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Review

The Concept of Composite Index of Anthropometric Failure (CIAF): Revisited and Revised

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ABSTRACT

Estimation of total undernutrition with summation of Gomez and Waterlow's three class divisions in Svedberg formulated composite index of anthropometric failure (CIAF) and Nandy's revised CIAF have underestimated the prevalence of stunting with overweight children and only overweight children. The present report proposes a new scheme which would accurately estimate the prevalence of anthropometric failure (both under as well as overweight). This new classification will help in better estimating the dual burden of malnutrition among children.

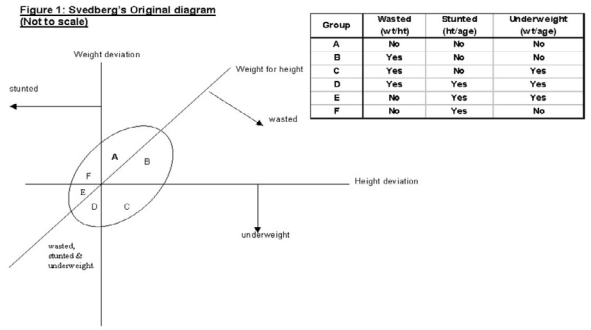
Keywords
Anthropometric Failure; Underweight; Stunting; Wasting.

Development economist Peter Svedberg in the year 2000, formulated the composite index of anthropometric failure (CIAF) for detecting total malnourished children in developing countries.[1] This classification was based on three indices of undernutrition, i.e. stunting (height-for-age, HAZ), underweight (weight-for-age, WAZ) and wasting (weight-for-height, WHZ). These three indices have been distinguishable of their position is below the normal range of World Health Organization's international reference. In workable stage, stunting (HAZ) is detecting long-term undernutrition with deprivation of food or exposure to infection; wasting (WHZ) is a well-known indicator of acute undernutrition or recent weight loss and underweight (WAZ) is used as a composite measure of WHZ and HAZ.[2] For their functional unique characteristics these indices separately cannot provide a single conclusion of the overall burden of undernutrition among children in a population. Ending the hierarchal conclusion of undernutrition, Svedberg (2000) has pointed out that HAZ, WAZ and WHZ are dependent entities where WAZ is often used to reflect the extent of both chronic and acute malnutrition, it cannot distinguish between the other two indices due to overlapping. WAZ may have limited functions and it does not detect the sum of those children who are HAZ and/or WHZ, and so provides an underestimate of the extent of anthropometric failure in a population. What is required as an alternative tool for identifying all undernourished children, be they HAZ and/or WHZ and/or WAZ; the solution is the CIAF.

In the first-time presentation on CIAF, Svedberg (2000), has clearly outlined the relationship between three indices of undernutrition in a graphical presentation (Figure 1). Where the vertical axis presented the deviation of weight the horizontal axis indicated height deviation. The diagonal line presented the amalgamation of weight for height. All these indices of undernutrition and normal are logically secured in their sectional position in the circle of this graph. In all sectional parts of this circle, Svedberg has included WAZ children in sections or Groups C, D, and E but categorical Groups B and F are shown excluding WAZ children; HAZ children are included in Groups D, E and F but excluded in Groups B and C; and the other category WHZ children are included in the B, C, and D, but excluded in Groups E and F. After graphical presentation and detecting acceptable and non-acceptable state among HAZ, WAZ and WHZ children, Svedberg had formulated an estimation depending on the capability of all anthropometric indicators which was termed as the Composite Index of Anthropometric Failure (CIAF).[1] The estimating formula for detecting overall undernutrition among children is:

$$CIAF=(1-A)/(A+B+C+D+E+F)=(1-A)/1= 1-A$$

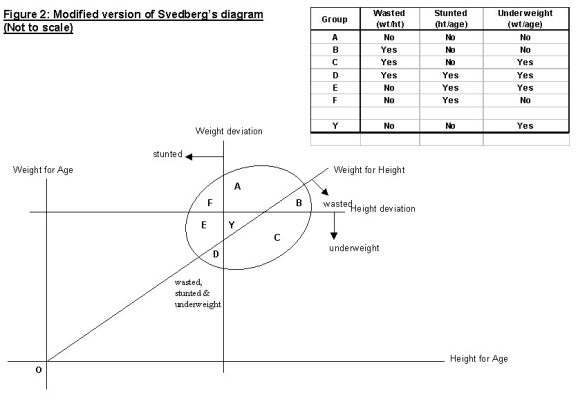
Figure 1. *Svedberg's Original Graphical Presentation on CIAF with Six Sections (A to F)*



Group	Wasted (wt/ht)	Stunted (ht/age)	Underweight (wt/age)
A	No	No	No
B	Yes	No	No
C	Yes	No	Yes
D	Yes	Yes	Yes
E	No	Yes	Yes
F	No	Yes	No

Except for Group A (not anthropometric failure), the overall prevalence of malnutrition is determined by summing up the five groups jointly. After few years of Svedberg's formulated CIAF, Shailen Nandy and co-workers (2005) had added a new Group Y (Figure 2) which denotes only the underweight children.[3] Currently, the revised Svedberg model has become a useful policy-making tool of planners for designing interventions programme to reduce malnutrition in developing countries.[4]

Figure 2. *Revised CIAF with Seven Sections (A to F and Y)*



Group	Wasted (wt/ht)	Stunted (ht/age)	Underweight (wt/age)
A	No	No	No
B	Yes	No	No
C	Yes	No	Yes
D	Yes	Yes	Yes
E	No	Yes	Yes
F	No	Yes	No
Y	No	No	Yes

With the emergence of dual burden of malnutrition, this CIAF model of classification is not sufficient. At present, CIAF is detecting only those children whose weight and height are below the normal reference population of WHO and The Centers for Disease Control and Prevention (CDC).[5,6] It does not address the issue of dual burden of malnutrition where there is a concomitant coexistence of stunting with overweight/obesity (children suffering from overnutrition, i.e. overweight/obesity). Like HAZ, WAZ and WHZ; overweight children suffer from many diseases.[7-11] According to WHO (2013), childhood obesity is one of the most serious public health challenges of 21st century.[12] Several recent studies among children from various countries have reported the presence of overweight and obesity simultaneously with stunting, i.e., low HAZ.[13-18] Recent studies have also demonstrated the global emergence of only overweight/obesity among school-age children in both developed and developing countries.[19-20]

For lack of correct identification of overweight with stunting children and only overweight children by revised Svedberg's CIAF, we hereby propose two new groups to estimate anthropometric over failure (OF). The two new groups are Stunting with overweight and overweight only (Table 1). In graphical presentation (Figure 3) overweight (upper portion of dotted diagonal line) category has two distinct portions, i.e., along with stunting (with low HAZ) (G) and normal height (normal HAZ) (H).

Figure 3. *Proposed CIAF Categories (A to H and Y))*

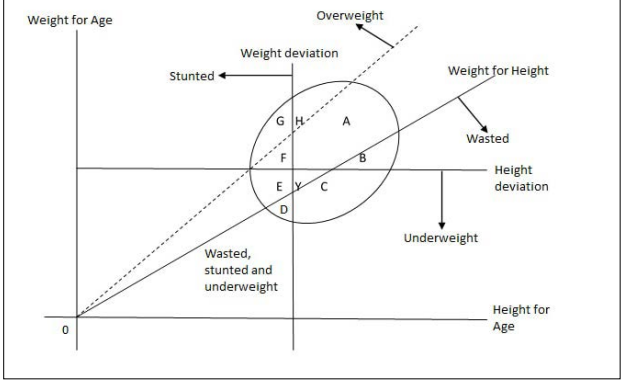


Table 1. *Proposed New Composite Index of Anthropometric Failure Categories*

CIAF Categories	Wasted	Stunted	Underweight	Overweight
Group A - No failure	No	No	No	No
Group B - Wasted only	Yes	No	No	No
Group C - Wasted & Underweight	Yes	No	Yes	No
Group D - Wasted, Stunted & Underweight	Yes	Yes	Yes	No
Group E - Stunted & Underweight	No	Yes	Yes	No
Group F - Stunted only	No	Yes	No	No
Group G – Stunted & Overweight	No	Yes	No	Yes
Group H - Overweight only	No	No	No	Yes
Group Y - Underweight only	No	No	Yes	No

Lastly, we hereby propose the following revised formula for detecting Under Failure (UF), Over Failure (OF) and Only Normal (ON).

$$CIAF = \frac{(1\text{-}A)}{((A+B+C+D+E+F+Y)+(G+H))}$$

(Where, A=No failure or normal, B=Wasted only, C=Wasted and Underweight, D=Wasted, Stunted and Underweight, E=Stunted and Underweight, F=Stunted only, G=Stunted and Overweight, H=Overweight only and Y=Underweight only)

$$\text{or, } \frac{(1\text{-}ON)}{(ON+UF+OF)}$$

$$\text{Where, } UF = \frac{(1\text{-}(ON+OF))}{(ON+UF+OF)}$$

$$\text{and } OF = \frac{(1\text{-}(ON+UF))}{(ON+UF+OF)}$$

(Where, ON=Only Normal, UF=Under Failure and OF=Over Failure)

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