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Internal consistency: from alpha to omega?

MEDICINE AND NUMBERS

KENNETH STENSEN

Kenneth Stensen, PhD in medical and health sciences, master of
psychology and associate professor at the Regional Centre for Child and
Youth Mental Health and Child Welfare, Department of Mental Health,
Norwegian University of Science and Technology.
The author has completed the ICMJE form and declares no conflicts of
interest.

STIAN LYDERSEN

stian.lydersen@ntnu.no
Stian Lydersen, PhD, professor of medical statistics at the Regional
Centre for Child and Youth Mental Health and Child Welfare,
Department of Mental Health, Norwegian University of Science and
Technology.
The author has completed the ICMJE form and declares no conflicts of
interest.

**Questionnaires often consist of scales composed of different
questions and are intended to measure a given factor, for
example anxiety or depression. Internal consistency is a
measure of the strength of the relationship between
questions in the same scale.**

When developing questionnaires and scales, we want them to be as reliable and
valid as possible. In other words, the scales must be accurate, and they must
measure what they are intended to measure. Internal consistency is a measure
of whether questions that are intended to measure the same phenomenon are
'pulling in the same direction', and is often examined when new questionnaires

are being developed or collected data are being assessed. A scale should include a sufficient number of questions to measure the underlying factor, but for practical reasons it is desirable to avoid too many questions.

Cronbach's alpha

Cronbach's alpha was first described in an article in 1951 (1) and has since been by far the most frequently used measure of internal consistency of scales. However, Cronbach's alpha builds on the assumption that the responses to individual questions are normally distributed, have equal variance and equally explain the factor. These assumptions are seldom fully met (2, 3). In fields such as medicine and psychometrics, the response alternatives will often be in steps that range from 'to a small extent' to 'to a very great extent', and the responses will often cluster near one end of the steps. The assumptions will therefore not be met, and alpha will be unsuitable and provide inaccurate or biased estimates of internal consistency. As a result, scales that in fact have a high internal consistency might be rejected or modified, or scales that actually have a low internal consistency might be retained.

McDonald's omega

Several alternatives to Cronbach's alpha have been proposed, for example McDonald's omega, coefficient h and the 'greatest lower bound' (2). McDonald's omega is based on a factor analytic approach, in contrast to alpha, which is primarily based on the correlation between the questions. Omega has proven to be more robust than alpha against deviations from the assumptions noted above, and will thus generally be a more suitable measure of internal consistency. The difference between alpha and omega will often be small, but can also be substantial, depending on the extent of the deviations from the assumptions (4). Alpha and omega will have a value between 0 and 1. Internal consistency is usually considered acceptable if the estimate is 0.70 or higher (2). Examples of alpha and omega are shown in Table 1, which is taken from a study that investigated a questionnaire used to measure mental health problems in children (5). In the example, there are only small differences between alpha and omega. The largest difference is for the scale 'somatic complaints', which may indicate that the deviations from the assumptions for alpha were larger in this scale than in the others.

Table 1

Excerpt from Stensen et al. (5) showing Cronbach's alpha and McDonald's omega. Estimate and 95 % confidence interval.

Scale (number of questions)	Cronbach's alpha	McDonald's omega
Emotionally reactive (7)	0.683 (0.656 to 0.701)	0.703 (0.679 to 0.727)
Anxious/depressed (8)	0.690 (0.668 to 0.711)	0.689 (0.664 to 0.713)

Scale (number of questions)	Cronbach's alpha	McDonald's omega
Somatic complaints (7)	0.441 (0.400 to 0.484)	0.376 (0.323 to 0.433)
Withdrawn (10)	0.752 (0.734 to 0.769)	0.757 (0.738 to 0.776)
Attention problems (9)	0.874 (0.863 to 0.884)	0.888 (0.879 to 0.897)
Aggressive behaviour (25)	0.921 (0.915 to 0.927)	0.926 (0.921 to 0.932)

It is important that the scales being used have good internal consistency. Since measures of internal consistency exist that have better properties than alpha, the time may be ripe to proceed from alpha to – for example – omega.

REFERENCES

1. Cronbach LJ. Coefficient alpha and the internal structure of tests. Psychometrika 1951; 16: 297–334. [CrossRef]

2. McNeish D. Thanks coefficient alpha, we'll take it from here. Psychol Methods 2018; 23: 412–33. [PubMed][CrossRef]

3. Sijtsma K. On the use, the misuse, and the very limited usefulness of Cronbach's alpha. Psychometrika 2009; 74: 107–20. [PubMed][CrossRef]

4. Yang Y, Green SB. Coefficient alpha: a reliability coefficient for the 21th century? J Psychoed Assess 2011; 29: 377–92. [CrossRef]

5. Stensen K, Jozefiak T, Lydersen S. Psychometric properties of the caregiver-teacher report form in a sample of Norwegian preschool children. Nord J Psychiatry 2022; 76: 1–7. [PubMed][CrossRef]