ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

Placental thickness and its correlation to gestational age estimated by fetal biometry: A cross-sectional study

Ashwini Nagesh Naik[1], Sushilkumar Kale[2], Atul Tayade[3], Dhananjay Ghodke[4]

[1]Junior Resident, [2,4]Associate Professor, [3]Professor and Head, Department of Radiodiagnosis, MGIMS, Sewagram, Wardha, Maharashtra, India

Submission: 22-06-2022 Revision: 29-08-2022 Publication: 01-10-2022

ABSTRACT

Background: Accurate estimation of gestational age is important not only for appropriate antenatal care but also is crucial for undertaking various diagnostics tests such as chorionic villous sampling and amniocentesis. In certain conditions, where biometry cannot be entirely relied on for estimation of gestational age placental thickness (PT) that can be used for estimation of gestational age. **Aims and Objectives:** The aims of this study were as follows: (1) To analyze relationship between PT and gestational age as determined by fetal biometry in second and third trimester of pregnancy. (2) To find out cutoff PT value for differentiating between preterm and term gestations. **Materials and Methods:** This was a cross-sectional, in which 140 patients, in 2nd and 3rd trimester, were included on the basis of a predefined inclusion and exclusion criteria. PT was measured in mm along with their respective standard deviation. The correlation between PT and gestational age as determined by biometry. **Results:** The mean age of the studied cases was found to be 4.15 ± 3.5 years. At 12 weeks of gestation, the mean PT was 14.36 mm. There was a strong positive correlation between gestational age and PT in 2nd (r = 0.9943) and 3rd (r = 0.9973) trimesters. After 37 weeks of gestation, there was no significant correlation between PT and gestational age (P = 0.469). **Conclusion:** PT has a significant positive correlation with gestational age in 2nd and 3rd trimester of pregnancy (up to 37 weeks of gestation) and can be reliably used for determination of gestational age independent of fetal biometry.

Key words: Placental thickness; Ultrasound; Fetal biometry; Gestational age

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v13i10.46005

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Estimation of gestational age is an important part of evaluation of a pregnant woman. Accurate estimation of gestational age is important from the perspective of management of infant in immediate postnatal period.[1] The problems faced by small for gestational age (intrauterine growth restricted babies) are entirely different from preterm neonates, while the pathologies such as necrotizing enterocolitis, hyaline membrane disease, neonatal hyperbilirubinemia, and retinopathy of prematurity are more common in preterm neonates pathologies such as perinatal asphyxia, meconium aspiration, polycythemia, and hypoglycemia are seen more frequently in small for gestational age babies.[2] Precise estimation of gestational age will differentiate between small for gestational age preterm babies. Proper estimation of gestational age is not only important for the purpose of postnatal management of infants, but it is also essential for conducting various antenatal natal diagnostic tests such as amniocentesis, chorionic villous biopsy, and glucose tolerance test. Proper assignment of gestational age is of important also for the proper interpretation of various markers which are used as screening for various fetal abnormalities including the risk of aneuploidy (alfa fetoprotein, human chorionic gonadotropin, unconjugated estriol, and inhibin).[3] Moreover, estimation of gestational age is also in cases of mothers having Rh negative blood group, in whom

Address for Correspondence:
Ashwini Nagesh Naik, Junior Resident, Department of Radiodiagnosis, MGIMS, Sewagram, Wardha, Maharashtra, India.
Mobile: +91-8975654842. **E-mail:** ashn9719@gmail.com

administration of anti-D injection is done between 28 and 34 weeks of gestation. Estimation of proper gestational age is also crucial for the purpose of medical termination of pregnancy as the medical termination of pregnancy act prescribes where and who can perform medical termination of pregnancy solely on the basis of gestational age.[4]

Ultrasound is the investigation of choice for determination of fetal well-being as well as for the estimation of gestational age. Up to 12 weeks of gestation crown to rump, length is used for estimation of gestational age and between 12 and 16, various other parameters such as head circumference (HC), abdominal circumference (AC), and femur length (FL) are widely used in addition to biparietal diameter (BPD).[5] While fetal biometry is the standard way by which gestational age of the fetus is determined there are certain pathologies, in which fetal biometry cannot be wholly relied on for the estimation of gestational age. These conditions include pathologies such as trigonocephaly, brachycephaly, and other craniosynostosis (conditions affecting head shapes thereby making HC and BPD unreliable for gestational age estimation), diaphragmatic hernia, and anterior abdominal wall defects (affecting AC) and skeletal dysplasias (making FL unreliable).[6] In all these conditions, gestational age estimation must ideally be done independent of biometry to avoid erroneous estimation of gestational age. Placental thickness (PT) is one such parameter which can be used for the estimation of gestational age and which is entirely independent of fetal biometry.[7]

Imaging of placenta is an essential part of obstetric ultrasound. The placenta is usually imaged in terms of its location which is important in ruling out pathologies such as placenta previa, presence of pathologies such as retroplacental hematoma and abruptio placenta, as well as to rule out possibility of morbidly adherent placenta.[8] In addition to all these pathologies, placental imaging can also be used for estimation of gestational age. Many studies have concluded that the PT can be used not only for estimation of gestational age independent of fetal biometry but also it can be used for diagnosing pathologies such as intrauterine growth retardation, gestational diabetes, and Hb Barts disease.[9]

We undertook this cross-sectional study to evaluate whether PT can be used in the estimation of gestational age in healthy pregnant women.

Aims and objectives

The aims of this study were as follows:

1) To analyze relationship between PT and gestational age as determined by fetal biometry in second and third trimester of pregnancy.
2) To find out cutoff PT value for differentiating between preterm and term gestations.

MATERIALS AND METHODS

This was a prospective cross-sectional study, in which 140 patients, in 2nd and 3rd trimester of pregnancy, referred to radiology department from the department of obstetrics and gynecology of our institute were included on the basis of a predefined inclusion and exclusion criteria. Informed and written consent was obtained from all the participants of the study. The study was approved by the Institutional Ethical Committee. The study was approved by the Institutional Ethical Committee. Keeping power (1-β error) at 80% and confidence interval (1-α error) at 95%, the minimum sample size required in each group was 80 patients therefore, we included 140 (more than minimum required number of cases) patients in this study. The ultrasonography machine used for determination of fetal biometry as well as PT was Phillips affinity 70.

For the purpose of determination of fetal biometry as well as PT a convex probe (having 3.5 MHZ transducer) was used. Patients were scanned with partially filled bladder and in supine position. After applying the coupling jelly transducer was placed on skin surface of anterior abdominal wall. First gestational age of the fetus was determined on the basis of fetal biometric parameters such as BPD, HC, AC, and FL. Placenta was imaged and site of placenta was determined. The location as well as its distance from internal OS was noted down. The PT was determined in millimeter at the level of umbilical cord insertion. The care was taken to scan perpendicular to chorionic as well as basal plates. In cases where active contraction occurred during scanning, a repeat scan was done after sometimes when the contraction has ceased. The estimation of liquor was done using four quadrant method. The fetus was image to find out any anomalies. Previous scans if available was analyzed and interval growth was determined to rule out possibility of intrauterine growth restriction. PT was measured in mm along with their respective standard deviation (SD). Normally distributed data were presented in terms of means and SD. Pearson coefficient was used to determine the correlation between PT and gestational age as determined by biometry. The SSPS 21.0 software was used for statistical analysis and $P<0.05$ was taken as statistically significant.

Inclusion criteria

The following criteria were included in the study:

1) All pregnant women in the 2nd and 3rd trimester of pregnancy.
2) Those who gave written consent to be part of the study.

3) Women having singleton pregnancies.
4) Documented date of last menstrual period.

Exclusion criteria

The following criteria were excluded from the study:

1) Those who refused consent.
2) Multiple pregnancy.
3) Date of last menstrual period is not known.
4) Fetus with anomalies.
5) Maternal systemic illnesses including uncontrolled diabetes, hypertension or heart diseases.
6) Pregnancy induced hypertension, eclampsia.
7) Post term pregnancies (more than 42 weeks of gestation).

RESULTS

In this study, 140 women were included in the study. The analysis of age group of the studied cases showed that the most common age group was between 20 and 25 years (67.92%), followed by 26–30 years (35.85%) and <20 years (20.75%). The mean age of the studied cases was found to be 4.15±3.5 years (Figure 1).

The analysis of the patients on the basis of mean age of the studied cases showed that most of the patients were between 25 and 30 weeks of gestation (45.71%), followed by 31 and 37 weeks of gestation (32.86%) and 13 and 24 weeks (14.29%). Relatively, a smaller number of patients presented after 37 weeks of gestation (7.14%). Most common location of placenta was anterior (30%), followed by posterior (20.71%), fundoposterior (19.29%), and fundoanterior (18.57%). In 32 (22.86%) cases, placenta was found to be low lying (Table 1).

The analysis of mean PT at various weeks of gestations starting from 12 weeks of gestation showed that at 12 weeks of gestation, the mean PT was 14.36 mm. This thickness went on gradually increasing until 39 weeks of gestation following which there was a slight reduction in PT until 42 weeks of gestation. At 37 weeks of gestation, the mean PT was found to be 35.98 mm and this could be used for differentiating between term and preterm pregnancies (Figure 2).

The mean placenta thickness between 12 and 24 weeks was found to be 18.82±3.24 cms, whereas PT was 31.10±3.49 cms between 24 weeks to 37 weeks. Between 37 and 42 weeks, PT was found to be 36.27±0.30 cms. There was a gradual increase in mean PT from 12 to 37 weeks, after which the PT did not have a positive correlation with gestational age (Table 2).

Pearson's analysis was done to find out correlation between the gestational age as obtained by fetal biometry and PT at various weeks of gestations. It was found that in the second trimester (12–24 weeks), there was a strong positive correlation between gestational age and PT (r=0.9943). The positive correlation between gestational age and PT in the second trimester (12–24 weeks) was found to be statistically highly significant (P<0.0001). Similarly, in the third trimester also (25–37 weeks), there was a strong positive correlation between gestational age and PT (r=0.9973). The positive correlation between gestational age and PT in the third trimester (25–37 weeks) was found to be statistically highly significant (P<0.0001). However, there was a weak negative correlation between gestational age and PT between 37 and 42 weeks of gestation. This negative correlation was weak and statistically not significant (P=0.469) (Table 3).

DISCUSSION

Accurate estimation of gestational age is important for various reasons that include differentiating preterm babies

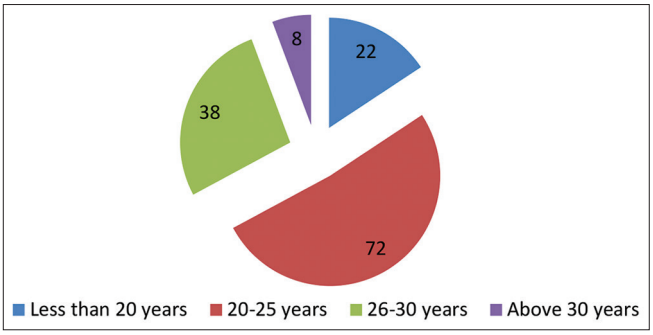

Figure 1: Age distribution of the studied cases

Table 1: Gestational age and placental location in studied cases

Gestational age and placental location	No. of cases	Percentage
Gestational age		
13–24 weeks	20	14.29
25–30 weeks	64	45.71
31–37 weeks	46	32.86
Above 37 weeks	10	7.14
Total	140	100
Placental location		
Anterior	42	30.00
Posterior	29	20.71
Fundal anterior	26	18.57
Fundal posterior	27	19.29
Fundal	12	8.57
Lateral	4	2.86
Total	140	100
Low lying or placenta previa		
Yes	32	22.86
No	108	77.14
Total	140	100

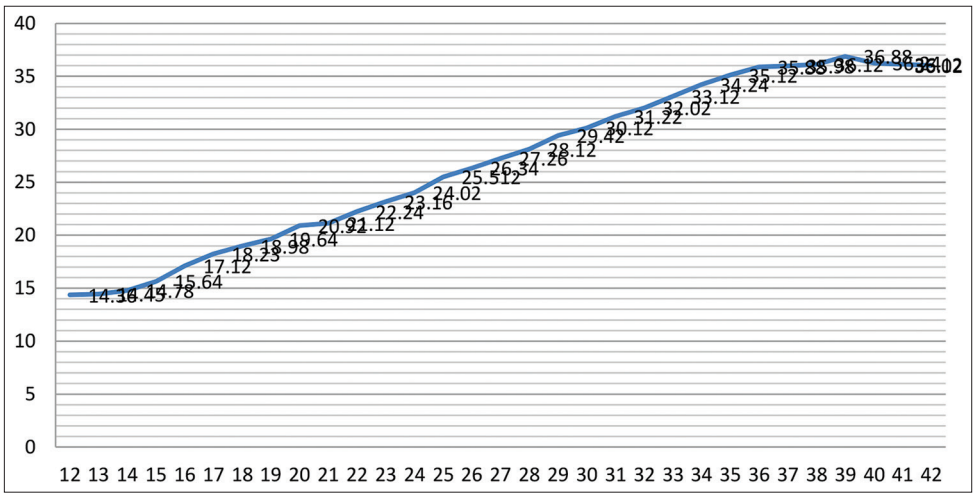

Figure 2: Mean placental thickness at various weeks of gestation

Table 2: Mean PT at different weeks of gestation

Gestational age	Mean PT	Standard deviation
12–24 weeks	18.82 cms	3.24 cms
25–37 weeks	31.10 cms	3.49 cms
37–42 weeks	36.27 cms	0.30 cms

PT: Placental thickness

from small for gestational age babies, for undertaking various diagnostic tests including chorionic villous sampling, amniocentesis, and triple or quadruple marker tests.[10] Moreover, accurate estimation of gestational age is also important for undertaking medical termination of pregnancy as it is the gestational age which decides who and where such medical termination can take place.[11] The most common method of estimation of gestational age is by fetal biometry by ultrasound examination which is easy and reliable method that does not involve any ionizing radiation.[5] However, there are instances, where fetal biometry cannot be fully relied upon. These conditions include pathologies affecting biometric parameters such as craniosynostosis, diaphragmatic hernia, anterior abdominal wall defects, and skeletal dysplasias.[12] In all these instances, there is a need of estimation of gestational age independent of fetal biometry. PT can be used for estimation of gestational age independent of fetal biometry. Various studies have shown that there is a positive correlation between increasing gestational age and PT.[13]

Karthikeyan et al., conducted a study to analyze the relationship between PT and the fetal growth parameters in normal singleton pregnancies. The authors included 211 pregnant women in this cross-sectional prospective study. The pregnancies were between 11 and 40 weeks and they were not complicated by either maternal or fetal diseases. The BPD, the AC, the HC, the FL, and the PT were measured by USG using a 3.5 MHz transducer. The maximum mean PT in the 1st, 2nd, and 3rd and the combined trimesters were 16.5 mm, 23.78 mm, 35.81 mm, and 28.49 mm, respectively. The correlation between PT and the other fetal parameters was investigated by Pearson's correlation analysis. The values were expressed as mean±SD. The statistical tests were two-tailed, with $P<0.01$, which indicated the statistical significance. There was a strong positive correlation between PT and GA, with the correlation coefficient values for the 1st, 2nd, and 3rd trimesters being $r=0.609$, $r=0.812$, and $r=0.814$, respectively. There was a significant positive correlation between PT and BPD, AC, FL, ABC, HC, and FW also. On the basis of these findings, the authors concluded that PT can be used as a predictor of the GA.[14] Similar findings were also reported by the authors such as Agwuna et al.,[15] and Mathai et al.[16]

Humadi et al., conducted a study to determine the validity of the PT for calculating the gestational age during the third trimester. For this purpose, 90 women with low-risk pregnancy and gestational age between 34 and 37 completed weeks were recruited from the antenatal clinic. The fetal gestational age was estimated by the accurate date of the last menstrual period and early ultrasound at 11–14 weeks of gestation. PT was determined at the umbilical cord implantation site. The association between PT and gestational age was established. The study found that PT in millimeters had a linear relationship and a statistically significant positive correlation with gestational age (in weeks) in the third trimester. A cutoff PT more than 36.3 mm can be used to differentiate between term and preterm pregnancy. On the basis of these findings, the authors concluded that PT can be used as a parameter for accurate estimation of gestational age during third trimester of pregnancy.[17] Similar findings were also reported by the authors such as Nagpal et al.[18]

Table 3: Correlation of gestational age and PT

Gestational age	Gestational age by fetal biometry (in weeks)	Mean PT (in mm)	Pearson coefficient (r value)	P value
Gestational age from 12 to 24 weeks	12	14.36	0.9943 (Strong positive correlation between 2 variables)	<0.00001 Highly significant
	13	14.45		
	14	14.78		
	15	15.64		
	16	17.12		
	17	18.23		
	18	18.98		
	19	19.64		
	20	20.92		
	21	21.12		
	22	22.24		
	23	23.16		
	24	24.02		
Gestational age from 25 to 37 weeks	25	25.51	0.9973 (Strong positive correlation between 2 variables)	<0.00001 Highly significant
	26	26.34		
	27	27.26		
	28	28.12		
	29	29.42		
	30	30.12		
	31	31.22		
	32	32.02		
	33	33.12		
	34	34.24		
	35	35.12		
	36	35.88		
	37	35.98		
Gestational age from 38 to 42 weeks	38	36.12	−0.438 (Weak negative correlation)	0.469 Not significant
	39	36.88		
	40	36.24		
	41	36.12		
	42	36.02		

PT: Placental thickness

In our study, the mean PT at term (37 weeks) was found to be 35.98 cms. The cutoff level of 37.98, therefore, could be used in differentiating between preterm and term gestations. Balakrishnan et al., undertook a study to evaluate the PT as a sonographic parameter for estimation of gestational age and to identify the differences in ultrasonographic PT with advancing gestational age based on implantation site. For this purpose, the authors included singleton pregnancies of more than 11 weeks of gestation with no fetal anomalies and with no associated medical or obstetrical complications were included in the study. In this study, the cutoff level of PT which differentiated between term and preterm gestation was 36.5±1.4 mm.[19] The findings of this study in terms of cutoff level of PT in term pregnancies (37 weeks of gestation) were found to be similar to our study.

Limitations of the study

This was a cross-sectional study and a single reading of PT was taken in each patient. Same patient was not followed up for estimation of PT at different stages of pregnancy. Various factors known to affect PT such as maternal height and weight were not taken into consideration.

CONCLUSION

PT is found to have a strong positive correlation with gestational age as determined by fetal biometry, and hence, it can be used for estimation of gestational age independently of fetal biometry. This becomes important in cases where fetal biometry cannot be entirely relied on for estimation of gestational age such as in cases of fetus having craniosynostosis, diaphragmatic hernia, anterior abdominal wall defects, and skeletal dysplasia.

ACKNOWLEDGMENT

The authors would like to acknowledge all the faculty and residents of Department of Radiodiagnosis, MGIMS, Sewagram, Wardha for extending their valuable support in undertaking this study.

REFERENCES

1. Butt K, Lim K, and Diagnostic Imaging Committee. Determination of gestational age by ultrasound. J Obstet Gynaecol Can. 2014;36(2):171-181.

https://doi.org/10.1016/S1701-2163(15)30664-2

2. Muhihi A, Sudfeld CR, Smith ER, Noor RA, Mshamu S, Briegleb C, et al. Risk factors for small-for-gestational-age and preterm births among 19,269 Tanzanian newborns. BMC Pregnancy Childbirth. 2016;16:110.
   https://doi.org/10.1186/s12884-016-0900-5
3. Dugoff L, and Society for Maternal-Fetal Medicine. First- and second-trimester maternal serum markers for aneuploidy and adverse obstetric outcomes. Obstet Gynecol. 2010;115(5):1052-1061.
   https://doi.org/10.1097/AOG.0b013e3181da93da
4. Upadhyay UD, Weitz TA, Jones RK, Barar RE and Foster DG. Denial of abortion because of provider gestational age limits in the United States. Am J Public Health. 2014;104(9):1687-1694.
   https://doi.org/10.2105/AJPH.2013.301378
5. Skupski DW, Owen J, Kim S, Fuchs KM, Albert PS, Grantz KL, et al. Estimating gestational age from ultrasound fetal biometrics. Obstet Gynecol. 2017;130(2):433-441.
   https://doi.org/10.1097/AOG.0000000000002137
6. Goncalves L and Jeanty P. Fetal biometry of skeletal dysplasias: A multicentric study. J Ultrasound Med. 1994;13(12):977-85.
   https://doi.org/10.7863/jum.1994.13.12.977
7. Azagidi AS, Ibitoye BO, Makinde ON, Idowu BM and Aderibigbe AS. Fetal gestational age determination using ultrasound placental thickness. J Med Ultrasound. 2019;28(1):17-23.
   https://doi:10.4103/JMU.JMU_127_18
8. Nguyen D, Nguyen C, Yacobozzi M, Bsat F and Rakita D. Imaging of the placenta with pathologic correlation. Semin Ultrasound CT MR. 2012;33(1):65-77.
   https://doi.org/10.1053/j.sult.2011.10.003
9. Sun X, Shen J and Wang L. Insights into the role of placenta thickness as a predictive marker of perinatal outcome. J Int Med Res. 2021;49(2):300060521990969.
   https://doi.org/10.1177/0300060521990969
10. Aksoy S. Antenatal screening and its possible meaning from unborn baby's perspective. BMC Med Ethics. 2001;2:E3.
    https://doi.org/10.1186/1472-6939-2-3
11. March MI, Warsof SL and Chauhan SP. Fetal biometry: Relevance in obstetrical practice. Clin Obstet Gynecol. 2012;55(1):281-7.
    https://doi.org/10.1097/GRF.0b013e3182446e9b
12. Prefumo F and Izzi C. Fetal abdominal wall defects. Best Pract Res Clin Obstet Gynaecol. 2014;28(3):391-402.
    https://doi.org/10.1016/j.bpobgyn.2013.10.003
13. Njeze NR, Ogbochukwu JO and Chinawa JM. Correlation of ultrasound placental diameter and thickness with gestational age. Pak J Med Sci. 2020;36(5):1058-1062.
    https://doi.org/10.12669/pjms.36.5.1938
14. Karthikeyan T, Subramaniam RK, Johnson W and Prabhu K. Placental thickness and its correlation to gestational age and foetal growth parameters- a cross sectional ultrasonographic study. J Clin Diagn Res. 2012;6(10):1732-5.
    https://doi.org/10.7860/JCDR/2012/4867.2652
15. Agwuna KK, Eze CU, Ukoha PO and Umeh UA. Relationship between sonographic placental thickness and gestational age in normal singleton fetuses in Enugu, Southeast Nigeria. Ann Med Health Sci Res. 2016;6(6):335-340.
    https://doi.org/10.4103/amhsr.amhsr_457_15
16. Mathai BM, Singla SC, Nittala PP, Chakravarti RJ and Toppo JN. Placental thickness: Its correlation with ultrasonographic gestational age in normal and intrauterine growth-retarded pregnancies in the late second and third trimester. J Obstet Gynaecol India. 2013;63(4):230-3.
    https://doi.org/10.1007/s13224-012-0316-8
17. Humadi EH, Zghair MA and Kudhire NA. The accuracy of placental thickness in estimation of gestational age during late third trimester- A single centre cross sectional study. J Pak Med Assoc. 2021;71(Suppl 8)(12):S93-S96.
18. Nagpal K, Mittal P and Grover SB. Role of ultrasonographic placental thickness in prediction of fetal outcome: A prospective Indian study. J Obstet Gynaecol India. 2018;68(5):349-354.
    https://doi.org/10.1007/s13224-017-1038-8
19. Balakrishnan M and Virudachalam T. Placental thickness: A sonographic parameter for estimation of gestational age. Int J Reprod Contracept Obstet Gynaecol. 2016;5(12):4377-81.
    https://dx.doi.org/10.18203/2320-1770.ijrcog20164347

Authors Contribution:
AN- Concept and design of the study; interpreted the results, prepared first draft of manuscript and critical revision of the manuscript; **SK-** Statistically analyzed and interpreted; reviewed the literature and manuscript preparation; **AT-** Design of the study, statistically analyzed and interpreted; and **DG-** Preparation of manuscript and revision of the manuscript, concept, and coordination of the overall study.

Work attributed to:
Department of Radiodiagnosis, MGIMS, Sewagram, Wardha, Maharashtra, India.

ORCID ID:
Ashwini Nagesh Naik - https://orcid.org/0000-0003-4440-3381
SushilKumar Kale - https://orcid.org/0000-0003-2851-6730
Atul Tayade - https://orcid.org/0000-0002-1663-9162
Dhananjay Ghodke - https://orcid.org/0000-0003-4479-7229

Source of Support: Nil, **Conflict of Interest:** None declared.