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Revue d'Épidémiologie et de Santé Publique 63 (2015) 43–49
Revue d'Épidémiologie et de Santé Publique
Epidemiology and Public Health

Original article

Evaluation of anthropometric measurements at birth in predicting birthweight less than 2000 g in African and Asian newborns: A meta-analysis

Évaluation des mesures anthropométriques à la naissance comme indicateurs d'un poids inférieur à 2000 g parmi les nouveau-nés africains et asiatiques : méta-analyse

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Received 6 August 2014; accepted 17 November 2014
Available online 13 January 2015

Abstract

Background. – Particularly in developing countries, lower birthweight may be associated with higher neonatal mortality, and deliveries frequently take place at home where scales are not always available. Therefore, surrogate measurements for birthweight are necessary as a primary screening measure. The aim of this study was to determine whether newborn chest and arm circumferences can predict birthweight less than 2000 g.

Methods. – The selection criteria were studies published in English that could provide all the true- and false-positive and true- and false-negative results with regard to the prediction of birthweight less than 2000 g by other anthropometric measurements among apparently healthy neonates. Ten bibliographic databases (e.g., PubMed) were searched and a bivariate meta-analysis was conducted with hierarchical summary receiver operating characteristic (ROC) curves. A total of 36,987 participants in 24 studies for chest circumference and 16,164 participants in 15 studies for arm circumference were included. The study regions were limited to Africa and Asia.

Results. – For chest and arm circumferences (24 and 15 studies, respectively), pooled sensitivity (0.94 and 0.89, respectively) and specificity (0.94 and 0.96, respectively), and diagnostic odds ratios (263 and 174, respectively) were sufficiently high to allow good predictions. The diagnostic odds ratio for chest circumference was significantly higher than for arm circumference ($P < 0.001$). The generalizability of the findings is to some extent guaranteed.

Conclusion. – Newborn chest and arm circumferences may be useful predictors of birthweight less than 2000 g, with chest circumference possibly better.

Keywords: Anthropometry; Birth weight; Meta-analysis; Newborn; Sensitivity and specificity

Résumé

Position du problème. – Un faible poids à la naissance peut être associé à une mortalité néonatale plus élevée, notamment dans les pays en développement, où un instrument permettant de peser le nouveau-né n'est pas toujours disponible lors des accouchements à domicile. Aussi, des mesures de substitution sont nécessaires pour permettre un premier dépistage d'un poids de naissance trop faible. L'objectif de la présente étude était de déterminer si la mesure des tours de poitrine et de bras des nouveau-nés permettait de prédire un poids de naissance inférieur à 2000 g.

Méthodes. – Dix bases de données bibliographiques (dont PubMed) ont été interrogées afin de sélectionner les études publiées en anglais présentant des résultats sur la prédiction des poids de naissance inférieurs à 2000 g au moyen d'autres mesures anthropométriques en termes de vrais et faux positifs, et de vrais et faux négatifs, chez les nouveau-nés en apparente bonne santé. Une méta-analyse bivariée a été conduite avec l'utilisation des courbes ROC. Au total, 36 987 participants dans 24 études sur les tours de poitrine et 16 164 participants dans 15 études sur les tours de bras ont été retenus. Les régions concernées par les études couvraient seulement l'Afrique et l'Asie.

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http://dx.doi.org/10.1016/j.respe.2014.11.002
0398-7620/

Résultats. – Concernant les tours de poitrine et de bras (respectivement, 24 et 15 études), les sensibilités (respectivement, 0,94 et 0,89), les spécificités (respectivement, 0,94 et 0,96) et les odds ratios diagnostiques (respectivement, 263 et 174) se sont révélés suffisamment élevés pour assurer de bonnes prédictions. L'odds ratio diagnostique du tour de poitrine était significativement supérieur à celui du tour de bras ($p < 0{,}001$). La généralisation des résultats est dans une certaine mesure garantie.

Conclusion. – Le tour de bras des nouveau-nés, et davantage encore le tour de poitrine, peuvent se révéler des indicateurs utiles d'un poids de naissance inférieur à 2000 g.

Mots clés : Anthropométrie ; Poids de naissance ; Méta-analyse ; Nouveau-né ; Sensibilité et spécificité

1. Introduction

Particularly in developing countries, newborns with birthweight <2000 g rather than <2500 g (i.e., low birthweight) may be at dramatically increased risk of neonatal death [1,2], and deliveries frequently take place at home where scales are not always available [3]. Therefore, surrogate measurements for birthweight, especially the identification of newborns with birthweight <2000 g, are necessary as a primary screening measure. When predicting low birthweight (i.e., birthweight <2500 g), chest and arm circumferences may have high and strong accuracy, though not confirmative, but chest circumference may be more precise [4]. A birthweight <2000 g indicates the need for more immediate and appropriate care [5]. Fewer studies have evaluated the prediction of birthweight <2000 g by other anthropometric measurements, in part because of lower prevalence of birthweight <2000 g than <2500 g. Summarized findings based on large sample sizes would be difficult not only to plan but also to implement in the field. Following this rationale, a meta-analysis of the literature was conducted aiming to determine whether newborn chest or arm circumference is useful in predicting birthweight <2000 g.

2. Methods

2.1. Primary outcomes

The primary outcomes were sensitivity and specificity, positive and negative likelihood ratios, and the diagnostic odds ratio, and area under the curve (AUC) on a hierarchical summary receiver operating characteristic (ROC) curve with regard to the prediction of birthweight <2000 g for chest and arm circumferences manually measured at birth.

2.2. Selection criteria

The selection criteria were studies, published in English, that could provide all the true- and false-positive and true- and false-negative results with regard to the prediction of birthweight <2000 g by other anthropometric methods among apparently healthy neonates. The studies missing some of these results were included when the missing results could be calculated from other known results, the number of participants, the prevalence of low birthweight, the diagnostic indices, etc., as long as there were consistencies among all the data.

More than one study was frequently extracted from one article, given that some of the articles provided more than one set of true- and false-positive and true- and false-negative results by assessing more than one anthropometric measurement, using more than one cut-off point of the same anthropometric measure, and/or involving more than one population. The same studies reported in more than one article were integrated into one study to prevent duplication.

PubMed (MEDLINE) was first searched to identify articles reporting eligible studies (February 2014). The search terms were: (''birthweight'' or ''birth weight'' or ''birth-weight'') and (''2000 g'' or ''2,000 g'' or ''2 kg'' or ''2.0 kg'') and (''height'' or ''heights'' or ''length'' or ''lengths'' or ''circumference'' or ''circumferences'' or ''thickness'' or ''thicknesses''). After excluding clearly unrelated articles by scanning titles and abstracts, the articles were collected for full-text retrieval. After excluding articles judged to be unrelated according to the full text, the remaining articles were considered potentially eligible articles, and their studies potentially eligible studies. Titles and abstracts of (a) articles displayed by clicking ''Related'' at the right of the screens of these potentially eligible articles and (b) articles retrieved in the reference sections of these potentially eligible articles were scanned to identify additional potentially eligible articles. Other databases searched included CINAHL, PsycINFO, Wiley Online Library (which offers integrated access to Cochrane Clinical Answers, Cochrane Library, EBM Guidelines: Evidence-Based Medicine, and Essential Evidence Plus), ProQuest (which includes ProQuest Health and Medical Complete and ProQuest Dissertations & Theses Database), Web of Knowledge, Google Scholar, and SciVerse Scopus.

2.3. Quality assessment

Quality Assessment of Diagnostic Accuracy Studies (QUADAS), a tool for the quality assessment of studies of diagnostic accuracy included in systematic reviews, consisting of 14 items [6], was used to assess study quality. The total number of ''yes'' responses to each of the QUADAS items was defined as the QUADAS score.

2.4. Statistical analysis

Stata/MP 13.0 (StataCorp, College Station, TX, USA) was used to statistically analyze the data. Each study's spike plots of Cook's distance and scatter plots of standardized residuals of