

APPLIANCES

The electronic stadiometer: an appropriate technology for height measurement in health surveys

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INTRODUCTION

Height for age and weight for height are two of the fundamental indicators of protein-energy malnutrition and together they provide the information necessary to apply the Waterlow classification of children as normal, stunted, wasted or wasted and stunted¹, each of which implies a quite different public health priority². One of the recognized problems using the Waterlow classification, however, is the difficulty in accurately measuring height owing to the lack of low-cost light-weight height measuring equipment². Not only are conventional stadiometers heavy, they are also often bulky and therefore very difficult to carry in field surveys. Furthermore, many types of stadiometer require solid perpendicular structures against which to measure.

Height is also a useful indicator in adults and has been used on a number of occasions as a proxy for socio-economic status^{3,4}. It is particularly valuable in places where income estimates are unreliable (as they tend to be in developing country settings with a significant proportion of subsistence farming and/or irregular informal work) or in situations of high social mobility where it is the person's childhood and adolescent socio-economic welfare which is of greatest interest to the investigator. This paper

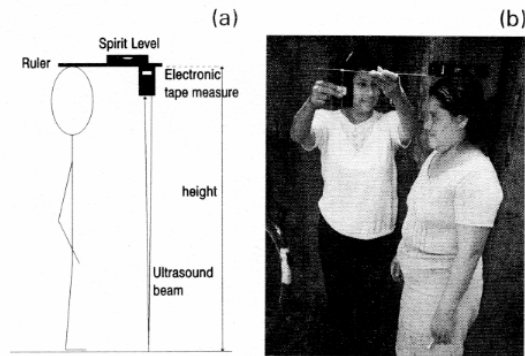


Figure 1. The electronic stadiometer. (a) A diagram showing the construction; (b) the stadiometer in use

describes an apparatus which we designed to measure height in women and children in a large study of the impact of maternal literacy on child health in Nicaragua.

THE APPARATUS

The apparatus is simply an electronic tape-measure of the sort used by real estate agents to measure house size, connected to a metal rule and spirit level (Figures 1a and b). There are various types of electronic tape-measure on the market. We chose to use the Smarttape, manufactured by TTI (West Midlands, UK) and sold at a retail price of approximately £25. It is powered by a 9 V alkaline battery which it is claimed will give up to 100 000 readings. In practice, we found that battery life was quite short, perhaps because field workers often forgot to turn the Smarttape off after each measurement. Two rubber bands were used to hold the Smarttape against the lower edge of a metal ruler. A spirit level with a magnetic strip on its base was placed on top of the ruler. Based on the principle of parallax, the Smarttape uses ultrasound to measure the distance from the ground to the base of the ruler – automatically adding in its own length. Including the price of the spirit level and metal rule, the total unit cost for an electronic stadiometer is less than £30.

ACCURACY

A reliability analysis was carried out by repeating the height measurements on 338 women on different days and, in most cases, by different observers with different electronic stadiometers. The mean height of the women obtained in the first measurement was 150.98 cm compared with 150.38 cm for the second

measurement. The intraclass correlation (reliability) coefficient was 0.88 which is good considering that this is based on actual field use and includes within-subject variation, inter-observer variation and variation between the 12 Smarttape units used. Within-subject variation alone is typically around 1 cm in adults over the course of the day with the highest height measurements obtained in the morning². The standard error of measurement was found to be 2.2 cm.

DURABILITY

Virtually no problems were encountered with the spirit levels and rulers although it is important that the rule does not readily bend. The Smarttapes on the other hand, were a little more delicate. Of the 12 purchased, only seven were in full working order at the end of the study. Some were damaged when dropped, others were made inoperable by rain. Nevertheless, considering that 10 487 height measurements were recorded, a life span of

approximately 2000 measurements per unit (i.e. a cost of about 1.5 pence per recorded measurement), does not seem exorbitant. A more solid construction is however, desirable for field work of this nature.

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REFERENCES

- 1 Waterlow JC. Classification and definition of protein-calorie malnutrition. *BMJ* 1978;3:566
- 2 Jelliffe DB, Jelliffe EFP. *Community nutritional assessment: with special reference to less technically developed countries*. Oxford: Oxford Medical Publications, Oxford University Press, 1989
- 3 Floud R. Measuring European inequality: the use of height data. In: Fox J, ed. *Health inequalities in European countries*. Aldershot: Gower, 1989:231-49
- 4 Sandiford P, Lankshear C, Montenegro M, Sanchez G, Coldham C, Cassel J. The Nicaraguan Literacy Crusade: How lasting were its benefits? *Dev Pract*, 1994 (in press)