activities.					
31	When I engage in sports activities, I only care about winning and nothing else.					
32	The lack of encouragement from the university, college, and community for female students to engage in sports activities is the reason I do not participate.					
33	The large number of exercises given in the physical education class causes me fatigue and injuries.					
34	I do not like the idea of exercising at university as it is a waste of time and effort.					
35	I do not like to engage in sports activities that are dangerous and have a high probability of causing injuries.					
36	I do not see the need to add a mandatory physical education course as part of the curriculum.					



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37	I do not consider practicing sports activities to be an important means of recreation and entertainment at the university.					
38	I do not prefer sports activities that are highly competitive, as they lead to injuries.					
39	Nothing makes me feel happier and more relaxed than exercising, even to a small degree.					
40	Exercise has health and social benefits that influence the behavior of female university students.					
41	I am physically unable to engage in any sporting activity at home or at university.					
42	I cannot engage in physical activity because it does not take into account my health condition and causes me fatigue.					
43	We don't have enough time to waste on physical activity.					
44	Doing sports activities always makes me happy.					
45	Practicing physical education causes a waste of time and consequently failure in the college's theoretical subjects.					
46	Practicing simple exercises is of utmost importance					



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	to me.					
47	Regular exercise allows university students to relax from the pressures of work and theoretical lectures.					
48	Regular exercise reduces aggressive behavior among university students.					
49	Practicing sports makes me tense, intolerant, and experience excessive emotional reactions.					
50	Time should be allocated for practicing sports activities at the university on a weekly and regular basis.					
51	The sports activity should include easy tasks that include all students without exception.					
52	I like participating in group sports activities in which a large number of female students participate.					