

Qatar population-specific centile charts of placental weight in 80 722 newborns: relation to maternal age, gestational age, newborn birth weight, and gender, between the 37th and 42nd weeks of gestation

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Abstract. *Background:* Data about placental weight (PW) in relation to birth weight (BW) and gestational age (GA) are lacking in Arabic countries. *Aims of the study:* (a) to find out the national PW standards for babies born between 37th and 42nd weeks of gestation in male and female babies born in Qatar; (b) to study the relation, if any, between PW and maternal age, gestational age (GA), birth weight (BW), and gender of the newborn. *Materials and Methods:* A National population-based retrospective chart review study was conducted between 1-2016 to 12-2019 (n = 80 722). Data of gestational age (GA) at delivery (in weeks), newborn birth weight (BW), PW, and gender at birth, were collected from singleton babies born between 37th and 42nd weeks of gestation. *Results:* The PW ranged from 440 to 860 grams (g) with a mean of 682 ± 96 g. at term for boys and 673 ± 94 g. for girls. The mean BW was 3 036 ± 448 g and BW/PW ratio was 0.203 ± 0.026. The PW continued to increase through 41 weeks' gestation, in boys and girls with a significant decrease at the 42nd week of gestation. PW was significantly correlated with BW (r = 0.596, P: < 0.001) and GA (r = 0.15, P: <0.001) and accounted for 43.4% of the explained variability in birth weight. *Conclusions:* PW was a significant predictor of BW with a consistent increase in PW until the 41st week of gestation in boys and girls and a positive correlation with BW and GA. (www.actabiomedica.it)

Key words: Growth, placental weight, birth weight, gestational age, sex, Qatar

Introduction

The main tasks of the placenta are to serve as a barrier or filter, to transfer substances between maternal and fetal circulation, and to facilitate a large spectrum of endocrine activities. Changes in maternal homeostasis with subsequent alterations in placental growth and function can result in changes in fetal

growth rate in both normal and abnormal pregnancies. Research results suggest that placental weight (PW) partially mediates the effects of pre-pregnancy obesity, gestational diabetes mellitus (GDM), and excessive gestational weight gain (GWG) on fetal growth among term infants (1-4).

Molteni et al. (5) reported a linear relation-ship between fetal growth and placental mass, fetal

weight, and placental growth in both early and late gestation and a significant increase in the mean placental weight and the fetal-placental weight ratio with advancing gestation in pregnancies that were appropriate-for-gestational age.

Thame et al. (1) and Ronald et al. (6) provided evidence that both placental volumes and the rate of placental growth may influence fetal size. These effects are evident in the first half of pregnancy and appear to be mediated through maternal weight and weight gain.

Jones et al. (7) assessed placental volumes utilizing longitudinal ultrasonographic techniques. The mean placental volume was 200 cm² at 21 weeks gestation, 300 cm² at 28 weeks, and 500 cm² at term. There was a decreasing growth rate in the last trimester, although 15 percent of placentas showed a continuous increase through pregnancy.

Diamant et al. (8) described increased placental mass, glycogen and lipids amount in the placentas of women with diabetes compared to those with normal glucose tolerance.

Challier et al. (9) reported that obese women with body mass index (BMI) before pregnancy: > 30 kg/m²] had from two- to threefold increase in the number of macrophages in the placenta in comparison with placentas of pregravid women with BMI < 25 kg/m². Moreover, other studies have reported that PW was linked with pregnancy outcomes. Heavy PW was linked to poor perinatal death, low Apgar score, neonatal respiratory distress, and increased neonatal intensive care unit (NICU) admissions (10-14).

Matsuda et al. (15) studied 53 650 infants and their placentas and reported that an "inappropriately heavy placenta" was associated with a significantly smaller fetal/placental weight ratio (FW/PW). These findings occurred more in female newborn babies, small for gestational age (SGA) newborns, and infants from preeclamptic mothers. On the other hand, low PW was associated with medical complications in the mother (16-18).

Barker et al. (19) reported that altered growth of the placenta was a predictor of maternal medical diseases including cardiovascular disease, hypertension, and diabetes mellitus. In addition, other factors such as race, ethnicity, and socioeconomic status also affect the PW and placental vascular malperfusion (20,21). A significant correlation between PW and postnatal

infantile and childhood growth and the association between a disproportionately large placenta with an increased risk of long-term cardiovascular mortality has been also reported (22,23).

The aims of the study were: (a) to determine the Qatar population-specific centile charts of PW in newborns born between 37th and 42nd weeks of gestation in 80 722 male and female babies born in Qatar between 1-2016 to 1-2020, and (b) to study the relation, if any, between PW on the one hand and maternal age, gestational age (GA), birth weight (BW), and gender of the newborn baby.

Subjects and methods

Our population-based analysis consisted of a 4-year cohort data (January 2016 to December 2019) for births conducted in all Hamad Medical Center (HMC) hospitals. These hospitals account for about 90% of all births in the country. The inclusion criterion for this analysis was term singleton live births from the 37th+⁰ to 42nd+⁶ weeks of gestation.

Ethics

All procedures were in accordance with the 1964 Helsinki declaration and its later amendments. The study was part of the Vulnerable Newborn Study, approved by the Hamad Medical Corporation Institutional Review Board and Ethical Committee (IRB No MRC-01-21-277).

Statistical analysis

We summarized the distribution of variables using numbers and percentages, mean and standard deviation (SD). Pearson correlation coefficients explored the relationship between PW and BW, maternal age, gender, GA. To explore and estimate the association between PW and BW, we fitted an unadjusted and adjusted linear regression model. The beta coefficient with 95% CI and R² were obtained. The adjustment was made for maternal age, gender, and GA. Statistical significance was set at P: <0.05.

Table 1. Birth weight and placental weight (g) centiles by gestational age (weeks) for boys and girls at gestational age from 37th to 42nd weeks of gestation

		Male										
Gestational age (weeks)	count	Birth weight		Placenta weight (g)								
		mean	sd	mean	sd	p5	p10	p25	p50	p75	p90	p95
37	4,266	3036	448	632	114	440	482	565	640	700	755	810
38	10,356	3225	423	652	109	470	510	600	650	700	780	830
39	12,971	3355	411	664	101	490	530	610	680	710	780	820
40	9,876	3475	404	682	96	520	565	626	680	725	800	850
41	3,256	3578	402	693	101	515	575	640	700	750	810	860
42	191	3548	452	677	100	520	550	620	680	720	800	850
Total	40,916	3336	442	664	105	485	528	608	680	720	790	832
		Female										
Gestational age (weeks)	count	Birth weight		Placenta weight (g)								
		mean	sd	mean	sd	p5	p10	p25	p50	p75	p90	p95
37	3,910	2928	454	627	117	430	480	560	630	690	750	820
38	9,366	3111	414	645	108	460	510	585	650	700	770	820
39	12,879	3238	395	659	101	490	530	600	670	710	780	820
40	9,937	3354	388	673	94	510	560	620	680	720	780	820
41	3,488	3439	396	683	95	516	570	630	680	722	800	850
42	226	3425	402	669	106	500	529	610	680	720	780	810
Total	39,806	3225	428	658	103	480	522	600	665	710	780	820

Results

Mean PW according to GA is presented in tables 1 and 2. The placental weight continued to increase through 41st weeks' gestation, with a mild but significant decrease in the 42nd week of gestation. The mean PW at term were 682 ± 96 g for boys and 673 ± 94 g for girls (Table 1). The mean placental weights were significantly heavier in boys versus girls in all gestational age groups.

PW was significantly correlated with GA ($r = 0.15$, $P < 0.001$) (Table 3) and accounted for 43.4% of the explained variability in birth weight.

The PW was correlated to birth weight in newborn male and female babies (Figures 1 and 2).

Birth weight was correlated significantly with the GA ($r = 0.324$, $P < 0.001$) and decreased significantly in women after the age of 35 years (Figure 3).

Infant and placental weight PW pairs were analyzed according to their GA. Graphs were constructed to depict normal PW gain changes over the determined

Table 2. Placental weight as a function of gestational age (Mean \pm SD)

Gestational age (wk)	Mean PW (g)	SD
37	629.95	115.51
38	648.66	108.61
39	661.39	101.22
40	677.34	95.14
41	687.74	98.08
42	672.69	103.56

GA (37th to 42nd weeks). Mean PW continued to increase through 41st weeks' gestation in both sexes (Figures 4 and 5).

Discussion

Placental weight (PW) is a valuable indicator of its function, predicting both pregnancy outcomes and lifelong health. Population-based centile charts

of placental weight-for-gestational-age are useful for identifying extremes of PW. However, PW centiles differ among different populations, ethnicities, and socioeconomic statuses (24,25).

Our study showed that the mean PW at term was 680 ± 96 g for newborn boys and 665 ± 94 g for newborn girls. This was relatively higher than those reported in Thailand (519 ± 89 g), Nigeria (590 ± 82 g), Ethiopia (524.3 ± 8.1 g), Brazil (612 ± 138 g), Japan (578.8 ± 92.6 g), China (547 ± 68.5 g), and Italy (561.8 ± 91.0 g) but comparable to those reported in the UK (626 ± 135.5 g for newborn females and 641 ± 139.3 g for newborn males) and Norway (664 ± 147 g)

Table 3. Correlation between variables

	Birth wt.	Placenta wt.	Gestation age	Maternal age
Birth wt.	1.000			
Placenta wt.	0.597*	1.00		
Gestation age	0.324*	0.153*	1.00	
Maternal age	0.07	0.04	-0.12*	1.00

Legend: * P: < 0.001.

(15, 26-36). This may be explained by the high prevalence of obesity and gestational diabetes mellitus (GDM) in women in Qatar at the birth-bearing age.

The overall prevalence of newly detected diabetes in pregnancy among the 2 000 patients who fulfilled the inclusion/exclusion criteria was 24.0% (95% CI 22.1–25.9) of which type 2 diabetes mellitus (T2DM) was 2.5% (95% CI 1.9–3.3), GDM was 21.5% (95% CI 19.7–23.3) and excessive weight gain during pregnancy occurred in 44.1% of them (15, 26-36).

In support of our findings, Kucuk M et al. (37) detected significantly higher PW in pregnant women with GDM (694.8 ± 152) versus pregnancy women without GDM the normal control group (610.2 ± 116.6 g) (37). Bianchi et al, (38) and Mandò et al. (39) confirmed that PW and thickness were higher in obese pregnant women pregnancies and in overweight women who had excessive weight gain during gestation compared to normal pregnancies. Wallace et al. (40) studied a large cohort of pregnancies (n= 55 105) and reported that PW in the upper tertiles (mean 788 g) was associated with a higher risk of cesarean section, post-term delivery and high birth weight (P: < 0.001).

Flatley et al. (41) studied the PW and the difference in between males and females, in 97 882

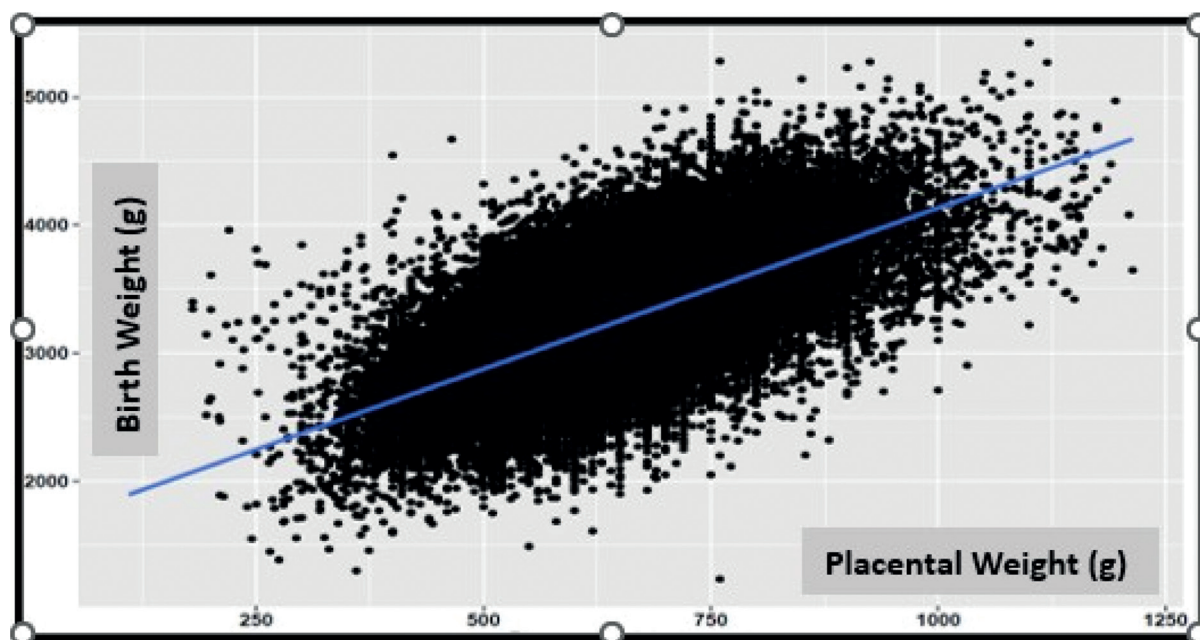


Figure 1. Correlation between placental weight and birth weight ($r = 0.597$, $P: < 0.001$).

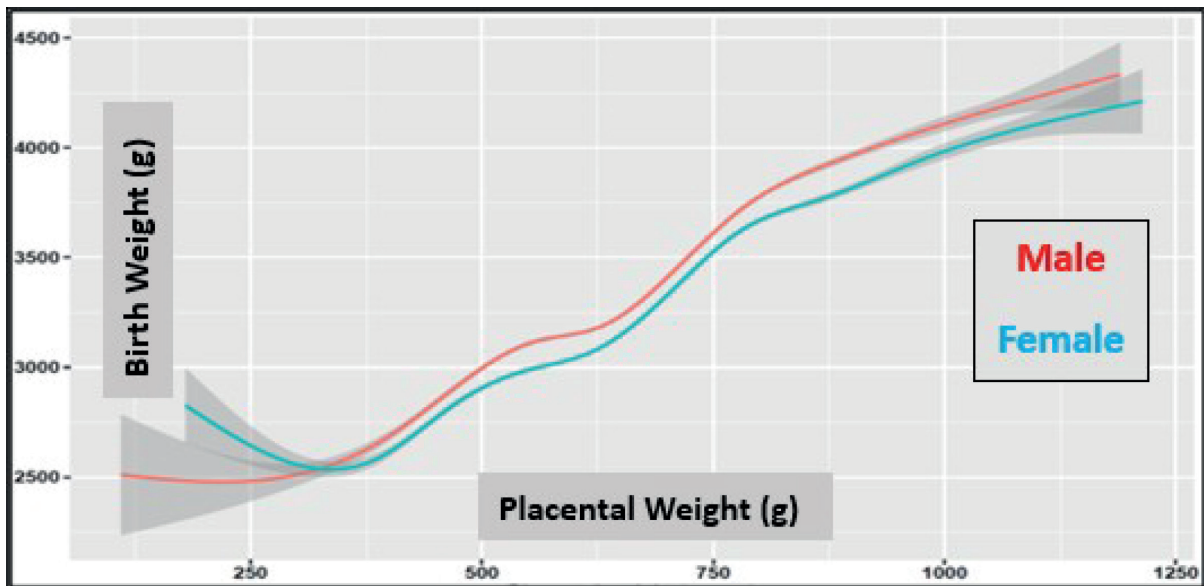


Figure 2. Placental weight in relation to birth weight in newborn male and female babies (the gray boundary around the line is the 95% confidence interval).

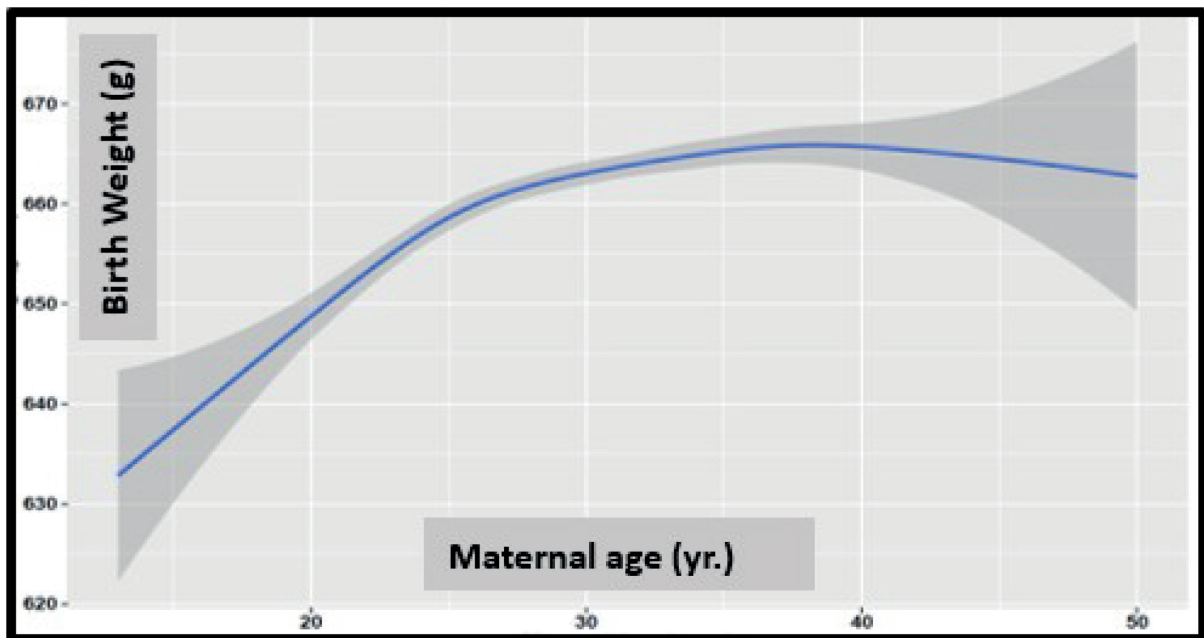


Figure 3. Birth weight as a function of maternal age (the gray boundary around the line is the 95% confidence interval).

pregnancies in Norway. In their study, the mean PW for newborn males was (654.4 g for nullipara and 684.9 g for multipara) and for newborn females. The mean PW was 646 g for nullipara and 673 g for multipara. These data confirmed our findings of the

slightly heavier PW of male vs female newborns at full-term.

The overall PW curves and tables stratified by the GA in a large cohort of pregnancies offer population standards for use in clinical research studies. These

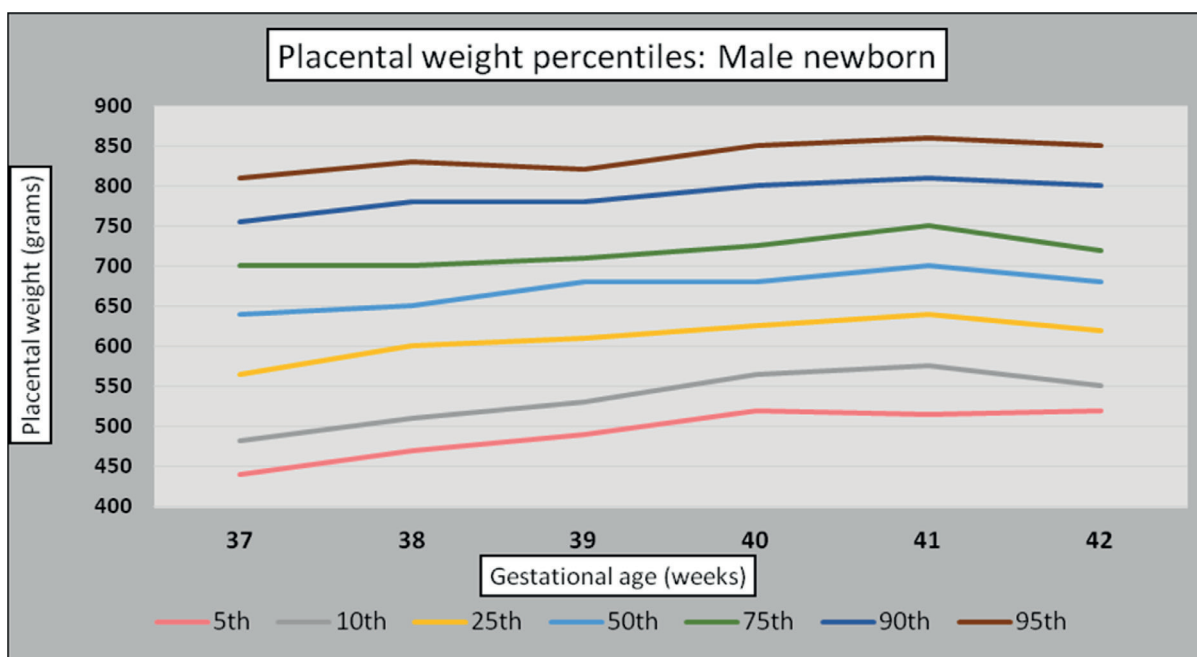


Figure 4. Male newborn placental weight standards (g).

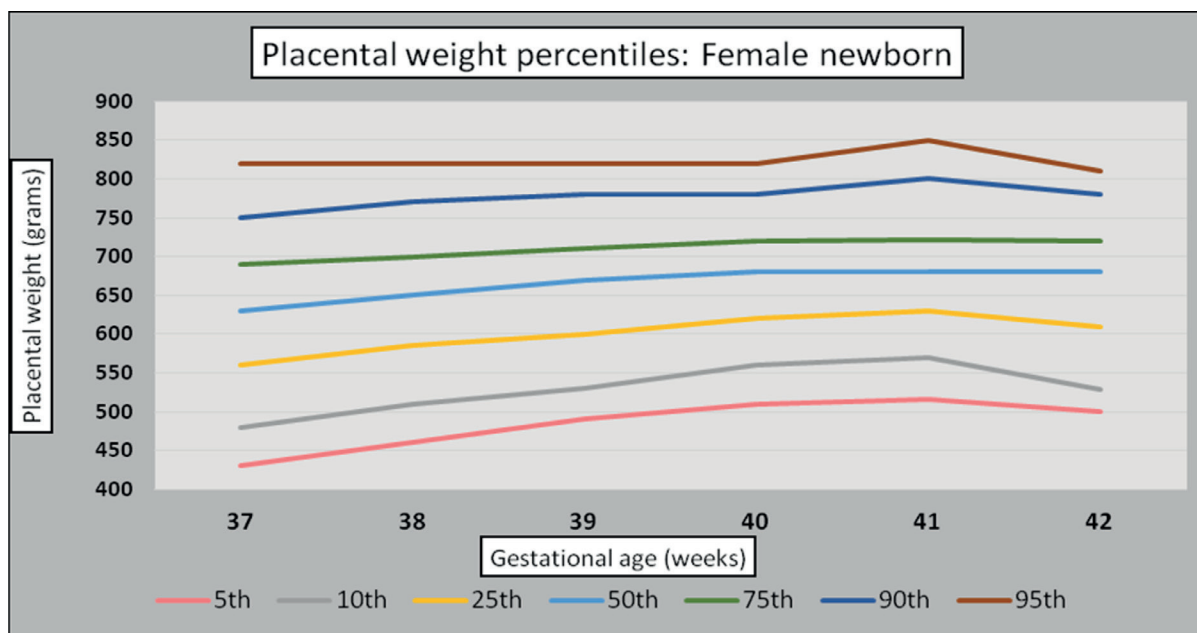


Figure 5. Female newborn placental weight standards (g).

curves are the first in the Arab gulf area. Our data confirm that PW increases progressively throughout the 37th to the 41st week of gestation. However, the rate of PW gain tended to slow during the later weeks of pregnancy. This slowing pattern can be explained by

the previously described histological changes in placentas delivered in healthy pregnancies between 22- and 40 weeks of gestation described by Teasdale (42). The first stage of placental growth, which lasts through 36 weeks, is characterized by increases in both the

parenchymal (the trophoblast tissue, cytotrophoblast, syncytiotrophoblast), and fetal capillaries of peripheral and stem villi) and non-parenchymal tissue (the decidua and chorionic plates, septa, fetal vessels, connective tissue, and fibrin deposits). This phase of rapid placental growth is necessary for rapid fetal growth in the last trimester of pregnancy (average fetal weight = 660 g at 25 weeks and 2 785 g at 36 weeks of gestation). The second phase (maturation phase) lasting from 36 weeks until term, is characterized by an increase in fetal growth (weight = 2785 g at 36 weeks and 3 380 g at 40th week) with only a slower increase in the placental weight due to gaining only non-parenchymal placental tissue (42).

In conclusion, PW is a good predictor of birth weight with a consistent increase in placental weight from the 37th until 41st weeks of gestation and a mild but significant decrease in the 42nd week of gestation. The reference standards of PW in our large specific centile charts in the Qatar population may be useful in studies investigating the role of the placenta in mediating pregnancy outcomes and lifelong health in the Arab gulf area.

Conflicts of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement, etc.) that might pose a conflict of interest in connection with the submitted article.

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