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Use of Canscore for Clinical Assessment of Nutritional Status of Newborns: A Comparison with Anthropometric Criteria

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Abstract

Background: Fetal Malnutrition (FM) is caused by inadequate formation of fat, subcutaneous tissues and muscle mass in the fetus, which is associated with several morbidities. Thus, accurate and timely diagnosis of FM is crucial in newborns. In this study, we aimed to compare the nutritional status (Fetal Malnutrition) of a newborn in Ghaem Hospital, Mashhad University of Medical Sciences, Iran, based on CANSCORE with anthropometric criteria.

Methods: In this cross-sectional descriptive study, 367 neonates who were born from 2020 to 2021 in the maternity ward of Ghaem Hospital, Mashhad were evaluated in the first 24 to 48 hours of life. Demographic characteristics, anthropometric criteria and CANSCORE of neonates were recorded and analyzed using SPSS software (version 16). A p-value <0.05 was considered statistically significant.

Results: 367 neonates (54.8% females), with a mean gestational age of 38.7 ± 1.4 weeks, were studied. Mean anthropometric indices, including height, mid-arm circumference and head circumference were 50.05 ± 2.3 cm, 10.5 ± 1.1 cm, and 34.8 ± 1.5 cm, respectively. Average CANSCORE was 25.5 ± 1.9. The majority of the neonates were AGA (89.6%), while 6% were SGA. According to MAC/HC, BMI, and PI, 0%, 14.4% and 12.3% of newborns were malnourished, respectively. CANSCORE identified FM in 19.1% of neonates. A significant correlation between neonates' weight (SGA, AGA, LGA) and CANSCORE was detected (p<0.001). Bivariate analysis with Pearson's correlation showed a significant and positive relationship between all anthropometric indices and CANSCORE (p<0.05).

Conclusion: CANSCORE is an accurate clinical tool for identifying FM in term newborns.

Key Words: CANSCORE, Fetal Malnourishment, Malnourishment, Neonate.

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1- INTRODUCTION

Fetal malnutrition (FM) is a clinical state in newborns characterized by inadequate formation of fat, subcutaneous tissues, and muscle mass in the fetus during intrauterine growth (1, 2). FM, which may occur at any birth weight, manifests itself with diminished and subcutaneous tissues, and loosening of skin over various body sites such as arms, knees and legs. In severe cases, the neonate might look emaciated and have recognizable “old man” facies (3, 4). A number of known risk factors for FM include low socioeconomic status of mother, infections, maternal malnutrition, and maternal diseases such as diabetes mellitus, hypertension and preeclampsia (5-7). FM substantially increases the risk of neonatal morbidities, and many perinatal adverse events, including asphyxia, hypoglycemia and meconium aspiration, are primarily seen in malnourished newborns (4, 8-10). FM constitutes one of the main causes of child mortality, and together with Intrauterine Growth Restriction (IUGR), are the most important contributors to Disability-Adjusted Life Years (DALYs) in children less than 5 years old (9). Moreover, implications of FM extend well beyond the neonatal period, as studies have demonstrated that FM is associated with sudden infant death syndrome, learning difficulties, and mental retardation (11, 12).

Various indices can be employed to diagnose and quantitate malnourishment in newborns, including birth weight, Ponderal Index (PI), mid-arm circumference and mid arm-arm/head circumference ratio (13-16). However, such methods have their own limitations. For instance, although birth weight is commonly used to assess the condition of a newborn, body proportions may considerably differ between infants with similar weight; specifically, water content of the infant body gradually decreases from nearly 80% in neonates born at 28 weeks, to 65% in term newborns. In addition, different adverse events can occur in infants of the same birth weight, but with different gestational ages (17, 18). In response to these shortcomings, Metcoff developed the Clinical Assessment of Nutrition Score (CANSCORE) in order to better identify and differentiate FM (8). CANSCORE is a quick, easy-to-use clinical tool that does not require any sophisticated equipment and provides a reliable method for assessing the in-utero nutritional status of the neonate, since its parameters are independent of weight and can be used in all children being small (SGA), appropriate (AGA) or large (LGA) for gestational age (7, 19).

So far, the accuracy and utility of CANSCORE in identifying FM has been demonstrated by multiple studies from different countries. In a study on 637 Indian term newborns, 25% of the study population were SGA according to birth weight for gestational age, while 40% of them were suffering from FM according to CANSCORE (20). A study by Singhal et al. also reported that more than 8% of AGA babies suffered from FM, and CANSCORE was an effective tool for identifying these cases (21). In another study in Nigeria by Adebami et al., 12.1% of the term newborns were SGA, while CANSCORE identified 18.8% of them as FM (4). Similarly Kushwaba et al. had demonstrated an association between neonatal morbidity and FM, regardless of weight for gestational age (22). More recently, in their study on preterm neonates, Ayse et al. reported a prevalence of 54.8% for FM based on CANSCORE, whereas only 19.4% of newborns were SGA (6). Considering the paucity of reports that have evaluated FM and the efficacy of CANSCORE in identifying malnourished newborns in Iran, we hereby aimed to compare the nutritional status

(Fetal Malnutrition) of newborns in Ghaem Hospital, Mashhad University of Medical Sciences, based on CANSCORE with anthropometric criteria.

2- MATERIALS AND METHODS

2-1. Design and sampling

This cross-sectional descriptive study was conducted from 2020 to 2021 in the maternity ward of Ghaem Hospital, Mashhad University of Medical Sciences, Mashhad, Iran. Based on a study by Mehta et al. (20), considering $\alpha = 0.05$ and $\beta = 0.2$, a sample size of 367 people was calculated (d = 0.05 and p = 40%): N = z 2 p (1-p) / d 2 = 367.

2-1-1. Inclusion and exclusion criteria

After obtaining informed written consent from the mothers, a questionnaire containing demographic characteristics, anthropometric criteria and CANSCORE was prepared and filled. The exclusion criteria were as follows: congenital anomalies, gestational age <37 weeks at birth, unreliable gestational age, multiple pregnancies, need for NICU admission, and history of gestational diabetes in the mother.

2-2. Data collection

The following parameters were measured and recorded in all newborns in the first 24 to 48 hours of life:

• Birth weight: Naked birth weight measured with +/-10 gr accuracy using electronic scale.

• Height: Crown to heel measured with +/-0.1 cm accuracy using an infantometer.

• Occipital frontal circumference: Determined as the largest circumference of the skull using an inflexible strip with an accuracy of +/-0.1 cm.

• Mid-arm circumference: Measured in the left arm, halfway between the acromion tip and the olecranon appendage, using an inflexible band with an accuracy of +/-0.1 cm.

Using birth weight and based on Alexander nomogram and intrauterine growth charts, neonates were categorized as SGA (<2500 g), AGA (2500-4000 g), and LGA (>4000 g) (20). Other indices were calculated as follows:

• Ponderal index (PI): PI = weight (g) × 100 / length (cm) 3. Neonates with PI less than 2.2 g / cm3 were considered malnourished.

• Mid-arm / head circumference ratio (MAC / HC): Based on a study by Mahalingam et al., A cut off point of 0.27 was used to determine malnourishment (23).

• Body mass index (BMI): BMI = weight (kg) / height (m) 2. A cut off point of 11.20 kg / m2 was used to identify malnutrition (21).

Finally, CANSCORE as described by Metcoff was used to assess FM in study subjects. CONSCORE consists of nine clinical parameters: hair, cheeks, neck, arms, chest, abdomen, back, buttocks, and legs. A maximum of score 4 is given to parameters without any signs of malnourishment, and a minimum score of 1 is given in case of severe malnourishment, hence a score range of 9 to 36, in babies with scores below 25 was considered as having FM (8).

All indices and criteria were assessed by a trained medical student and supervised by a neonatal subspecialist.

2-3. Data analysis

The data was analyzed using statistical software SPSS (Version 16, IBM, Portsmouth, Hampshire, UK). $P < 0.05$ was considered statistically significant.

3- RESULTS

A total of 367 neonates, 54.8% females, with a mean gestational age of 38.7 ± 1.4 weeks, were studied. Mean body mass index was 12.7 ± 1.5 and average CANSCORE was 25.5 ± 1.9 (**Table 1**).

The majority of the subjects were AGA (89.6%), while 6% were SGA. According to MAC/HC, BMI, and PI, 0%, 14.4% and 12.3% of newborns were malnourished, respectively. Finally, CANSCORE identified FM in 19.1% of neonates (**Table 2**).

A significant correlation between neonates' weight (SGA, AGA, LGA) and CANSCORE was detected (p<0.001, **Table 3**).

As shown in **Table 4** and **Fig. 1**, bivariate analysis with Pearson's correlation showed a significant and positive relationship between all anthropometric indices and CANSCORE (p<0.05).

Table-1: Quantitative characteristics of the participants

Variable	Mean	Std. Deviation	Minimum	Maximum
GA	38.7038	1.45235	37.00	42.00
Weight	3185.9264	442.01722	2070.00	4370.00
Head	34.8373	1.50389	30.00	39.50
Mid-arm	10.5902	1.18827	8.00	14.00
Height	50.0545	2.31349	37.00	58.00
CANSCORE	25.5504	1.91971	18.00	31.00
MAC/HC	.3039	.03036	.22	.40
PI	2.5477	.36684	1.55	5.67
BMI	12.7108	1.53160	8.06	20.96

Table-2: Qualitative characteristics of the participants

Variable		Frequency(Percent)
Gender	Male	166(45.2)
	Female	201(54.8)
Weight	SGA	22(6)
	AGA	329(89.6)
	LGA	16(4.4)
CANSCORE	<25	70(19.1)
	>=25	297(80.9)
MAC/HC	<27	0(0)
	>=27	367(100)
BMI	<11.2	53(14.4)
	>11.2	314(85.6)
PI	<=2.2	45(12.3)
	>2.2	322(87.7)

Table-3: Relationship between CANSCORE and weight among the participants

Variable		Weight Frequency(Percent)				P value
		SGA	AGA	LGA	Total	
CANSCORE	<25	19(86.4)	51(15.5)	0(0)	70(19.1)	<0.001
	>=25	3(13.6)	278(84.5)	16(100)	297(80.9)	

Table-4: Results of bivariate analysis

Variable		Canscore	PI	BMI	GA	Weight	Head	Arm	Height
Canscore	Pearson Correlation	1	.282**	.515**	.290**	.737**	.439**	.707**	.435**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
PI	Pearson Correlation	.282**	1	.930**	.110*	.425**	.162**	.405**	-.496**
	Sig. (2-tailed)	.000		.000	.034	.000	.002	.000	.000
BMI	Pearson Correlation	.515**	.930**	1	.191**	.723**	.326**	.639**	-.166**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.001
GA	Pearson Correlation	.290**	.110*	.191**	1	.269**	.205**	.271**	.167**
	Sig. (2-tailed)	.000	.034	.000		.000	.000	.000	.001
Weight	Pearson Correlation	.737**	.425**	.723**	.269**	1	.514**	.824**	.551**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
Head	Pearson Correlation	.439**	.162**	.326**	.205**	.514**	1	.460**	.352**
	Sig. (2-tailed)	.000	.002	.000	.000	.000		.000	.000
Arm	Pearson Correlation	.707**	.405**	.639**	.271**	.824**	.460**	1	.400**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000
Height	Pearson Correlation	.435**	-.496**	-.166**	.167**	.551**	.352**	.400**	1
	Sig. (2-tailed)	.000	.000	.001	.001	.000	.000	.000	

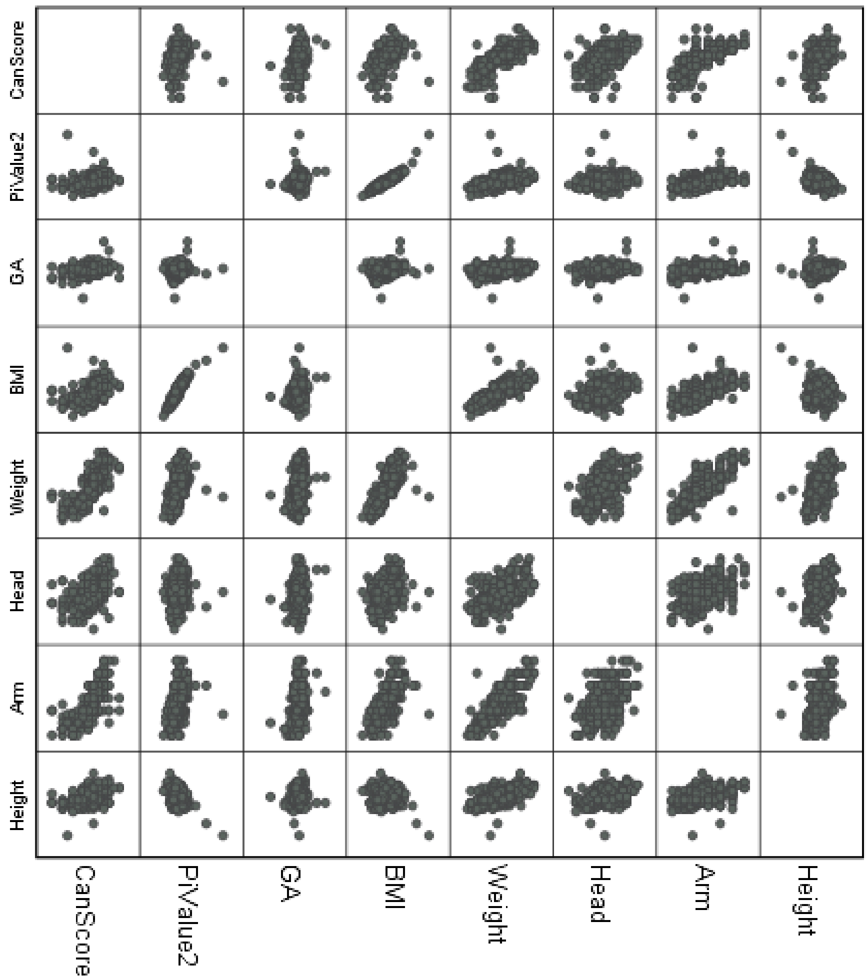

Fig. 1: Results of bivariate analysis

4- DISCUSSION

In the present study, 367 neonates (54.8% females) born in the maternity ward of Ghaem Hospital, Mashhad, Iran, were evaluated. Statistical analysis showed that most patients (80.9%) had a CANSCORE > 25. According to this index, 19.1% of patients were malnourished, while only 6% were SGA. In a study conducted by Ezenwa et al., on 140 preterm neonates (between 28 and 36 completed weeks of gestation), CANSCORE was 34.3%. But Ayse et al., reported a prevalence of 54.8% for FM based on CANSCORE, while only 19.4% of newborns were SGA (6). In our study, we only focused on term newborns, and our results showed that CANSCORE was a more sensitive tool for identifying malnourishment. Also One study in India showed that 25% of term newborns were SGA according to birth weight for gestational age, while 40% of them had FM according to CANSCORE (20); and Kushwaba et al. reached the same conclusions in their studies (4, 22).

Similarly, in a study by Kashyap et al., CANSCORE lower than 25 identified 72.60% of babies as well-nourished and 27.40% as malnourished. In this study a significant relationship between neonatal weight and CANSCORE was seen. Also in study by Ezenwa et al., BMI and PI identified FM in 40.0% and 30.0% of the neonates; and they concluded that BMI was more sensitive for detecting FM in preterm newborns (25).

Collectively, these results indicate that CANSCORE is an accurate and sensitive tool for detecting FM. Moreover, statistical analysis demonstrated a significant and positive correlation between all anthropometric indices and CANSCORE. But in a study by Adebami et al., in 2008, 18.8% of the study subjects had FM based on CANSCORE. The mean weight, mid-arm circumference, and PI of babies with FM were significantly lower than healthy newborns ($p<0.001$), while mean head circumference and height did not considerably differ between the two groups ($p>0.05$). However, intrauterine growth standard and PI alone missed 49.4% and 61.4% of FM cases (19). Another research by Singh et al., in India, concluded that FM occurs both in SGA and AGA newborns, but was much more frequent in SGA babies (29).

In line with these results, Sankhyan et al. stated that when CANSCORE was taken as standard, weight for gestation and MAC/HC had the highest sensitivity for detecting FM (92.5% & 90.5%, respectively) (16). Likewise, in their research, Lakkappa et al. and Sethi et al. demonstrated that CANSCORE had superior accuracy in detecting FM (27, 28).

Interestingly, few studies so far have investigated the shortcomings of CANSCORE. One prominent drawback is that the results of CANSCORE are subjective, and might vary from one observer to another (30). Nonetheless, this obstacle can be overcome by practice. In this study, in order to increase the accuracy, CANSCORE parameters were assessed by a trained medical student who was supervised by a neonatal specialist. It has also been noted that evaluating CANSCORE is more time consuming than measuring, for example, birth weight. However, as shown in our study, this might be justified by the superior predictive value and accuracy of CANSCORE in identifying FM. Finally, CANSCORE does not determine the severity of malnutrition, and the cut-off point of 25 has not been universally agreed upon (30).

5- CONCLUSION

The findings of the current study are consistent with the aforementioned reports. In our study, a significant and positive correlation between all anthropometric indices and CANSCORE was seen; CANSCORE was more accurate in identifying FM.

Thus, we recommend regular use of CANSCORE at birth for accurate identification of fetal malnourishment in order to take proactive measures to minimize morbidity and mortality associated with FM. However, in this study, we only evaluated term newborns. CANSCORE may also be useful in detecting FM in preterm neonates, but some modifications might be necessary. These modification(s) can be the basis for further studies. Moreover, conducting research aimed at finding other cut-off points for CANSCORE that are standardized for each community can be beneficial.

6- ACKNOWLEDGEMENTS

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7- FUNDING

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8- ETHICAL CONSIDERATIONS

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Mashhad University of Medical Sciences by the ethics code of IRMUMS.fm.REC.1395.1.9.

Informed Consent Statement: “Not applicable.”

9- CONFLICTS OF INTEREST

None.

10- AUTHORS' CONTRIBUTIONS

Visualization and Conceptualization :BI, NP; methodology: MR, BI; investigation and resources: MD,MR; writing—original draft preparation: MR, MD; software: MD, BI, MR; formal analysis and data curation: MR; writing, review and editing: NP, MD, MR; supervision: NP; project administration: BI, MR; funding acquisition: BI.

All authors have read and agreed upon the published version of the manuscript.

11- REFERENCES

1. Pitkin RM, Kaminetzky HA, Newton M, Pritchard JA. Maternal nutrition. Obstetrics & Gynecology. 1972; 40(6):773-85.

2. Scott KE, Usher R. Fetal malnutrition: its incidence, causes, and effects. American journal of obstetrics and gynecology. 1966; 94(7):951-63.

3. Neel N, Alvarez J. Risk factors of fetal malnutrition in a group of Guatemalan mothers and neonates. Boletin de la Oficina Sanitaria Panamericana Pan American Sanitary Bureau. 1991; 110(2):93-107.

4. Adebami O, Owa J, Oyedeji G, Oyelami O. Prevalence and problems of foetal malnutrition in term babies at Wesley Guild Hospital, South Western Nigeria. West African Journal of Medicine. 2007; 26(4):278-82.

5. Adebami OJ, Owa JA, Oyedeji GA, Oyelami OA, Omoniyi-Esan GO. Associations between placental and cord blood malaria infection and fetal malnutrition in an area of malaria holoendemicity. The American journal of tropical medicine and hygiene. 2007; 77(2):209-13.

6. Korkmaz A, Teksam O, Yurdakok M, Yigit S, Tekinalp G. Fetal malnutrition and its impacts on neonatal outcome in preterm infants. Turk J Pediatr. 2011; 53(3):261-8.

7. Owa J, Adebami J. Looking for the best indicator of fetal malnutrition: An overview. Internet J Nutr Wellness. 2007; 3:12-6.

8. Metcoff J. Clinical assessment of nutritional status at birth: Fetal malnutrition and SGA are not synonymous. Pediatric Clinics of North America. 1994; 41(5):875-91.

9. Black RE, Allen LH, Bhutta ZA, Caulfield LE, De Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. The lancet. 2008; 371(9608):243-60.

10. Deodhar J, Jarad R. Study of the prevalence of and high risk factors for fetal malnutrition in term newborns. Annals of tropical paediatrics. 1999; 19(3):273-7.

11. Hill R, Verniaud W, Deter R, Tennyson L, Rettig G, Zion T, et al. The Effect of Intrauterine Malnutrition on the Term Infant: A 14-year Progressive Study. Acta Pædiatrica. 1984; 73(4):482-7.

12. Henrichsen L, Skinhøj K, Andersen G. Delayed growth and reduced intelligence in 9–17 year old intrauterine growth retarded children compared with their monozygous co-twins. Acta Paediatrica. 1986; 75(1):31-5.

13. Eregie CO. Arm/head ratio in the nutritional evaluation of newborn infants: a report of an African population. Annals of tropical paediatrics. 1992; 12(2):195-202.

14. Sasanow SR, Georgieff MK, Pereira GR. Mid-arm circumference and mid-arm/head circumference ratios: standard curves for anthropometric assessment of neonatal nutritional status. The Journal of pediatrics. 1986; 109(2):311-5.

15. Roje D, Ivo B, Ivica T, Mirjana V, Vesna C, Aljosa B, et al. Gestational age-the most important factor of neonatal ponderal index. Yonsei medical journal. 2004; 45(2):273-80.

16. Sankhyan N, Sharma VK, Singh S. Detection of fetal malnutrition using "CAN score". The Indian Journal of Pediatrics. 2009; 76:903-6.

17. Bakketeig L. Current growth standards, definitions, diagnosis and classification of fetal growth retardation. European journal of clinical nutrition. 1998; 52(1):S1.

18. Frisancho AR, Compton A, Matos J. Ineffectiveness of body mass indices for the evaluation of neonate nutritional status. The Journal of pediatrics (USA). 1986.

19. Adebami OJ, Owa J. Comparison between CANSCORE and other anthropometric indicators in fetal malnutrition. The Indian Journal of Pediatrics. 2008; 75:439-42.

20. Mehta S, Tandon A, Dua T, Kumari S, Singh SK. Clinical assessment of nutritional status at birth. Indian pediatrics. 1998; 35:423-8.

21. Singhal V, Agal P, Kamath N. Detection of Fetal Malnutrition by CAN Score at Birth and its Comparison with other Methods of Determining Intrauterine Growth. 2012.

22. Kushwaha K, Singh Y, Bhatia V, Gupta Y. Clinical assessment of nutritional status (Cans) in term new borns and its relation to outcome in neonatal period. Journal of neonatology. 2004; 18(1):55-9.

23. Vedmedovska N, Rezeberga D, Teibe U, Melderis I, Donders GG. Placental pathology in fetal growth restriction. European journal of obstetrics, gynecology, and reproductive biology. 2011; 155(1):36-40.

24. Adebami OJ, Owa JA, Oyedeji GA, Oyelami OA. Prevalence and problems of foetal malnutrition in term babies at Wesley Guild Hospital, South Western Nigeria. West Afr J Med. 2007; 26(4):278-82.

25. Ezenwa B, Ezeaka V. Is canscore a good indicator of fetal malnutrition in preterm newborn? Alexandria Journal of Medicine. 2018; 54(1):57-61.

26. Kashyap L, Dwivedi R. Detection of fetal malnutrition by clinical assessment of nutritional status score (can score) at birth and its comparison with other methods of determining intrauterine growth. Pediatric Oncall Journal. 2006; 3(1):9-12.

27. Lakkappa L, Somasundara S. Assessment of fetal nutrition status at birth using the clinical assessment of nutritional status score. Indian Journal of Child Health. 2018; 5(12):713-6.

28. Sethi A, Gandhi DD, Patel SH, Presswala DK, Patel SB. CANSCORE-Important index for detection of fetal malnutrition at birth. National Journal of Medical Research. 2016; 6(03):226-9.

29. Singh S, Sood A. Assessment of Fetal Malnutrition and its proportion among AGA and SGA using CAN Score. J Medical Science AND clinical Res. 2018; 6(6):902-7.

30. Sifianou P. Approaching the diagnosis of growth-restricted neonates: a cohort study. BMC pregnancy and childbirth. 2010; 10(1):1-6.