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### **Supplemental Material**

#### **Serum Perfluoroalkyl Substances, Vaccine Responses, and Morbidity in a Cohort of Guinea-Bissau Children**

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## Supplementary material

Table S1: Odds ratio for presence of fever, coughing, diarrhea, and any morbidity at inclusion and 9 months with a doubling of serum-PFAS concentrations at inclusion among boys and girls.

	Inclusion <sup>a</sup>		9 months <sup>a</sup>	
	n/N	OR (95 % CI)	n/N	OR (95 % CI)
<b>Fever</b>				
<b>PFHxS</b>				
boys	28/123	1.15 (0.50, 2.66)	8/123	0.86 (0.20, 3.69)
girls	19/113	1.42 (0.73, 2.79)	11/113	0.99 (0.40, 2.45)
p-value for interaction		0.70		0.87
<b>PFOS</b>				
boys	28/123	1.65 (0.93, 2.94)	8/123	1.40 (0.52, 3.77)
girls	19/113	1.07 (0.51, 2.24)	11/113	1.05 (0.43, 2.55)
p-value for interaction		0.36		0.67
<b>PFOA</b>				
boys	28/123	1.06 (0.56, 1.99)	8/123	1.48 (0.48, 4.56)
girls	19/113	0.73 (0.30, 1.76)	11/113	1.77 (0.60, 5.17)
p-value for interaction		0.50		0.82
<b>PFNA</b>				
boys	28/123	1.65 (1.00, 2.72)	8/123	1.09 (0.52, 2.27)
girls	19/112	0.88 (0.48, 1.60)	11/112	1.35 (0.62, 2.96)
p-value for interaction		0.12		0.69
<b>PFDA</b>				
boys	28/123	1.49 (0.78, 2.86)	8/123	1.59 (0.53, 4.74)
girls	19/113	1.48 (0.64, 3.43)	11/113	0.91 (0.33, 2.50)
p-value for interaction		0.99		0.46
<b>PFUnDA</b>				
boys	28/123	1.43 (0.69, 2.97)	8/123	0.82 (0.28, 2.40)
girls	19/113	1.20 (0.64, 2.26)	11/113	0.59 (0.18, 2.00)
p-value for interaction		0.72		0.70
<b>Coughing</b>				
<b>PFHxS</b>				
boys	37/123	1.20 (0.56, 2.55)	19/123	1.13 (0.43, 3.00)
girls	34/113	1.34 (0.75, 2.41)	13/114	3.68 (1.41, 9.64)
p-value for interaction		0.82		0.09
<b>PFOS</b>				
boys	37/123	0.99 (0.60, 1.62)	19/123	1.52 (0.78, 2.96)
girls	34/113	1.03 (0.56, 1.88)	13/114	1.57 (0.69, 3.61)
p-value for interaction		0.92		0.95
<b>PFOA</b>				
boys	37/123	1.16 (0.65, 2.05)	19/123	1.40 (0.66, 2.98)
girls	34/113	0.94 (0.48, 1.84)	13/114	3.17 (1.13, 8.92)
p-value for interaction		0.64		0.21
<b>PFNA</b>				
boys	37/123	0.95 (0.63, 1.44)	19/123	1.28 (0.75, 2.19)
girls	34/112	1.24 (0.76, 2.02)	13/113	1.46 (0.72, 2.96)
p-value for interaction		0.42		0.78
<b>PFDA</b>				

boys	37/123	0.75 (0.41, 1.37)	19/123	1.41 (0.66, 3.00)
girls	34/113	0.80 (0.39, 1.62)	13/114	0.86 (0.32, 2.32)
p-value for interaction		0.91		0.44
<b>PFUnDA</b>				
boys	37/123	1.25 (0.66, 2.35)	19/123	0.98 (0.43, 2.23)
girls	34/113	0.66 (0.31, 1.38)	13/114	1.02 (0.48, 2.15)
p-value for interaction		0.20		0.94

#### Diarrhea

<b>PFHxS</b>				
boys	18/123	1.00 (0.36, 2.76)	15/123	1.53 (0.50, 4.71)
girls	9/113	1.45 (0.65, 3.24)	7/114	1.61 (0.70, 3.73)
p-value for interaction		0.57		0.94
<b>PFOS</b>				
boys	18/123	1.55 (0.78, 3.05)	15/123	1.74 (0.75, 4.03)
girls	9/113	0.59 (0.21, 1.62)	7/114	0.55 (0.16, 1.83)
p-value for interaction		0.12		0.12
<b>PFOA</b>				
boys	18/123	1.22 (0.57, 2.62)	15/123	1.56 (0.63, 3.86)
girls	9/113	0.80 (0.23, 2.72)	7/114	1.50 (0.38, 5.88)
p-value for interaction		0.56		0.96
<b>PFNA</b>				
boys	18/123	1.23 (0.72, 2.11)	15/123	1.29 (0.70, 2.39)
girls	9/112	0.52 (0.22, 1.23)	7/113	1.07 (0.43, 2.65)
p-value for interaction		0.10		0.74
<b>PFDA</b>				
boys	18/123	1.66 (0.76, 3.59)	15/123	1.81 (0.71, 4.56)
girls	9/113	0.35 (0.10, 1.20)	7/114	0.48 (0.13, 1.86)
p-value for interaction		0.04		0.11
<b>PFUnDA</b>				
boys	18/123	1.58 (0.67, 3.70)	15/123	1.20 (0.45, 3.21)
girls	9/113	0.36 (0.09, 1.46)	7/114	0.52 (0.11, 2.35)
p-value for interaction		0.08		0.36

#### Any morbidity <sup>b</sup>

<b>PFHxS</b>				
boys	49/122	1.39 (0.68, 2.85)	28/123	1.60 (0.69, 3.71)
girls	50/113	1.27 (0.72, 2.26)	24/113	1.98 (0.98, 4.03)
p-value for interaction		0.85		0.70
<b>PFOS</b>				
boys	49/122	1.58 (0.97, 2.58)	28/123	1.58 (0.88, 2.82)
girls	50/113	0.73 (0.42, 1.27)	24/113	1.13 (0.58, 2.17)
p-value for interaction		0.04		0.45
<b>PFOA</b>				
boys	49/122	1.31 (0.76, 2.25)	28/123	1.82 (0.93, 3.58)
girls	50/113	0.74 (0.39, 1.39)	24/113	2.34 (1.05, 5.20)
p-value for interaction		0.18		0.64
<b>PFNA</b>				
boys	49/122	1.13 (0.77, 1.67)	28/123	1.21 (0.77, 1.92)
girls	50/112	0.91 (0.58, 1.43)	24/112	1.25 (0.72, 2.17)
p-value for interaction		0.47		0.93
<b>PFDA</b>				

boys	49/122	1.39 (0.80, 2.44)	28/123	1.63 (0.84, 3.16)
girls	50/113	0.61 (0.31, 1.19)	24/113	0.85 (0.40, 1.84)
p-value for interaction		0.07		0.21
<b>PFUnDA</b>				
boys	49/122	1.69 (0.90, 3.15)	28/123	1.00 (0.50, 2.02)
girls	50/113	0.59 (0.30, 1.16)	24/113	0.84 (0.42, 1.68)
p-value for interaction		0.03		0.72

<sup>a</sup> Adjusted for weight (to nearest 10 g) and age (days) at inclusion, maternal education (none/any/unknown), and breastfeeding without solids (inclusion: yes/no, 9 months: duration in days).

<sup>b</sup> Fever, diarrhea, coughing or vomiting.

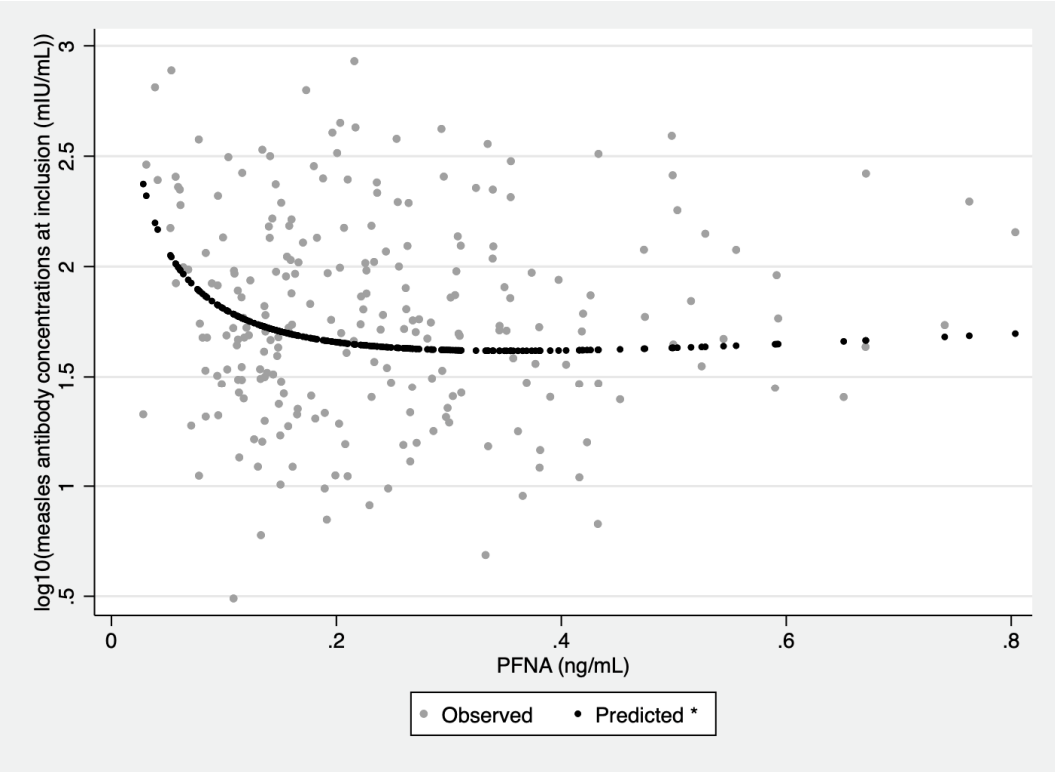
Table S2: Percent difference in measles antibody concentrations at inclusion, 9 months, and 2 years with a doubling of serum-PFAS concentrations at inclusion among boys and girls.

	Measles antibody concentration									
	Inclusion <sup>a</sup>		9 months – control <sup>a</sup>		9 months – intervention <sup>b</sup>		2 years – control <sup>b</sup>		2 years – intervention <sup>b</sup>	
	(no measles vaccine)		(no measles vaccine)		(1 measles vaccine)		(1 measles vaccine)		(2 measles vaccines)	
	N	% difference (95 % CI)	N	% difference (95 % CI)	N	% difference (95 % CI)	N	% difference (95 % CI)	N	% difference (95 % CI)
<b>PFHxS</b>										
boys	123	1 (-29, 43)	46	-18 (-53, 42)	75	10 (-31, 74)	46	-9 (-42, 44)	54	-20 (-45, 16)
girls	113	-8 (-30, 21)	54	15 (-30, 91)	58	7 (-23, 49)	54	-32 (-54, 2)	37	21 (-14, 71)
p-value for interaction		0.68		0.35		0.93		0.34		0.11
<b>PFOS</b>										
boys	123	-10 (-29, 13)	46	-37 (-56, -8)	75	-23 (-42, 3)	46	22 (-11, 66)	54	-8 (-27, 16)
girls	113	-16 (-36, 10)	54	-13 (-41, 30)	58	-19 (-45, 17)	54	-28 (-48, -1)	37	9 (-22, 52)
p-value for interaction		0.71		0.23		0.87		0.02		0.42
<b>PFOA</b>										
boys	123	-17 (-36, 8)	46	-19 (-47, 23)	75	10 (-21, 54)	46	-7 (-34, 30)	54	-7 (-27, 19)
girls	113	-5 (-30, 29)	54	-3 (-40, 54)	58	18 (-22, 78)	54	-21 (-46, 15)	37	28 (-6, 75)
p-value for interaction		0.50		0.57		0.79		0.51		0.11
<b>PFNA</b>										
boys	123	-12 (-27, 7)	46	-15 (-36, 12)	75	3 (-20, 34)	46	8 (-14, 36)	54	1 (-16, 23)
girls	112	-7 (-26, 16)	54	-1 (-28, 37)	57	-17 (-41, 17)	54	-16 (-35, 9)	37	8 (-19, 43)
p-value for interaction		0.73		0.49		0.32		0.15		0.72
<b>PFDA</b>										
boys	123	-16 (-36, 11)	46	-39 (-60, -7)	75	-31 (-52, -2)	46	17 (-18, 67)	54	8 (-21, 47)
girls	113	-10 (-34, 23)	54	2 (-33, 55)	58	-13 (-45, 38)	54	-19 (-43, 14)	37	5 (-30, 57)
p-value for interaction		0.77		0.08		0.42		0.14		0.91
<b>PFUnDA</b>										
boys	123	-6 (-29, 25)	46	-19 (-45, 20)	75	-40 (-61, -7)	46	12 (-18, 54)	54	3 (-28, 48)
girls	113	-12 (-33, 15)	54	39 (-19, 137)	58	-9 (-33, 24)	54	-7 (-41, 45)	37	-11 (-45, 43)
p-value for interaction		0.73		0.11		0.13		0.49		0.62

<sup>a</sup> Analyses of pre-vaccination antibody concentrations were adjusted for weight (to nearest 10g) and age (days) at inclusion, maternal education (none/any/unknown), breastfeeding without solids (inclusion: yes/no, 9 months: duration in days), maternal measles antibody concentration (IU/mL).

<sup>b</sup> Analyses of post-vaccination antibody concentrations were adjusted for maternal education (none/any/unknown), duration of breastfeeding without solids (duration in days), measles antibody concentration at previous visit (IU/mL, log-transformed), and time from vaccination to blood sampling (days).

Figure S1: Predicted association between PFNA and measles antibody concentrations at inclusion based on the confounder adjusted model including both  $\log_{10}(\text{PFNA})$  and  $\log_{10}(\text{PFNA})$  squared, excluding highly influential observations ( $df \text{ beta} > 2/\sqrt{N}$ ).



\* Prediction was based on mothers with an education that were breastfeeding without solids at inclusion. Maternal antibody concentrations, child weight and age were set to their median.