Supplemental Table 1. Geometric means (pmol/L) and 95% CIs of serum estrogens/estrogen metabolites by burns associated with hair relaxer frequency of burns in postmenopausal control women not using menopausal hormone therapy in the Ghana Breast Health Study

	Geometric Mean (95% Confidence Interval)				
	Never had burns	1-2 times burned	3-4 times burned	5+ times burned	ptrend
Estrone	358.09 (253.59-505.66)	407.48 (281.69-589.45)	333.98 (224.67-496.47)	404.17 (266.19-613.68)	0.39
Unconjugated	63.18 (53.73-74.29)	74.13 (61.15-89.88)	63.17 (52.30-76.31)	73.59 (57.77-93.74)	0.09
Conjugated	277.12 (185.66-413.64)	317.15 (206.29-487.59)	257.55 (162.32-408.63)	309.52 (191.24-500.95)	0.47
Estradiol	36.15 (28.00-46.69)	39.13 (28.94-52.91)	34.62 (25.44-47.11)	40.68 (28.55-57.96)	0.31
Unconjugated	23.68 (19.24-29.14)	25.92 (19.83-33.88)	22.61 (17.41-29.36)	29.10 (20.97-40.38)	0.13
Conjugated	6.17 (3.33-11.42)	7.35 (3.80-14.22)	7.06 (3.58-13.94)	7.03 (3.49-14.19)	0.33
2-Hydroxyestrone	57.45 (51.19-64.47)	57.01 (49.49-65.67)	55.43 (48.85-64.21)	61.25 (50.13-74.83)	0.69
2-Hydroxyestradiol	9.82 (7.52-12.83)	9.09 (6.81-12.12)	9.48 (7.01-12.81)	10.04 (7.32-13.77)	0.63
2-Methoxyestrone	23.07 (19.25-27.66)	22.95 (18.54-28.42)	21.39 (17.49-26.15)	26.25 (20.41-33.77)	0.34
Unconjugated	8.78 (7.15-10.79)	9.22 (7.24-11.73)	9.30 (7.39-11.72)	11.05 (8.23-14.85)	**0.04**
Conjugated	11.72 (8.88-15.47)	10.50 (7.60-14.51)	10.58 (7.72-15.93)	10.66 (7.14-15.93)	0.40
2-Methoxyestradiol	13.19 (10.60-16.43)	12.99 (10.30-16.39)	13.58 (10.60-17.40)	12.75 (9.80-16.59)	0.47
Unconjugated	3.15 (2.55-3.90)	3.08 (2.44-3.87)	3.20 (2.56-4.00)	4.04 (3.12-5.22)	**0.01**
Conjugated	8.65 (6.29-11.90)	8.94 (6.39-12.51)	8.23 (5.60-12.10)	7.07 (4.76-10.48)	0.74
2-Hydroxyestrone-3-methyl ether	3.75 (3.04-4.63)	4.17 (3.27-5.33)	3.80 (2.99-4.84)	4.01 (3.09-5.20)	0.23
4-Hydroxyestrone	8.44 (6.21-11.47)	8.15 (5.90-11.26)	7.51 (5.37-10.49)	8.09 (5.62-11.65)	0.76
4-Methoxyestrone	3.76 (3.07-4.60)	3.57 (2.86-4.47)	3.75 (2.97-4.72)	4.14 (3.22-5.31)	0.15
4-Methoxyestradiol	1.53 (1.24-1.88)	1.58 (1.26-1.98)	1.59 (1.25-2.03)	1.52 (1.18-1.97)	0.70
16α-Hydroxyestrone	37.52 (28.14-50.04)	35.42 (25.86-48.52)	34.64 (25.05-47.91)	42.26 (29.18-61.20)	0.46
Estriol	94.30 (76.60-116.08)	104.20 (82.46-131.68)	83.91 (66.44-105.97)	102.18 (77.42-134.86)	0.31
Unconjugated	9.53 (8.39-10.81)	9.98 (8.68-11.47)	9.66 (8.39-11.12)	11.08 (9.23-13.30)	0.07
Conjugated	85.54 (65.53-103.97)	91.50 (70.42-118.88)	71.97 (55.25-93.74)	87.85 (64.53-119.59)	0.42
16-Ketoestradiol	19.11 (15.64-23.35)	19.11 (15.26-23.94)	16.53 (13.07-20.92)	19.16 (14.43-25.45)	0.94
16-Epiestriol	21.54 (16.71-27.75)	20.41 (15.66-26.60)	17.36 (13.07-23.07)	24.02 (17.57-32.82)	0.54
17-Epiestriol	27.77 (21.30-36.18)	31.01 (23.49-40.94)	27.98 (20.94-37.37)	26.33 (19.32-35.88)	0.70

Geometric means adjusted for age at blood draw (continuous), blood draw year (2013, 2014, 2015), smoking status (never, former, current, missing), diabetes (yes, no, missing), time since menopause (≤2, 3-5, 6-10, >10, missing), ever used oral contraceptives (yes, no, missing) and categorical current BMI

p-value for trend was estimated using the Wald test, all FDR q-values ≥ 0.20

Supplemental Table 2. Geometric means (pmol/L) and 95% CIs of serum estrogens/estrogen metabolites by skin lightener use (number of years) characteristics in postmenopausal control women not using menopausal hormone therapy in the Ghana Breast Health Study

| | Geometric Means (95% Confidence Intervals) | | | | | | (>20 years vs. <1 year) | |
	<1 year	1-5 years	6-10 years	11-20 years	>20 years	p-trend	%Δ	p-diff
Estrone	360.74 (250.58-519.32)	393.58 (231.60-668.83)	328.48 (204.09-528.69)	407.89 (188.38-883.23)	383.90 (230.27-640.05)	0.771	6.4	0.591
Conjugated	64.86 (54.24-77.56)	72.92 (54.15-98.18)	64.64 (48.71-85.78)	66.46 (43.86-100.70)	67.33 (49.20-92.15)	0.876	3.8	0.750
Unconjugated	284.53 (186.48-434.12)	291.91 (154.38-551.98)	255.08 (148.28-438.81)	318.20 (128.64-787.12)	292.08 (157.72-540.90)	0.684	2.7	0.563
Estradiol	35.17 (26.07-47.46)	33.69 (20.78-54.63)	29.20 (18.73-45.53)	36.69 (17.40-77.37)	29.62 (17.81-49.26)	0.514	-15.8	0.804
Conjugated	23.35 (17.72-30.76)	23.55 (14.75-37.60)	20.42 (13.23-31.51)	21.93 (10.83-44.40)	20.33 (12.47-33.14)	0.610	-12.9	0.891
Unconjugated	6.15 (3.24-11.65)	7.04 (3.17-15.66)	3.99 (1.72-9.26)	9.86 (3.26-29.84)	5.23 (2.20-12.41)	0.935	-15	0.842
2-Hydroxyestrone	57.80 (51.29-65.13)	58.02 (45.92-73.30)	56.47 (46.24-68.96)	57.16 (39.01-83.74)	55.71 (44.71-69.42)	0.462	-3.6	0.540
2-Hydroxyestradiol	9.13 (6.92-12.04)	8.84 (6.14-12.73)	7.41 (5.10-10.78)	9.58 (6.19-14.82)	8.74 (6.01-12.70)	0.208	-4.3	0.309
2-Methoxyestrone	21.51 (18.11-25.56)	20.90 (15.58-28.05)	22.19 (16.12-30.54)	24.38 (16.61-35.78)	18.46 (14.19-24.00)	0.730	-14.2	0.293
Conjugated	8.75 (7.19-10.65)	10.18 (7.34-14.10)	10.50 (7.55-14.59)	8.38 (5.29-13.28)	7.12 (5.27-9.61)	0.571	-18.6	0.996
Unconjugated	10.59 (8.24-13.60)	7.39 (4.49-12.15)	7.75 (4.59-13.07)	12.37 (5.57-27.46)	10.26 (6.92-15.19)	0.925	-3.1	0.880
2-Methoxyestradiol	12.65 (10.05-15.93)	13.32 (9.76-18.18)	14.22 (10.38-19.47)	11.72 (8.23-16.68)	10.21 (7.58-13.76)	0.936	-19.3	0.348
Conjugated	3.04 (2.49-3.72)	3.60 (2.75-4.70)	3.24 (2.49-4.22)	3.05 (2.11-4.41)	3.32 (2.55-4.34)	0.353	9.2	0.546
Unconjugated	8.60 (6.20-11.92)	8.26 (4.96-13.75)	9.90 (6.33-15.50)	8.40 (5.29-13.34)	5.75 (3.46-9.57)	0.430	-33.1	0.951
2-Hydroxyestrone-3-methyl ether	3.60 (2.96-4.39)	3.15 (2.36-4.21)	4.19 (3.09-5.67)	4.88 (3.15-7.56)	2.87 (2.11-3.90)	0.268	-20.3	0.070
4-Hydroxyestrone	7.28 (5.36-9.90)	7.47 (4.69-11.89)	8.46 (5.76-12.42)	10.56 (5.96-18.69)	7.74 (4.92-12.17)	0.067	6.3	0.146
4-Methoxyestrone	3.60 (2.97-4.37)	3.38 (2.51-4.53)	3.61 (2.80-4.65)	3.32 (2.34-4.72)	3.01 (2.29-3.95)	0.885	-16.4	0.410
4-Methoxyestradiol	1.46 (1.17-1.83)	1.50 (1.05-2.15)	1.74 (1.26-2.42)	1.56 (0.99-2.47)	1.28 (0.92-1.77)	0.371	-12.3	0.209
16α-Hydroxyestrone	34.96 (26.17-46.69)	42.68 (26.49-68.77)	31.05 (21.16-45.57)	32.65 (19.72-54.05)	33.96 (21.63-53.31)	0.943	-2.9	0.660
Estriol	82.02 (67.56-99.58)	95.08 (66.95-135.02)	69.75 (52.49-92.68)	98.12 (70.19-137.17)	84.27 (58.21-121.98)	**0.027**	2.7	**0.003***
Conjugated	9.53 (8.40-10.81)	9.70 (7.96-11.83)	8.89 (7.55-10.47)	12.10 (8.40-17.43)	10.07 (8.21-12.34)	0.198	5.7	0.284
Unconjugated	69.89 (56.25-86.85)	83.20 (56.56-122.38)	60.76 (44.38-83.20)	80.71 (53.74-121.22)	72.10 (48.21-107.84)	**0.018**	3.2	**0.002***
16-Ketoestradiol	17.50 (14.01-21.84)	21.90 (15.45-31.03)	15.03 (11.12-20.31)	19.66 (12.26-31.53)	18.32 (12.50-26.86)	0.374	4.7	0.277

16-Epiestriol	18.83 (14.82-23.93)	20.34 (14.28-28.97)	17.45 (12.72-23.95)	26.74 (19.43-36.82)	18.00 (12.69-25.52)	0.400	-4.4	0.395
17-Epiestriol	27.75 (21.51-35.78)	20.85 (14.37-30.25)	27.47 (19.91-37.91)	32.47 (22.69-46.45)	25.27 (17.69-36.09)	0.609	-8.9	0.399

Geometric means adjusted for age at blood draw (continuous), blood draw year (2013, 2014, 2015), smoking status (never, former, current, missing), diabetes (yes, no, missing), time since menopause (≤2, 3-5, 6-10, >10, missing), ever used oral contraceptives (yes, no, missing).

p-value trend was estimated using the Wald test

%Δ indicates the percentage change in estrogen/estrogen metabolite levels, comparing women reporting ever skin lightener use vs never use and was estimated by taking the ratio of the geometric mean difference in estrogen/estrogen metabolite levels between women who used skin lightener users >20 years to the geometric mean of women reported <1 year of skin lightener use, multiplied by 100

*indicates FDR q-values < 0.1