DOI: https://doi.org/10.53555/nnmhs.v9i4.1645 Publication URL: https://nnpub.org/index.php/MHS/article/view/1645

THE ACCURACY OF RISK SCORES IN PREDICTING PRETERM BIRTH : A SYSTEMATIC REVIEW

Roni Andre Syahputra Damanik*

**Faculty of Medicine, University of Jambi, Indonesia*

***Corresponding Author** :
ronidamanikandre@gmail.com

Abstract

Around the world, premature birth, also known as preterm birth (PTB), is one of the leading causes of perinatal illness and death. The majority of preterm births (two-thirds) are the result of spontaneous preterm birth (SPTB), while the remaining one-third are necessary for medical reasons owing to complications with either the mother or the fetus. A combination of factors, including a large decline in birth rates and an increase in the average mother age at the time of conception, has led to an increase in the number of pregnancies accomplished with the use of assisted reproductive technology (ART), as well as an increase in the number of children who are delivered prematurely. Despite the enormous advancements that have been achieved in the treatment of premature babies, the prevention of preterm births is not yet a reality. This is despite the fact that there has been substantial success made in treating premature newborns. There are a number of risk factors that have been linked to premature birth, including a cervix that is too short, a maternal age that is larger than 35 years, a maternal body mass index that is greater than 25, smoking habits, and comorbid risk factors (such as hypertension and diabetes).

Keyword: *Cervical length; Mother age; Preterm birth; Risk scores*

INTRODUCTION

Preterm birth (PTB) is one of the top causes of perinatal morbidity and mortality around the world. The majority of PTB cases (two-thirds) are due to spontaneous PTB (SPTB); the remaining one-third are medically required, due to maternal or fetal problems.[1] SPTB is traditionally characterized as birth between $20^{0/7}$ and $37^{0/7}$ weeks gestation following spontaneous commencement of labor, preterm prelabor membrane rupture, or premature cervix dilatation (cervical insufficiency).[2,3]

However, several experts have recently realized that some spontaneous deliveries late in the second trimester (e.g., $16^{0/7}$ to $19^{6/7}$), formerly thought to be miscarriages, may also be SPTB due to similarities in risk factors, presentation, and recurrence. Preterm infants require lengthy hospitalizations and are at a high risk of unfavorable outcomes such as breathing issues, neurodevelopmental sequelae, necrotizing enterocolitis, feeding difficulties, blindness, deafness, and intraventricular hemorrhage. Preterm newborns are also more likely to die during the neonatal period and up to the age of five years than term infants.[3,4]

As a result, the health demands of premature newborns can be significant and lifelong, affecting both the family and society as a whole, and PTB is a serious public health issue. Preterm birth affects approximately 11% of infants worldwide, with the majority of cases occurring in low-income nations. PTB is still one of the most common pregnancy-related problems in the United States. Though the rate of preterm birth in the United States fell somewhat from 2008 to 2014, to 9.57%, it climbed to 9.63% between 2014 and 2015.[1,5,6] Preterm delivery kills 35% of all children and affects 15 million infants worldwide at a rate of 11%.[7,8]

Given that PTB has big effects on society in the US and around the world, a lot of attention has been paid to finding the women who are most at risk, with a focus on SPTB because it causes most early births. SPTB is a bad thing because it can be caused by a number of different things. SPTB is most likely to happen again if it has happened before. But other than that, it's hard to predict PTB because the situation is different and there are many different causes and risk factors.[9,10] The talk about the facts about how well risk scores can predict a premature birth.

METHODS

PRISMA 2020 complied with requirements for data acquisition, processing, and reporting. The decision to implement new restrictions was influenced by multiple factors. This review investigates the predictive accuracy of risk scores for preterm birth. All written materials regarding the effect of nocturia on mortality must be composed in English, according to the primary findings of the study. This systematic review analyzed scholarly articles published after 2015 that met the inclusion criteria of the study. The collection will exclude editorials, entries lacking a DOI, reviews of previously published books, and duplicate journal articles that are excessively extensive.

The search for studies to be included in the systematic review was carried out from April, 11th 2023 using the PubMed and SagePub databases by inputting the words: “risk scores” and “predicting preterm birth”. Where *("risk factors"[MeSH Terms] OR ("risk"[All Fields] AND "factors"[All Fields]) OR "risk factors"[All Fields] OR ("risk"[All Fields] AND "scores"[All Fields]) OR "risk scores"[All Fields]) AND ("predict"[All Fields] OR "predictabilities"[All Fields] OR "predictability"[All Fields] OR "predictable"[All Fields] OR "predictably"[All Fields] OR "predicted"[All Fields] OR "predicting"[All Fields] OR "prediction"[All Fields] OR "predictions"[All Fields] OR "predictive"[All Fields] OR "predictively"[All Fields] OR "predictiveness"[All Fields] OR "predictives"[All Fields] OR "predictivities"[All Fields] OR "predictivity"[All Fields] OR "predicts"[All Fields]) AND ("premature birth"[MeSH Terms] OR ("premature"[All Fields] AND "birth"[All Fields]) OR "premature birth"[All Fields] OR ("preterm"[All Fields] AND "birth"[All Fields]) OR "preterm birth"[All Fields])* is used as search keywords.

Equally influential on the acceptability of studies were their abstracts and titles. Consequently, they must rely on historical documents. Considering that research findings are typically consistent, unpublished English papers are required. For the systematic review, only studies meeting the inclusion criteria were considered. This restricts the search results to only those that meet the specified criteria. The evaluation procedure is divided into the following sections. The research took into account authors, publication dates, geographic locations, activities, and motivations. After EndNote had recorded a search's results, the database scoured for duplicate articles and removed them.

This article involved two people reviewing the titles and abstracts of all the papers. Each author carefully considers relevant abstracts and article titles before deciding which articles to cover. Each paper that meets the review criteria will be subject to a comprehensive and thorough analysis. After completing our investigation, we will review relevant scientific publications that we may have missed the first time. Relevant research was included, while we excluded research that was not relevant.

RESULT

Miller, et al (2015)[11] showed age of the mother and in vitro fertilization were not substantially related to a short cervix. Black (adjusted odds ratio [aOR] = 3.77, 95% confidence interval [CI] = 2.42-5.87) and Hispanic (aOR = 1.73, 95% CI = 1.10-2.74) race-ethnicity, current tobacco use (aOR = 3.67, 95% CI = 1.56-8.62), prior indicated preterm birth (aOR = 2.26, 95% CI = 1.26-4.05), and having a prior cervical excisional procedure (aOR = 2.96, 95% CI = 1.86-4.70) were independent risk factors for a short cervix. Universal screening has a specificity of 62.8%, whereas risk-based screening has 96.5%. The sensitivity to offer transvaginal scanning was 62.8% with one variable and 14% with two factors.

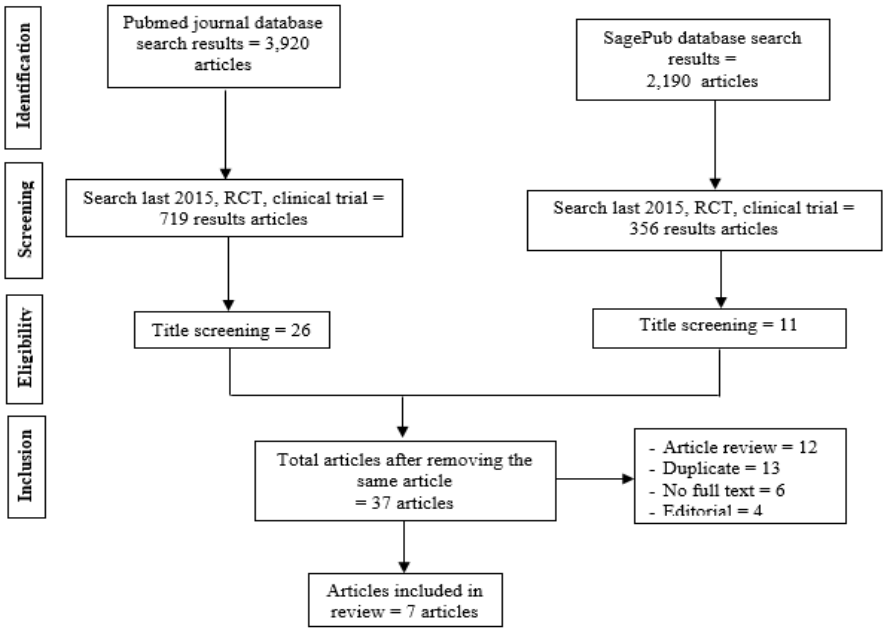

Figure 1. Article search flowchart

Cho, et al (2016)[12] showed the mean cervical lengths did not differ substantially between the two techniques (mean SD = 3.78 ± 0.82 cm for transabdominal and 3.82 ± 0.77 cm for transvaginal sonography, respectively; P =.09). Short cervical lengths (2 cm) on transabdominal sonography predicted transvaginal short cervical lengths 100%. Transabdominal sonography had 21.4%, 98.68%, 50.00%, 95.32%, and 13.22 for predicting preterm birth, while transvaginal sonography had 28.57%, 94.94%, 66.6%, 95.78%. Short cervical lengths predicted premature birth in transabdominal sonography instances.

Esplin, et al (2017)[13] conducted a study with 9,410 women, of which 474 (5.0%) had spontaneous preterm births, 335 (3.6%) had medically indicated preterm births, and 8601 (91.4%) had term births. They showed 8.0% of women with spontaneous preterm birth had a cervical length <25 mm between 16 and 22 weeks of pregnancy, and 23.3% between 22 and 30 weeks. 7.3% women with spontaneous preterm birth had fetal fibronectin levels >50 ng/mL at 16 to 22 weeks, and 8.1% at 22 to 30 weeks. The area under the receiver operating characteristic (ROC) curve for screening between 22 and 30 weeks was 0.59 (95% CI = 0.56–0.62) for fetal fibronectin level alone, 0.67 (95% CI = 0.64–0.70) for transvaginal cervical length alone, and 0.67 (95% CI, 0.64–0.70) for the combination as continuous variables.

Li, et al (2022)[14] showed Higher education level of pregnant women (bachelor [OR = 0.82; 95%CI = 0.81-0.84]; master or above [OR = 0.82; 95%CI = 0.81-0.83]), pre-pregnancy overweight (OR = 0.96; 95%CI = 0.95-0.98) and obesity (OR = 0.94; 95%CI = 0.93-0.96), and prenatal care (OR = 0.48; 95%CI = 0.47-0.50) were associated with a reduced risk of preterm birth, while age ≥ 35 years (OR = 1.27; 95%CI = 1.26-1.29), black race (OR = 1.26; 95%CI = 1.23-1.29), pre-pregnancy underweight (OR = 1.26; 95%CI = 1.22-1.30), pregnancy smoking (OR = 1.27; 95%CI = 1.24-1.30), pre-pregnancy diabetes (OR = 2.08; 95%CI = 1.99-2.16), pre-pregnancy hypertension (OR = 2.22; 95%CI = 2.16-2.29), previous preterm birth (OR = 2.95; 95%CI = 2.88-3.01), and plurality (OR = 12.99; 95%CI = 12.73-13.24) were related to an increased risk of preterm birth. The AUC and accuracy of the prediction model in the testing set were 0.688 (95%CI = 0.686-0.689) and 0.762 (95%CI = 0.762-0.763), respectively.

Table 1. The litelature include in this study

Author	Origin	Method	Sample	Risk Predictor	Conclusion
Miller, 2015[11]	United tate of America (USA)	Cohort study	18,250 women	Short cervix, maternal age, race	If screening for cervical length is restricted to women who have at least one of the established risk factors for a short cervix, then the number of women undergoing ultrasonograms for the assessment of cervical length will be significantly reduced. However, because of this method, approximately forty percent of women who have a cervix that is too short go undiagnosed.
Cho, 2016[12]	Republic of Korea	Prospective study, comparative	1,465 women	Cervical Lengths Measured by Transabdominal and Transvaginal Sonography for Predicting Preterm Birth	It is possible that transvaginal sonography is not necessary for women whose cervical lengths are measured on transabdominal sonography and found to be lengthy. Women whose cervical lengths are unmeasurable or short (less than two or less than two and a half centimeters) on transabdominal sonography should have

					transvaginal sonography in order to quantify their cervical lengths for the purpose of predicting premature birth.
Esplin, 2017[13]	USA	Prospective observational cohort study	9,410 women	Serial transvaginal cervical lengths and quantitative vaginal fetal fibronectin levels	Quantitative vaginal fetal fibronectin and serial transvaginal ultrasound cervical length both demonstrated poor predictive accuracy for spontaneous preterm birth in nulliparous women carrying a singleton pregnancy. These findings do not lend support to the practice of routinely using these tests on women of this kind.
Li, 2022[14]	USA	Case control study	3,006,989 pregnant women in 2019 and 3,039,922 pregnant women in 2018	Normogram based on information on pregnant women and their spouses	The nomogram that was developed to predict the risk of preterm delivery in pregnant women had an excellent performance, and the necessary predictors are readily available clinically. As a result, the nomogram may be able to serve as a straightforward instrument for the prediction of preterm birth.
Liu, 2019[15]	USA	Population-based cohort study	7,141,630 singleton livebirths	Maternal age and race	In the general population, having a mother who was obese prior to becoming pregnant is strongly connected with an increased chance of giving birth prematurely; however, this risk varies depending on the mother's age as well as her race or ethnicity. It is imperative that further research be conducted in order to comprehend the underlying mechanics.
Gete, 2020[16]	Australia	Prospective observational cohort study	3,508 singleton live births	Dietery pattern	According to the findings of this research, more adherence to the traditional vegetable pattern before becoming pregnant is related with a decreased risk of preterm delivery, especially spontaneous preterm birth among women who have never given birth before. This discovery calls for more research to be done.
Premkumar , 2016[17]	USA	Retrospective cohort study	23,425 singleton pregnancies	Maternal race / ethnicity and chronic hypertension	Chronic hypertension affects medically indicated preterm birth differently by race/ethnicity. Although data on medically indicated preterm delivery was limited, the larger effect of chronic hypertension among African-American and Asian/ Pacific Islander women on medically indicated and total preterm birth rates suggests an independent variable that was not captured in the data analysis.
Wei, 2019[18]	China	Retrospective cohort study	Population-based retrospective cohort study	DM	Preconception IFG or DM was associated with spontaneous abortion, PTB, macrosomia, SGA, and perinatal infant mortality. Policymakers should prioritize preconception glycemic control.

Obese mothers are more likely to give birth prematurely, however this risk varies by age and race or ethnicity. Understanding the mechanics requires more investigation.[15] After adjustment for lifestyle factors and pregnancy complications, greater adherence to the traditional vegetables pattern before pregnancy was associated with a lower risk of preterm birth and spontaneous preterm birth, highest tertile compared with lowest tertile (aOR = 0.72, 95% CI = 0.53-0.99), and (RR ratio = 0.62, 95% CI = 0.39-1.00), respectively. However, the pre-pregnancy BMI attenuated these associations. No significant associations were found between dietary habits before pregnancy and LBW.[16]

The impact of chronic hypertension on preterm birth and medically indicated preterm birth varies by race/ethnicity. The greater effect of chronic hypertension on medically indicated and total preterm birth rates among African-American and Asian/Pacific Islander women raises the possibility of an independent variable that is not accounted for in the data analysis, despite the fact that data regarding the indication for medically indicated preterm delivery were limited in this data set.[17]

DISCUSSION

The significant drop in birth rates combined with the rising average maternal age at the time of conception has resulted in a rise in the number of pregnancies achieved with the use of assisted reproductive technology (ART) as well as an increase in the number of infants born prematurely. The prevention of premature births has not yet been realized, despite the significant progress that has been made in the treatment of premature newborns.[19,20] Recent article has focused on the primary prevention of premature births in asymptomatic women who have a high chance of having a premature baby.

Since the risk of SPTB is consistently inversely proportional to the length of the cervix, a short mid-trimester cervical length is one of the most significant risk factors for SPTB.[11] TVS, transabdominal, transperineal, and digital cervix checks are available. Digital tests measure dilatation, location, consistency, and length. Subjective assessment. Mismeasured

cervical length. It cannot identify internal cervical os and upper cervical canal changes. Ultrasound penetrates cervical tissue to treat both diseases. Dorsal lithotomy performs TVS and TPS. Accurate measurements require these characteristics.[21] Study is conceivable that transvaginal sonography is not required for women with long cervical lengths as determined by transabdominal sonography.[12]

To *et al*.[22] showed normal cervical length distribution was 36 mm. 1% of women had lengths under 15 mm. In interventional investigations, this cut-off defines high-risk.[23] Celik *et al*.[24] created preterm delivery risk models using cervical-length measurements between 20 and 24 weeks' gestation and maternal history in over 58 000 women. They compared patients who delivered before 28 weeks, 28–30 weeks, 31–33 weeks, and 34–36 weeks. Sensitivities were 81%, 59%, 53%, and 29% for a 10% false-positive rate. Honest *et al*.[25] evaluated five studies that employed cervical-length measurements between 20 and 24 weeks with cut-offs of 20–30 mm to predict preterm birth before 34 weeks. Positive probability ratios were 2.3 for 30 mm and 7.6 for 20 mm.

Other study developed a large-sample preterm birth prediction model. Our results showed that bachelor or above education level of pregnant women and their spouses, pre-pregnancy overweight and obesity, and prenatal care were linked to a reduced risk of preterm birth, while age < 35 years, black race, pre-pregnancy underweight, pregnancy smoking, pre-pregnancy diabetes, gestation diabetes, pre-pregnancy hypertension, gestation hypertension, hypertension eclampsia, previous preterm birth, previo The testing set AUC of the preterm birth prediction model using these variables was 0.688. The model also fared well in external validation.[14]

Some studies link preterm birth to black ethnicity and advanced mother age. Black Americans had a higher preterm birth rate than whites in a meta-analysis.[26] Preterm birth was higher in pregnant black women over 35. Many variables may affect preterm birth and pre-pregnancy BMI. Pre-pregnancy obesity and preterm birth risk varied by age and race in a large sample study.[15,16] Study discovered that pre-pregnancy overweight and obesity reduced preterm birth risk. Other confounders may be impacting our results. Preterm birth was also linked to hypertension and diabetes.[17,18,27] Smoking contributed to fetal death or impairment.[28]

CONCLUSION

There are many factors that can be associated with prematurity, such as a short cervix, maternal age older than 35 years, greater maternal BMI, smoking habits, comorbid factors (hypertension and diabetes).

REFERENCE

[1]. Mathews TJ, Driscoll AK. Trends in Infant Mortality in the United States, 2005-2014. NCHS Data Brief. 2017 Mar;(279):1–8.
[2]. Howson CP, Kinney M V, McDougall L, Lawn JE. Born too soon: preterm birth matters. Reprod Health. 2013;10 Suppl 1(Suppl 1):S1.
[3]. Goldenberg RL, Culhane JF, Iams JD, Romero R. Epidemiology and causes of preterm birth. Lancet (London, England). 2008 Jan;371(9606):75–84.
[4]. Practice Bulletin No. 171: Management of Preterm Labor. Obstet Gynecol. 2016 Oct;128(4):e155-64.
[5]. Marlow N, Wolke D, Bracewell MA, Samara M. Neurologic and developmental disability at six years of age after extremely preterm birth. N Engl J Med. 2005 Jan;352(1):9–19.
[6]. Martin JA, Hamilton BE, Osterman MJK, Driscoll AK, Mathews TJ. Births: Final Data for 2015. Natl vital Stat reports from Centers Dis Control Prev Natl Cent Heal Stat Natl Vital Stat Syst. 2017 Jan;66(1):1.
[7]. Vogel JP, Chawanpaiboon S, Moller A-B, Watananirun K, Bonet M, Lumbiganon P. The global epidemiology of preterm birth. Best Pract Res Clin Obstet Gynaecol. 2018 Oct;52:3–12.
[8]. Walani SR. Global burden of preterm birth. Int J Gynaecol Obstet Off organ Int Fed Gynaecol Obstet. 2020 Jul;150(1):31–3.
[9]. Cunningham FG, Leveno KJ, Bloom SL, Cunningham FG; Leveno KJ; Bloom SL; et al, Cunningham FG, Leveno KJ, et al. Williams Obstetri. 25th ed. New York: The McGraw-Hill Companies; 2020.
[10]. Culhane JF, Goldenberg RL. Racial disparities in preterm birth. Semin Perinatol. 2011 Aug;35(4):234–9.
[11]. Miller ES, Tita AT, Grobman WA. Second-Trimester Cervical Length Screening Among Asymptomatic Women: An Evaluation of Risk-Based Strategies. Obstet Gynecol. 2015 Jul;126(1):61–6.
[12]. Cho HJ, Roh H-J. Correlation Between Cervical Lengths Measured by Transabdominal and Transvaginal Sonography for Predicting Preterm Birth. J ultrasound Med Off J Am Inst Ultrasound Med. 2016 Mar;35(3):537–44.
[13]. Esplin MS, Elovitz MA, Iams JD, Parker CB, Wapner RJ, Grobman WA, et al. Predictive Accuracy of Serial Transvaginal Cervical Lengths and Quantitative Vaginal Fetal Fibronectin Levels for Spontaneous Preterm Birth Among Nulliparous Women. JAMA. 2017 Mar;317(10):1047–56.
[14]. Li Y, Fu X, Guo X, Liang H, Cao D, Shi J. Maternal preterm birth prediction in the United States: a case-control database study. BMC Pediatr. 2022 Sep;22(1):547.
[15]. Liu B, Xu G, Sun Y, Du Y, Gao R, Snetselaar LG, et al. Association between maternal pre-pregnancy obesity and preterm birth according to maternal age and race or ethnicity: a population-based study. lancet Diabetes Endocrinol. 2019 Sep;7(9):707–14.
[16]. Gete DG, Waller M, Mishra GD. Prepregnancy dietary patterns and risk of preterm birth and low birth weight:

findings from the Australian Longitudinal Study on Women's Health. Am J Clin Nutr. 2020 May;111(5):1048–58.
[17]. Premkumar A, Henry DE, Moghadassi M, Nakagawa S, Norton ME. The interaction between maternal race/ethnicity and chronic hypertension on preterm birth. Am J Obstet Gynecol. 2016 Dec;215(6):787.e1-787.e8.
[18]. Wei Y, Xu Q, Yang H, Yang Y, Wang L, Chen H, et al. Preconception diabetes mellitus and adverse pregnancy outcomes in over 6.4 million women: A population-based cohort study in China. PLoS Med. 2019 Oct;16(10):e1002926.
[19]. Konar H. DC Dutta's Textbook Of Obstetrics Including Perinatology and Contraception. 8th ed. New Delhi: Jaypee Brothers Medical Publishers; 2015.
[20]. Cunningham FG; et al, Cunningham FG; Leveno KJ; Bloom SL; et al, F. Gary Cunningham, Kenneth J. Leveno, Steven L. Bloom, Catherine Y. Spong, Jodi S. Dashe BLH. Williams Obstetri. 25th ed. New York: The McGraw-Hill Companies; 2020.
[21]. Kagan KO, Sonek J. How to measure cervical length. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol. 2015 Mar;45(3):358–62.
[22]. To MS, Skentou CA, Royston P, Yu CKH, Nicolaides KH. Prediction of patient-specific risk of early preterm delivery using maternal history and sonographic measurement of cervical length: a population-based prospective study. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol. 2006 Apr;27(4):362–7.
[23]. Fonseca EB, Celik E, Parra M, Singh M, Nicolaides KH. Progesterone and the risk of preterm birth among women with a short cervix. N Engl J Med. 2007 Aug;357(5):462–9.
[24]. Celik E, To M, Gajewska K, Smith GCS, Nicolaides KH. Cervical length and obstetric history predict spontaneous preterm birth: development and validation of a model to provide individualized risk assessment. Ultrasound Obstet Gynecol Off J Int Soc Ultrasound Obstet Gynecol. 2008 May;31(5):549–54.
[25]. Honest H, Forbes CA, Durée KH, Norman G, Duffy SB, Tsourapas A, et al. Screening to prevent spontaneous preterm birth: systematic reviews of accuracy and effectiveness literature with economic modelling. Health Technol Assess. 2009 Sep;13(43):1–627.
[26]. Mehra R, Boyd LM, Ickovics JR. Racial residential segregation and adverse birth outcomes: A systematic review and meta-analysis. Soc Sci Med. 2017 Oct;191:237–50.
[27]. Bertagnolli M, Luu TM, Lewandowski AJ, Leeson P, Nuyt AM. Preterm Birth and Hypertension: Is There a Link? Curr Hypertens Rep. 2016 Apr;18(4):28.
[28]. Stock SJ, Bauld L. Maternal smoking and preterm birth: An unresolved health challenge. PLoS Med. 2020 Sep;17(9):e1003386.