Factors affecting pregnancy weight gain and relationships with maternal/fetal outcomes in Turkey

Nilufer Akgun, MD, Huseyin L. Keskin, MD, Isık Ustuner, MD, Gulden Pekcan, MD, Ayse F. Avsar, MD.

ABSTRACT

الأهداف: تحديد تأثير مؤشر كتلة الجسم ما قبل الحمل (BMI) وزيادة الوزن الحملي على مضاعفات الأم والجنين، ودراسة ما إذا كانت المرأة التركية تحقق زيادة الوزن الموصى بها في الحمل. والتحقق أيضاً في العلاقة بين زيادة الوزن في الحمل وطريقة الولادة، مع فحص القياسات الأنثروبومترية للأمهات.

الطريقة: أجريت دراسة مستعرضة بأثر رجعي على عدد 986 امرأة حامل من نوفمبر 2011م إلى نوفمبر 2015م في مستشفى أتاتورك للتعليم والبحث في أنقرة، تركيا. تم تقييم عمر الأم، مؤشر كتلة الجسم، وزيادة الوزن الشهري أثناء الحمل، وزن الولادة للمولود، والجنس، والنتائج السلبية الأم والجنين.

النتائج: ترتبط مضاعفات الأمهات بشكل إيجابي مع ارتفاع مؤشر كتلة الجسم قبل الحمل ($p<0.05$)، وترتبط بزيادة الوزن أثناء الحمل مع عدد مرات الحمل وزيادة وزن المولود ($p<0.05$). ومع ذلك، لم يلاحظ أي ارتباط بين متوسط زيادة وزن الحمل ومضاعفات الأمهات ($p>0.05$). وكانت النسبة المئوية للنساء اللواتي بناءً على معهد الطب (IOM) أكبر قدر من الوزن في مجموعة مؤشر كتلة الجسم (54.1%) وأدنى نسبة في مجموعة BMI (24.3%). تجاوزت زيادة الحمل توصيات IOM في مجموعات زيادة الوزن (56.3%) والسمنة (52.5%).

الخاتمة: في حين أن زيادة وزن الأمهات أثناء الحمل يؤثر على وزن حديثي الولادة، وارتفاع مؤشر كتلة الجسم قبل الحمل له تأثير سلبي على زيادة الوزن الموصى بها خلال فترة الحمل، مع زيادة المضاعفات للأمهات.

Objectives: To determine the effects of pre-pregnancy body mass index (BMI) and gestational weight gain on maternal and fetal complications, and to examine whether Turkish women achieve the recommended gestational weight gain. We also investigated the relationship between pregnancy weight gain and mode of delivery, with an examination of maternal anthropometry.

Methods: A retrospective cross-sectional study was conducted on a population of 986 pregnant women between November 2011 and November 2015 at Atatürk Education and Research Hospital, Ankara, Turkey. Maternal age, BMI, monthly weight gain during pregnancy, infant birth weight, gender, and maternal and fetal adverse outcomes were evaluated.

Results: The frequency of maternal complications was positively associated with elevated pre-pregnancy BMI ($p<0.05$), and weight gain during pregnancy was associated with parity and increased infant birth weight ($p<0.05$). However, no correlations were observed between mean pregnancy weight gain and maternal complications ($p>0.05$). The percentage of women who gained the Institute of Medicine (IOM)-recommended amount of weight was the highest in the underweight BMI group (54.1%) and the lowest in the obese BMI group (24.3%). Pregnancy weight gain exceeded IOM recommendations in the overweight (56.3%) and obese (52.5%) groups.

Conclusions: While maternal weight gain during pregnancy affects neonatal body weight, higher pre-pregnancy BMI has an adverse effect on recommended weight gain during pregnancy, with increased maternal complications.

Saudi Med J 2017; Vol. 38 (5): 503-508
doi: 10.15537/smj.2017.5.19378

From the Department of Gynecology and Obstetrics (Akgun, Keskin), Atatürk Education and Research Hospital, the Department of Nutrition and Dietetics, (Pekcan), Hasan Kalyoncu University, Gaziantep, and the Department of Gynecology and Obstetrics (Avsar), Yıldırım Beyazıt University, Ankara, Turkey.

Received 28th November 2016. Accepted 7th February 2017.

Address correspondence and reprint request to: Dr. Nilufer Akgun, Department of Gynecology and Obstetrics, Atatürk Education and Research Hospital, Ankara, Turkey.
E-mail: niluferakgun80@hotmail.com
ORCID ID: orcid.org/0000-0003-0414-9470

Nutrient intake and weight gain during pregnancy are the 2 main factors affecting maternal and infant outcomes.[1] The main factors that affect pregnancy weight gain are maternal pre-gestational body weight, height, ethnicity, age, parity (number of births), smoking, socioeconomic status, and daily energy intake.[1] The degree of weight gain during pregnancy can affect maternal mortality, complications during pregnancy, labor, and mode of delivery.[2] Moreover, excessive weight gain during pregnancy has been associated with breastfeeding difficulties during the postpartum period.[3] Weight gain during pregnancy also has an impact on gestational age-matched healthy development of the fetus and on birth weight.[4] Obesity has been increasing worldwide in recent years, with a prevalence of 23.9% in Turkey.[5] Elevated pre-pregnancy body mass index (BMI) in pregnant women is associated with gestational diabetes, hypertensive disorders, thromboembolic complications, preterm delivery, macrosomia, delivery complications, and increased rates of cesarean delivery.[6] The aims of this study were (i) to determine the relationship between body weight gained during pregnancy and type of birth (vaginal delivery versus cesarean section), maternal and prenatal diseases, and maternal complications, and (ii) to examine the effects of maternal anthropometry on the offspring's body weight.

Methods. For this retrospective cross-sectional study, we used historical data to select 1,252 pregnant women who were followed at a tertiary obstetrics center (Atatürk Education and Research Hospital) from November 2011 to November 2015 and who gave birth during a certain period. The study protocol conformed with the principles of the Declaration of Helsinki, and approval was obtained from the Institutional Review Board. The exclusion criteria were inadequate medical history (n=22), a history of genetic disorders (n=2), unknown pre-pregnancy BMI (n=104), pre-pregnancy morbid obesity (BMI >40 kg/m^2) (n=11), multiple pregnancy (n=19), and pre-gestational systemic disorders (diabetes, thyroid function disorders, cardiac disease, autoimmune disorders) or medications (antiepileptics or antidepressants) (n=108). After applying these exclusion criteria, 986 subjects remained in the study. Maternal age, number of pregnancies, parity, gestational age, pre-pregnancy body weight and height, BMI, final prenatal body weight, monthly pregnancy weight gain, occupation, smoking habits, infant birth weight and gender, and maternal and fetal adverse outcomes were recorded for each subject. The primary predictor variables were pre-pregnancy BMI and gestational weight gain. Pre-pregnancy weight (kg) and height (cm) were used to calculate BMI (kg/m^2), which was used as either a continuous or a categorical variable. The BMI cutoff values used to classify pre-pregnancy weight were those recommended by the Institute of Medicine (IOM)[1] as follows: underweight (<19.8 kg/m^2), normal weight (19.8-26.0 kg/m^2), overweight (26.1-29.0 kg/m^2), and obese (>29.0 kg/m^2).

Data were analyzed using SPSS for Windows (version 11.5, Illinois, USA). Descriptive statistics for continuous variables are expressed as mean ± standard deviation (SD), and categorical variables are expressed as the number of cases or percentage (%). Student's t-test was used to compare differences between 2 independent groups, and one-way analysis of variance followed by Tukey's honest significant difference test were used to compare differences among more than 2 groups. Differences among categorical variables were analyzed with Pearson's Chi-square test. The significance of correlations between continuous variables was analyzed with Spearman's correlation test, with $p \leq 0.05$ considered statistically significant.

Results. The mean age of the subjects was 26.2±4.8 years (range: 16-43 years). Most of the women (82.2%) were 19-30 years old. Of the 986 participants, 81 (8%) had a history of smoking during pregnancy, 802 (81.3%) were housewives, 477 (48.3%) were nulliparous, 384 (38.9%) were primiparous, and 125 (12.6%) were multiparous. The mean gestational age was 39.3±1.4 weeks. The mean pre-gestational BMI was 23.6±4.3 kg/m^2. The distribution of the IOM BMI categories for this cohort was: underweight: 170 (17.2%); normal weight: 593 (60.2%); overweight: 149 (15.1%); and obese: 74 (7.5%). A total of 636 infants (64.5%) were born vaginally. Among all of the newborns, 490 (49.6%) were male, and mean newborn weight was 3355±472 g. Birth weight was <2500 g in 2.6% of the newborns and >4000 g in 5.5%. Among

Disclosure. Authors have no conflict of interests, and the work was not supported or funded by any drug company.

the pre-gestational BMI groups, the mean pregnancy weight gain was 16.6±4.9 kg for the underweight group, 15.1±4.9 kg for the normal-weight group, 12.7±5.4 kg for the overweight group, and 9.8±6.2 kg for the obese group. As shown in **Figure 1**, the percentage of women who gained the IOM-recommended amount of weight[1] was highest in the underweight group (54.1%) and lowest in the obese group (24.3%). The percentage of women whose pregnancy weight gain exceeded IOM recommendations was highest among the overweight (56.3%) and obese (52.5%) groups. The amount of weight gain and BMI increase within the first trimester (6-14 weeks), second trimester (14-28 weeks), and third trimester (28-42 weeks) are shown in **Table 1**.

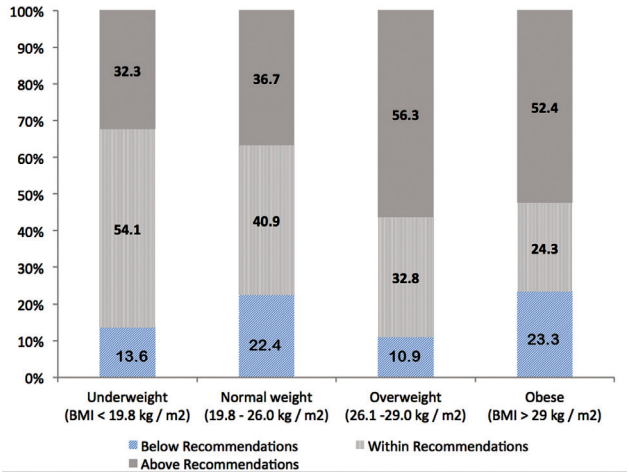

Figure 1 - Distribution of Turkish women in pregestational Institute of Medicine (IOM) body mass index categories with total pregnancy weight gain below, within, or above IOM recommendations.

Of all subjects enrolled in the study, 292 (29.6%) developed maternal/fetal complications. As shown in **Table 2**, these complications were most frequently observed in the obese BMI group (54.1%) and least in the underweight BMI group (23.6%). Among the specific complications, fetal distress (26.2%) was the most common, followed by gestational diabetes (19.6%), macrosomia (13.1%), intrauterine growth retardation (9%), abnormal amniotic fluid index abnormalities (oligohydroamnios [9%] and polyhydramnios [4%]), gestational hypertension (8.1%), preeclampsia (3.6%), postpartum hemorrhage (2.4), and preterm delivery (1.6%). In our cohort, pregnancy weight gain was

Table 1 - The maternal weight and weight gain (kg) and the mean body mass index (BMI) during pregnancy (kg/m²).

Variables	Age (years)			Total
	16-18 (n=21)	19-30 (n=811)	>30 (n=154)	
Prepregnancy				
Weight (mean±SD)	57.7 ± 10.0	60.8 ± 11.3	66.3 ± 12.5	61.6 ± 11.7
BMI (mean±SD)	22.2 ± 4.2	23.3 ± 4.1	25.7 ± 4.8	23.6 ± 4.3
6-14 weeks				
Weight (mean±SD)	58.5 ± 9.6	61.9 ± 11.2	67.5 ± 12.0	62.7 ± 11.5
Weight gain	0.8 ± 2.7	1.1 ± 2.8	1.2 ± 2.9	1.1 ± 2.8
BMI (mean±SD)	22.5 ± 3.9	23.7 ± 4.0	26.2 ± 4.6	24.1 ± 4.2
BMI rise	0.28 ± 1.0	0.43 ± 1.1	0.46 ± 1.1	0.43 ± 1.1
14-28 weeks				
Weight (mean±SD)	65.0 ± 8.4	68.2 ± 10.8	73.2 ± 11.7	68.9 ± 11.1
Weight gain	7.30 ± 5.6	7.50 ± 4.3	7.0 ± 4.1	7.4 ± 4.3
BMI (mean±SD)	25.1 ± 3.7	26.1 ± 3.9	28.4 ± 4.5	26.5 ± 4.0
BMI rise	2.8 ± 2.3	2.9 ± 1.6	2.7 ± 1.6	2.8 ± 1.7
28-42 weeks				
Weight (mean±SD)	68.6 ± 9.6	73.1 ± 10.8	76.8 ± 11.7	73.6 ± 11.0
Weight gain	10.9 ± 4.3	12.3 ± 4.9	10.5 ± 4.9	12.0 ± 4.9
BMI (mean±SD)	26.4 ± 3.8	28.0 ± 3.9	29.8 ± 4.4	28.2 ± 4.0
BMI rise	4.2 ± 1.6	4.7 ± 1.9	4.1 ± 1.9	4.6 ± 1.9

Table 2 - Maternal/fetal outcomes among pregestational IOM BMI categories

Variables	BMI <19.8 kg/m^2	BMI ≥19.8-26.0 kg/m^2	BMI ≥26.0-29.9 kg/m^2	BMI ≥30.0 kg/m^2	*P*-value
Maternal complications					
No	132 (76.4)	430 (72.0)	98 (65.7)	34 (45.9)	<0.01
Yes	38 (23.6)	163 (28.0)	51 (34.2)	40 (54.1)	
Delivery					
Vaginal delivery	133 (73.0)	364 (64.8)	99 (60.7)	40 (48.7)	0.01
Cesarean delivery	47 (27.0)	197 (35.2)	64 (39.3)	42 (51.3)	
Infant birth weight (g)	3203±356	3347±455	3432±484	3530±606	<0.01

Data for maternal complications and delivery are reported as n (%). Infant birth weights are reported as the mean ± SD.

positively associated with parity and infant birth weight (p<0.05) but was not associated with smoking, infant gender, birth type, or frequency of maternal complications (p>0.05). Although infant birth weight was higher (p<0.01) in the pre-pregnancy-obese group, most of these participants gained more weight during pregnancy than recommended. In addition, elevated pre-gestational BMI was significantly associated with an increased maternal complication rate and risk of cesarean delivery (**Table 2**).

Discussion. Obesity has become a major problem for Turkish women and is due to changes in lifestyle, industrialization, and migration from rural to urban areas.[7] Our study was conducted in the Turkish capital of Ankara, located in the central region of the country. As Ankara is home to migrants from all parts of Turkey, the cohort of pregnant women at our hospital provided a good representation of the Turkish pregnant-female population without significant bias. The relationship between weight gain during pregnancy and sociodemographic characteristics, such as pre-gestational BMI, age, parity, education level, maternal characteristics, and ethnic group has been discussed in the literature.[8-10] Maternal anthropometric properties differ among various populations,[11-14] and the cutoff values for these features vary among developed and developing countries.[15,16] For instance, studies in Vietnam, one of the least-developed Asian countries, have shown that the incidence of small-for-gestational-age (SGA) infants was higher among women with underweight pre-gestational BMIs, compared to similar women in developed countries.[14,17] A global maternal anthropometry study that considered births found that weight gain was significantly associated with birth weight and intrauterine growth.[11] Moreover, mothers with pre-gestational weights of <40 kg were 3 times as likely to have SGA babies than those with pre-gestational weights of ≥40 kg.[18] Another study in rural India showed that pregnant women with weights of <45 kg were at higher risk of giving birth to low-weight newborns, compared to women with weights of >45 kg.[19] Several other studies have found a similar relationship between low maternal BMI and risk of a low-weight newborn.[20] Only 2% of pregnant women in the United States have a BMI of <18.5 kg/m^2, while more than 50% have a BMI of >25 kg/m^2.[12] These observed anthropometric variations among pregnant women in various countries have prompted the need for studies to determine the optimal range of pre-gestational BMI and pregnancy weight gain for country-specific populations. Our study showed that while pre-pregnancy BMI was 23.6±4.3 kg/m^2, the total mean BMI increased to 28.2±4.0 kg/m^2 by the end of the pregnancy.

The gestational weight gain guidelines established by the IOM in 1990[1] recommend a pregnancy weight gain of 12.5-18 kg for underweight women, 11.5-16 kg for normal-weight women, 7.0-11.5 kg for overweight women, and <7 kg for obese women.[6] However, based on published studies, it has been suggested that these weight-gain goals would be difficult to achieve.[21] In our cohort, the mean weight gain in most of the subjects with pre-gestational underweight and normal BMI fell within their recommended ranges of pregnancy weight gain.[9] In contrast, most subjects with pre-gestational overweight and obese BMI levels experienced a mean weight gain that exceeded the recommended range for the respective groups. According to the World Health Organization, the healthiest level of pregnancy weight

gain occurs in women with a pre-gestational BMI of 20-24 kg/m².[21] In a study of a large sample of 8,542 pregnant women with normal BMIs, 32.6% had a pregnancy weight gain within the IOM recommended range, 18.7% gained less than the recommended range, and 48.7% gained in excess of the recommended range.[22] A Canadian study revealed that 55% of women with pre-gestational BMIs of >27 kg/m² had a pregnancy weight gain greater than the recommended range.[10] Similarly, more than half of the overweight and obese women in our cohort had a pregnancy weight gain that exceeded the IOM recommendations. Gestational obesity can lead to various prenatal and perinatal complications, including gestational diabetes, preeclampsia, induction failure and episiotomy complications, cephalopelvic disproportion and obstructed labor, preterm labor, increased frequency of cesarean delivery, and macrosomia.[23] In our cohort, the greatest proportion of subjects experiencing maternal/fetal complications was in the obese BMI group. This indicates that Turkish pregnant women with higher pre-pregnancy BMIs have more adverse obstetrical outcomes. Our findings agree with a study by Lim,[24] who reported that Swedish obese mothers with high pregnancy weight gain had increased risk of preeclampsia, cesarean section, and large-for-gestational-age babies. Excessive weight gain has the greatest impact on maternal/fetal outcomes; however, it is regarded as a reversible risk factor.

Study limitations. The deriving maternal body mass and BMI values solely from retrospective records, and being unable to track these records by the same project team in every trimester. Moreover, further research is needed on bigger populations and for longer periods to examine all aspects of these findings.

In conclusion, appropriate weight gain during pregnancy is an important factor in preventing maternal/fetal complications in the Turkish population. An appropriate pre-gestational BMI may be more important than pregnancy weight gain in preventing such complications. Prevention and treatment strategies to optimize pre-gestational BMI and pregnancy weight gain will likely be useful for promoting maternal/fetal health in Turkey.

References

1. Ferraro ZM, Barrowman N, Prud Homme D, Walker M, Wen SW, Rodger M, et al. Excessive gestational weight gain predicts large for gestational age neonates independent of maternal body mass index. ***J Matern Fetal Neonatal Med*** 2012; 25: 538-542.
2. Yu Z, Han S, Zhu J, Sun X, Ji C, Guo X. et al. Pre-pregnancy body mass index in relation to infant birth weight and offspring overweight/obesity: a systematic review and meta-analysis. ***PloS One*** 2013; 8: e61627.
3. Matias SL, Dewey KG, Quesenberry CP, Gunderson E P. Maternal prepregnancy obesity and insulin treatment during pregnancy are independently associated with delayed lactogenesis in women with recent gestational diabetes mellitus. ***Am J Clin Nutr*** 2014; 99: 115-121.
4. Gaskins AJ, Rich Edwards JW, Colaci DS, Afeiche MC, Toth TL, Gillman MW et al. Prepregnancy and early adulthood body mass index and adult weight change in relation to fetal loss. ***Obstet Gynecol*** 2014; 124: 662-669.
5. Gaskins AJ, Rich-Edwards JW, Colaci DS, Afeiche MC, Toth TL, Gillman MW, et al. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9·1 million participants. ***Lancet*** 2011; 377: 557-567.
6. Dodd JM, Turnbull D, McPhee AJ, Deussen AR, Grivell RM, Yelland LN, et al. Antenatal lifestyle advice for women who are overweight or obese: LIMIT randomised trial. ***BMJ*** 2014; 348: 1285.
7. Sozmen K, Unal B, Capewell S, Critchley J, O Flaherty M. Estimating diabetes prevalence in Turkey in 2025 with and without possible interventions to reduce obesity and smoking prevalence, using a modelling approach. ***Int J Public Health*** 2015; 60 Suppl 1: S13-S21.
8. Ota E, Haruna M, Suzuki M, Anh DD, Tho le H, Tam NT, et al. Maternal body mass index and gestational weight gain and their association with perinatal outcomes in Viet Nam. ***Bull World Health Organ*** 2011; 89: 127-136.
9. Ferraro ZM, Barrowman N, Prud'homme D, Walker M, Wen SW, Rodger M, et al. Excessive gestational weight gain predicts large for gestational age neonates independent of maternal body mass index. ***J Matern Fetal Neonatal Med*** 2012; 25: 538-542.
10. Gaillard R, Durmus B, Hofman A, Mackenbach JP, Steegers E A, Jaddoe VW. Risk factors and outcomes of maternal obesity and excessive weight gain during pregnancy. ***Obesity*** 2013; 21: 1046-1055.
11. Sletner L, Nakstad B, Yajnik CS, Morkrid K, Vangen S, Vardal MH. Ethnic differences in neonatal body composition in a multi-ethnic population and the impact of parental factors: a population-based cohort study. ***PloS One*** 2013; 8: e73058.
12. Neto F, Antonio H, Amorim MM, MeloAS, Lima MP, SenaA, et al. Correlation between maternal abdominal adiposity and anthropometric and metabolic profile during pregnancy. ***Obstetrics and Gynecology*** 2016; 127: 130S-131S.
13. Denison FC, Norwood P, Bhattacharya S, Duffy A, Mahmood T, Morris C, et al. Association between maternal body mass index during pregnancy, short-term morbidity, and increased health service costs: a population-based study. ***BJOG*** 2014; 121: 72-81.
14. Bodnar LM, Parks WT, Perkins K, Pugh SJ, Platt RW, Feghali M, et al. Maternal prepregnancy obesity and cause-specific stillbirth. ***Am J Clin Nutr*** 2015; 102: 858-864.

15. Befort CA, Nazir N, Perri MG. Prevalence of obesity among adults from rural and urban areas of the United States: findings from NHANES (2005-2008). ***J Rural Health*** 2012; 28: 392-397.
16. Johnson J, Clifton RG, Roberts JM, Myatt L, Hauth JC, Spong CY, et al. Pregnancy outcomes with weight gain above or below the 2009 Institute of Medicine guidelines. ***Obstet Gynecol*** 2013; 121: 969-975.
17. Langford A, Joshu C, Chang JJ, Myles T, Leet T. Does gestational weight gain affect the risk of adverse maternal and infant outcomes in overweight women? ***Matern Child Health J*** 2011; 15: 860-865.
18. Headen I, Mujahid MS, Cohen AK, Rehkopf DH, Abrams B. Racial/ethnic disparities in inadequate gestational weight gain differ by pre-pregnancy weight. ***Matern Child Health J*** 2015; 19: 1672-1686.
19. Uzogara SG. Underweight the less discussed type of unhealthy weight and its implications: A review. ***American Journal of Food Science and Nutrition Research*** 2016; 3: 126-142.
20. Potdar RD, Sahariah SA, Gandhi M, Kehoe SH, Brown N, Sane H, et al. Improving women's diet quality preconceptionally and during gestation: effects on birth weight and prevalence of low birth weight-a randomized controlled efficacy trial in India (Mumbai Maternal Nutrition Project). ***Am J Clin Nutr*** 2014; 100: 1257-1268.
21. Papathakis PC, Singh LN, Manary MJ. How maternal malnutrition affects linear growth and development in the offspring. ***Mol Cell Endocrinol*** 2016; 435: 40-47.
22. Kowal C, Kuk J, Tamim H. Characteristics of weight gain in pregnancy among Canadian women. ***Matern Child Health J*** 2012; 16: 668-676.
23. Yazdani S, Yosofniyapasha Y, Nasab BH, Mojaveri MH, Bouzari Z. Effect of maternal body mass index on pregnancy outcome and newborn weight. ***BMC Res Notes*** 2012; 5: 34.
24. Lim CC, Mahmood T, Obesity in pregnancy. ***Best Pract Res Clin Obstet Gynaecol*** 2015; 29: 309-319.

Clinical Practice Guidelines

Clinical Practice Guidelines must include a short abstract. There should be an Introduction section addressing the objective in producing the guideline, what the guideline is about and who will benefit from the guideline. It should describe the population, conditions, health care setting and clinical management/diagnostic test. Authors should adequately describe the methods used to collect and analyze evidence, recommendations and validation. If it is adapted, authors should include the source, how, and why it is adapted? The guidelines should include not more than 50 references, 2-4 illustrations/tables, and an algorithm.