Supplementary material:

Table S1: characteristics of the study population stratified by sex and urban/rural residence (Cameroon study: n=596)

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| --- | --- | --- |
| Characteristics | Women (n=377) | Men (n=219) |
| Rural (n=172) | Urban (n=205) | p-value | Rural (n=103) | Urban (n=116) | p-value |
| Age (years) | 39.7 ± 8.1 | 38.7 ± 8.8 | 0.239 | 37.3 ± 8.3 | 36.5 ± 9.0 | 0.486 |
| Education (years) | 8.1 ± 4.2 | 11.8 ± 5.2 | <0.001 | 8.9 ± 4.5 | 13.2 ± 5.2 | <0.001 |
| Education level, n (%)(completed)< Primary education Primary educationSecondary and high schoolUniversity | 51(29.6)92(53.8)25(14.5)4(2.3) | 24(11.7)79(38.5)68(33.2)34(16.6) | < 0.001 | 23(22.5)59(57.8)16(15.7)4(3.9) | 5(4.3)34(29.3)41(35.3)36(31.0) | < 0.001 |
| Alcohol intake, n (%)NeverPast Current  |  24(13.9)16(9.3)132(76.7) | 24(11.7)29(14.1)152(74.1) | 0.32 | 11(10.7)03(2.9)89(86.4) | 06(5.2)10(8.6)100(86.2) | 0.08 |
| Smoking status, n (%):NeverPast smokerCurrent smoker  | 161(93.6)10(5.8)1(0.6) | 181(91.4)16(8.1)1(0.5) | 0.74 | 56(57.7)21(21.7)20(20.6) | 52(46.9)30(27.0)29(26.1) | 0.26 |
| Fruit intake (times/week) | 3(1.5-6) | 2(1-4.5) | 0.06 | 2(1-6) | 2(1-3) | 0.03 |
| Vegetables intake (times/week) | 6(3-9.5) | 4(2-6) | <0.0001 | 4(2-6) | 3(2-6) | 0.16 |
| PAEE (KJ/Kg/day) | 55.3±21.0 | 38.0±16.6 | <0.0001 | 65.7±25.9 | 51.7±22.6 | 0.0001 |
| Sedentary time (min/day) | 918.3±140.2 | 1018.8±137.9 | <0.0001 | 878.7± 152.5 | 963.8±150.9 | 0.0005 |
| LPA time (min/day) | 381.5±94.9 | 332.1±104.6 | <0.0001 | 414.2±97.2 | 364.8±112.0 | 0.003 |
| MVPA time (min/day) | 121.8(75.6-204.2) | 71.4(47.1-112.1) | <0.0001 | 136.1(62.5-204.7) | 92.6(54.4-148.3) | 0.01 |
| GPAQ PAEE (KJ/Kg/day) | 79.2(7.2-181.6) | 7.1(3.4-51.7) | <0.0001 | 36.0(3.2-139.0) | 15.6(3.6-68.6) | 0.20 |
| GPAQ work (MET-min/week) | 7440(0-17520) | 0(0-4680) | <0.0001 | 720(0-12240) | 0(0-5760) | 0.04 |
| GPAQ leisure (MET-min/week) | 0(0-0) | 0(0-0) |  | 0(0-0) | 0(0-0) |  |
| GPAQ travel (MET-min/week) | 1800(560-3480) | 720(300-1440) | <0.0001 | 840(360-5040) | 840(280-2520) | 0.34 |

Results are presented as arithmetic mean [or median (25th-75th percentile) for non-normally distributed variables] or n (%). p-values are from a t-test for normally distributed continuous variables (or Mann Whitney test for non-normally distributed variables) and from a chi squared test for categorical variables.

PAEE, physical activity energy expenditure; LPA, light physical activity; MVPA, moderate to vigorous physical activity

Table S2: Metabolic characteristics of the study population stratified by sex and urban/rural residence (Cameroon study: n=596)

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| --- | --- | --- |
| Characteristics | Women (n=377) | Men (n=219) |
| Rural (n=172) | Urban (n=205) | p-value | Rural (n=103) | Urban (n=116) | p-value |
| Plasma zinc (µmol/L) | 13.2±2.8 | 13.3±2.4 | 0.57 | 14.2±3.1 | 14.5±2.7 | 0.36 |
| Plasma zinc deficiency, n (%) | 28(16.3) | 26(12.7) | 0.32 | 20(19.4) | 9(7.8) | 0.01 |
| BMI (kg/m2) | 24.8±4.9 | 29.1±5.5 | <0.0001 | 23.1±3.2 | 25.3±4.0 | <0.0001 |
| BMI categories, n (%)<25 25-29.9 ≥ 30 | 104(60.5)40(23.3)28(16.3) | 52(25.4)57(27.8)96(46.8) | <0.001 | 78(53.4)22(37.9)03(2.9) | 68(58.6)36(31.0)12(10.3) | 0.03 |
| Waist circumference (cm) | 85.0±11.4 | 94.1±12.6 | <0.0001 | 82.8±7.8 | 89.3±11.3 | <0.0001 |
| Central obesity, n (%) | 112 (65.1) | 174(84.9) | <0.0001 | 9(8.7) | 32(27.6) | 0.001 |
| Waist to hip ratio | 0.84±0.09 | 0.85±0.07 | 0.89 | 0.86±0.05 | 0.87±0.06 | 0.07 |
| Body fat (%) | 29.9±8.3 | 37.4±7.6 | <0.0001 | 15.8±5.4 | 20.2±7.0 | <0.0001 |
| Systolic blood pressure (mmHg) | 116.8±19.0 | 124.1±22.0 | <0.001 | 120.6±15.2 | 130.4±22.7 | <0.001 |
| Diastolic blood pressure (mmHg) | 73.9±12.2 | 79.7±13.6 | <0.0001 | 72.4±11.8 | 78.0±14.4 | 0.002 |
| Fasting blood glucose (mmol/L) | 4.78±1.39 | 4.89±1.09 | 0.42 | 4.70±1.48 | 4.64±1.54 | 0.77 |
| 2-h blood glucose (mmol/L) | 6.24±1.73 | 6.69±2.07 | 0.02 | 5.91±1.54 | 6.02±1.98 | 0.63 |
| Fasting insulin (pmol/L) | 22.1(14.0-39.1) | 24.9(13.6-38.4) | 0.61 | 14.7(6.5-28.7) | 17.2(7.9-28.9) | 0.48 |
| Adiponectin (µg/ml) | 6.78(4.63-9.33) | 5.63(3.76-7.81) | <0.001 | 4.39(3.13-6.41) | 4.41(3.08-6.01) | 0.98 |
| HOMA-IR index | 0.76(0.46-1.44) | 0.87(0.48-1.37) | 0.48 | 0.48(0.20-0.87) | 0.59(0.23-1.05) | 0.46 |
| CRP (mg/L) | 5.17(2.48-8.41) | 4.60(2.62-8.33) | 0.78 | 5.56(2.80-10.06) | 4.16(2.05-8.24) | 0.05 |
| Total cholesterol (mmol/L) | 3.85±0.96 | 4.02±0.99 | 0.09 | 3.63±0.96 | 3.76±0.97 | 0.33 |
| LDL cholesterol (mmol/L) | 2.26±0.84 | 2.37±0.85 | 0.24 | 2.08±0.79 | 2.15±0.85 | 0.52 |
| HDL cholesterol (mmol/L) | 1.19±0.33 | 1.27±0.33 | 0.02 | 1.19±0.35 | 1.23±0.31 | 0.42 |
| Triglycerides (mmol/L) | 0.78(0.63-1.01) | 0.71(0.57-0.90) | 0.02 | 0.70(0.58-0.93) | 0.73(0.56-0.98) | 0.87 |

Results are presented as arithmetic mean [or median (25th-75th percentile) for non-normally distributed variables] or n (%). p-values are from a t-test for normally distributed continuous variables (or Mann Whitney test for non-normally distributed variables) and from a chi squared test for categorical variables.

BMI, body mass index; CRP, C-reactive protein. Central obesity was defined as waist circumference ≥ 94 cm in men and 80 cm in women. Obesity using BMI was defined as BMI ≥ 30 Kg/m2

Table S3: Factors affecting plasma zinc concentrations (Cameroon study: n=596)

|  |  |  |
| --- | --- | --- |
| Correlates | β (95% CI) | p-value |
| Age (years) | -0.02(-0.04 to 0.01) | 0.15 |
| Men (vs women) | 1.08(0.63 to 1.53) | <0.001 |
| Education level< Primary education (ref)Primary educationSecondary and high schoolUniversity  | -0.21(-0.83 to 0.41)-0.38(-0.31 to 1.06)-0.24(-0.57 to 1.05) | 0.520.280.56 |
| Smoking statusNever smoked (ref)Former Current  | -0.29(-0.97 to 0.38)-0.60(-0.25 to 1.44) | 0.390.17 |
| Alcohol intakeNever (ref)Former Current  | -0.21(-0.74 to 1.16)-0.39(-1.09 to 0.31) | 0.660.28 |
| Residential areaRural (ref)Urban | 0.21(-0.22 to 0.64) | 0.34 |
| Marital statusSingle (ref)MarriedDivorcedWidowed | -0.08(-0.66 to 0.50)-0.26(-1.50 to 0.99)-0.63(-1.69 to 0.43) | 0.790.690.24 |
| Family size< 3 (ref)3-5>5 | 0.31(-0.21 to 0.84)0.86(0.21 to 1.51) | 0.240.01 |
| Fruits intake (times/week) | -0.11(-0.17 to -0.04) | 0.001 |
| Vegetables intake (times/week) | -0.14(-0.19 to -0.09) | <0.001 |
| PAEE (KJ/kg/day) | -0.01(-0.02 to -0.005) | 0.004 |
| Objective sedentary time (h/day) | 0.08( -0.01 to 0.17) | 0.09 |
| Objective LPA (h/day) | -0.02(-0.15 to 0.11) | 0.74 |
| Objective MVPA (h/day) | -0.20(-0.36 to -0.04) | 0.01 |
| GPAQ PAEE (KJ/Kg/day) | -0.006(-0.009 to -0.004) | <0.001 |
| GPAQ work (MET-h/week) | -0.004(-0.005 to -0.002) | <0.001 |
| GPAQ leisure (MET-h/week) | 0.01(0.002 to 0.02) | 0.02 |
| GPAQ travel (MET-h/week) | -0.01(-0.02 to -0.007) | <0.001 |
| BMI (kg/m2)Continuous | 0.05(0.009 to 0.09) | 0.02 |
| Body fat (%) | 0.04(0.01 to 0.07) | 0.006 |
| Waist circumference (cm) | 0.02(0.004 to 0.04) | 0.02 |
| CRP (mg/L) | -0.001(-0.01 to 0.01) | 0.93 |

β-coefficients represent the difference in plasma zinc in µmol/L per a unit difference in the predictor. Estimates are adjusted for age and sex (except for age adjusted for sex only and sex adjusted for age only)

PAEE, physical activity energy expenditure; LPA, Light physical activity; MVPA, moderate to vigorous physical activity; GPAQ, Global physical activity questionnaire; BMI, body mass index