Table S1. Observational and intervention studies examining associations between carotenoids during pregnancy and maternal or infant health outcomes

Study type	Study group	Observation or intervention	Assessed outcome	Results	Source
Observational studies					
Prospective cohort study	n=67 Norway, Australia, USA nondiabetic (n=20) and 1 type diabetic (n=47) 31.7 ± 4.6y, 28.5 ± 5.6 non-Hispanic	maternal serum carotenoids (α-C, β-C, Ly, L[1]) in 1, 2, 3 trimesters of pregnancy	subsequent PE+[2]	-↓ 45% α –C and 53% β-C plasma concentrations t 3 trimester in PE+ diabetic compared with PE-[3] diabetic ($p<0.05$)	[49]
Case-control study	n=304 Peru PE+ n=125, PE- n=179 26.6 ± 0.6y,-26.3 ± 0.5y n=271 Inca Indian ancestery n=48 <12 y of education	maternal serum carotenoids (α-C, β-C, Ly, L′, Z, β-Cr[4]) in 36.0 – 37.3 Hbd[5]	differences in carotenoids level between PE+ and PE-	-no differences	[50]
Case-control study	n=359 Zimbabwe PE+ n=173, PE- n=186 25.6 ± 6.4y, 26.6 ± 5.8y	maternal serum carotenoids (α-C, β-C, Ly, L′, Z, β-Cr) at 12 – 72h postpartum	differences in carotenoids level between PE+ and PE-	↓ 45%PE+ risk for women in the highest quartiles for α-C, β-C, L, Z, β-Cr: - β-C OR[6] 0.50 (95%CI[7] 0.25-1.00) - α -C OR 0.53 (95%CI 0.26-1.05) - β-Cr OR 0.47 (95%CI 0.19-1.11) - L OR 0.46 (95%CI 0.19-1.11) - Z OR 0.48 (95%CI 0.20-1.16)	[41]
Case-control study	n=5337 Canada PE+ n=111, PE- n=441 29.3 ± 5.7/5.4y 18 and 15% high school or less, 26 and 39% university graduate or more 75 and 82% North America/Europe/Australia	maternal serum carotenoids (α-C, β-C, Ly, L′, β-Cr, α-Cr[8]) in 24 – 26 Hbd	subsequent PE+	↓ PE+ risk: - L OR 0.60 (95%CI 0.46-0.77) - Ly OR 0.93 (95%CI 0.75-1.16) - carotenoids OR 0.82 (95%CI 0.62-1.07) - L OR 0.53 (95%CI 0.35-0.80) – early onset PE - L OR 0.62 (95%CI 0.47-0.82) – late onset PE	[48]

	5 and 11% family income<15000$/y				
Cohort study	n=23 423 Norway 5.4% PE+ <20y 3.8, 20-29y 58.1%, 30-39y 37.2%, ≥40y 0.9% ≤10y of education 4%, ≥16y 21% 5.4% daily smokers	dietary pattern at 17-22 Hbd (FFQ[9])	subsequent PE+	↓ risk for dietary pattern rich in vegetables and fruits: - OR 0.72, 95%CI 0.62-0.85)	[51]
Case-control study	n=650 n=207 preterm birth, n=443 term 20-34y 78 and 83% high school or less education 14 and 18% family income per year <15000 12 and 14%	maternal serum carotenoids (α-C, β-C, Ly, L, β-Cr, α-Cr) in 24 - 26 Hbd	subsequent spontaneous preterm birth	↓ risk for the highest quartile compared with the lowest: - β-C OR 0.4 (95%CI 0.2-0.7) - α -C OR 0.5 (95%CI 0.3-0.9) - β-Cr OR 0.6 (95%CI 0.3-1.1) - L OR 0.6 (95%CI 0.4-1.1) - Ly OR 0.6 (95%CI 0.4-1.1)	[65]
Case-control study	n=5738 USA n=471 preterm birth, n=5267 term 26.21 ± 6.61, 27.55 ± 6.07 46.6 – 59.6% Non-Hispanic white 16-19% education < high school 15.5-25.5% smoking 4-6.9% gestational diabetes	maternal dietary intake year before pregnancy	subsequent preterm birth	↑ risk for the lowest quartile compared with the highest: - β-C OR 1.9 (95%CI 1.1-1.7) - 32-34 Hbd - α -C OR 1.4 (95%CI 1.1-1.9) – 35-36 Hbd	[66]
Prospective cohort study	n=66000 Norway 5.3% preterm birth	dietary pattern during pregnancy (FFQ)	subsequent preterm birth	↓ risk for the prudent dietary pattern (rich in vegetables and fruits): - HR[10] 0.88 (95%CI 0.80-0.97)	[67]

	52.5%, ≥40y 2.0% <20y 1.0, 20-29y 44.5%, 30-39y <13y of education 31%, ≥17y 25% 5.4% daily smokers singleton pregnancies				
Case-control study	n=996 Canada n=324 SGA[11], n=672 controls 29.01 ± 5.74 – 29.07 ± 5.16y 19.8 and 15.5% high school or less, 35.5 and 38.1% university graduate or more 76.9 and 79.9% North America/Europe/Australia 13.6 and 10.9% family income<15000$/y 15.3 and 26.9% smokers	maternal serum carotenoids (β-C, Ly, L, β-Cr, α-Cr) in 24 - 26 Hbd	risk of SGA	- Ly OR 0.89 (95%CI 0.77-1.03) - carotenoids OR 0.64 (95%CI 0.54-0.78)	[70]
Cross-sectional study	n=200 Germany 32.3 ± 5.0 y no data about maternal characteristic Weeks of labour 39.1 ± 1.5	maternal serum carotenoids (α-C, β-C, Ly, L, Z, β-Cr) at delivery	birth parameters	- no associations	[69]
Prospective cohort study	N=251 Poland 28.26 ± 3.72 y 64% education beyond high school 21.5% environmental cigarette smoke exposure Weeks of labour 39.61 ± 1.2	maternal serum carotenoids (α-C, β-C, Ly, L, Z, β-Cr) at delivery	birth parameters	- no associations	[72]

Retrospective observational study	Italy n=24 gestational diabetes mellitus, insulin therapy no data about maternal characteristic	10mg L +2mg Z/d (n=12) since 28th Hbd for delivery vs. no supplementation (n=12)	oxidative stress in mother and newborn (TH[12] value)	- no difference in maternal oxidative stress - ↓ oxidative stress at 2 h of life in infants (26.5 ± 5.74 vs. 60.4 ± 21.6 TH value, p=0.01) - no difference in oxidative stress at 48-60 h of life (71.0 ± 27.2 vs. 74.1 ±24.8 TH value, p=0.84)	[62]
Intervention studies					
RCT	India n=251 low-risk, healthy 21.8 - 22.6 y 8.6 – 9.3 y of education singleton pregnancy	2mg Ly/d (n=116) since 16-20 Hbd for delivery vs. placebo (n=135)	subsequent PE+, fetal outcomes	- ↓ PE+ (8.6 vs 17.7% cases, p=0,043) - ↓ incidence of IUGR[13] (12% vs. 23.7%, p=0.033) - ↑ birth weight (2751.2 ± 315.8 vs. 2657.3 ± 444.3, p=0.049) - ↑ gestation weeks (37.7 ± 1.6 vs. 36.6 ± 2.2, p<0.05)	[55]
RCT	India n=159 low-risk, healthy 24.2 – 24.6 y singleton pregnancy	2mg Ly/d (n=77) vs. placebo (n=82) since 12-20 Hbd for delivery	subsequent PE+, fetal and maternal outcomes	- no differences in PE+ - gestational weeks - birth weight - ↑ incidence of preterm labour (10.4% vs. 1.22, p=0.02) - ↑ incidence of low birth weight (22.1% vs. 9,8%, p=0.05)	[56]
RCT	n=44 India high-risk of PE+, 18-23y n=26, 24-28y n=10, >28y n=8, singleton and multiple (n=3) pregnancies	2mg Ly/d (n=20) vs. no supplementation (n=24)	subsequent PE+ development, fetal outcomes	- no differences in PE+ - ↓ incidence of IUGR (5% vs. 33.3%, p=0.027)	[57]

		since 14-28 Hbd for delivery			
RCT	N=13709 Bangladesh Rural area	vitamin A 7000 μg Res[14]/d vs. β-C 42mg/d (7000 μg REs/d) vs. placebo since 1 trimester for 3 mo postpartum	pregnancy duration and birth parameters	- no significant differences	[73]

[1]- α-C - α-carotene, β-C - β-carotene, Ly - lycopene, L – lutein; [2]PE+ – with preeclampsia; [3]PE- – without preeclampsia; [4]Z – zeaxanthin,, β-Cr - β-cryptoxanthin; [5]Hbd – week of gestation; [6]OR – odds ratio; [7]CI - confidence interval; [8]α-Cr - α- cryptoxanthin; [9]FFQ – Food Frequency Questionnaire; [10]HR – hazard ratio; [11]SGA – small for gestational age; [12]TH – total hydroperoxides; [13]IUGR – Intrauterine Growth Restriction; [14]REs – retinol equivalents.