



Dietary intake of ARA and DHA during early life –
with a special focus on developing countries

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Dietary ARA and DHA in early life

- How diverse is the global dietary intake of ARA and DHA at population level?
- What is the estimated global dietary intake of ARA and DHA during the age period of 6-36 months in low income countries?

How diverse is the global dietary intake of ARA and DHA in developed and developing countries?

Methodology

Sources of data

1. Food Balance Sheets from the Food and Agriculture Organisation Statistics Division (2009-2011)
2. Fatty acid composition data from Australian food composition tables in NUTTAB 2010
3. ARA and DHA content of breast milk (Brenna et al, 2007)
4. Median duration of breastfeeding (USAID DHS, 2015), breast milk intake (WHO, 2002) and energy requirements of infants (FAO, 2001) at age 6-36 months
5. Gross National Income of individual countries (UN, DESA, 2013)

Data analysis

- The daily intakes of DHA and ARA (mg/day) were calculated on a combined average of fatty acid intake from breast milk and complementary food during the period 6-36 months
- This data was weighted according to the median duration of any breastfeeding
 - During the period of median duration of breastfeeding, it was assumed that 50% of the intake would be breast milk and the remaining 50% would be from complementary foods.
 - For the remaining months beyond the median duration of breastfeeding, it was assumed 100% of their food intake was from complementary foods.

Consumption data

Food categories selected for analysis of DHA and ARA in the diet :

- Bovine meat
- Poultry meat
- Mutton and goat meat
- Offals
- Eggs
- Milk and dairy products
- Fish, seafood

Average levels of ARA and DHA in select food categories from the Australia NUTTAB database

| Food category | mg/100 g food | |
|-------------------|---------------|-----|
| | ARA | DHA |
| Eggs | 180 | 20 |
| Fish, seafood | 50 | 310 |
| Bovine, meat | 50 | 5 |
| Mutton/Goat, meat | 80 | 10 |
| Poultry, meat | 70 | 10 |
| Pig meat | 60 | 10 |
| Meat, other | 60 | 10 |
| Offals, edible | 130 | 70 |

(Food Standards Australia New Zealand, 2011)

Per capita intake (g/d) of ARA and DHA food sources in 175 countries by Gross National Income (GNI)

| GNI | Eggs | Seafood | Beef | Mutton | Poultry | Pig meat | Other meat | Offal | Milk |
|-------------------|------|---------|------|--------|---------|----------|------------|-------|------|
| High income (42) | 27.7 | 46.6 | 40.6 | 3.7 | 55.0 | 77.0 | 3.4 | 6.4 | 543 |
| Upper middle (50) | 18.4 | 28.6 | 20.4 | 3.3 | 55.7 | 25.1 | 0.9 | 6.9 | 233 |
| Lower middle (53) | 9.0 | 32.4 | 15.2 | 3.0 | 27.3 | 11.5 | 0.6 | 4.5 | 109 |
| Low income (30) | 2.4 | 26.6 | 11.9 | 4.0 | 4.7 | 1.8 | 2.2 | 3.8 | 70 |

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Median per capita daily consumption (g/day) of egg, fish, meat, and milk commodities based on 2009-2011 FAO Food Balance Sheets

| Countries | Eggs | Fish, seafood | Bovine, meat | Mutton Goat, meat | Poultry, meat | Pig meat | Meat, other | Total meat | Offal, edible | Milk (excl. butter) |
|-------------------------|------|---------------|--------------|-------------------|---------------|----------|-------------|------------|---------------|---------------------|
| European Union | 29.8 | 49.9 | 40.7 | 3.1 | 52.0 | 85.0 | 4.2 | 185.0 | 7.1 | 601 |
| Australia & New Zealand | 19.0 | 42.7 | 82.5 | 37.4 | 86.5 | 50.8 | 5.0 | 262.2 | 15.7 | 435 |
| USA & Canada | 30.3 | 36.9 | 80.3 | 1.7 | 102.0 | 62.7 | 1.1 | 247.8 | 2.1 | 577 |
| China | 45.3 | 75.5 | 11.9 | 7.1 | 31.7 | 87.9 | 2.8 | 141.4 | 8.4 | 83 |
| Japan | 51.3 | 130.0 | 22.4 | 0.5 | 45.5 | 50.6 | 0.3 | 119.3 | 6.2 | 195 |
| Africa | 3.5 | 19.8 | 13.5 | 4.3 | 9.2 | 2.6 | 2.0 | 31.6 | 4.1 | 78 |

Median per capita daily intake of ARA (mg/day) and percent of daily total energy intake (%en) from food sources

| | | Per capita daily intake of ARA (mg/day) from food sources | | | | | | | | | | |
|-------------------------|----------------------|---|------|-------------|-------------------|---------------|----------|-------------|-------|------|-------|------------|
| Countries | Energy intake kcal/d | Eggs | Fish | Bovine meat | Mutton Goat, meat | Poultry, meat | Pig meat | Meat, other | Offal | Milk | TOTAL | ARA as %en |
| European Union | 3420 | 53.1 | 25.0 | 20.2 | 2.5 | 34.6 | 51.0 | 2.4 | 9.2 | 12.0 | 210 | 0.055 |
| Australia & New Zealand | 3170 | 34.2 | 21.4 | 41.3 | 29.9 | 60.6 | 30.5 | 3.0 | 20.4 | 8.7 | 250 | 0.074 |
| USA & Canada | 3650 | 54.5 | 18.5 | 40.2 | 1.4 | 71.4 | 37.6 | 0.7 | 2.7 | 11.6 | 239 | 0.061 |
| China | 2970 | 89.3 | 38.8 | 6.0 | 5.7 | 22.2 | 52.7 | 1.7 | 11.6 | 1.7 | 230 | 0.069 |
| Japan | 2810 | 92.3 | 65.0 | 11.0 | 0.4 | 31.4 | 29.9 | 0.2 | 7.9 | 3.9 | 242 | 0.078 |
| Africa | 2353 | 6.2 | 9.9 | 6.7 | 3.5 | 6.5 | 1.6 | 2.0 | 5.4 | 1.6 | 43 | 0.016 |

Median per capita daily intake of DHA (mg/day) and percent of daily total energy intake (%en) from food sources

| | | Per capita daily intake of DHA (mg/day) from food sources | | | | | | | | | |
|-------------------------|----------------------|---|---------------|-------------|-------------------|--------------|----------|-------------|--------|-------|------------|
| Countries | Energy intake kcal/d | Eggs | Fish, seafood | Bovine meat | Mutton Goat, meat | Poultry meat | Pig meat | Meat, other | Offals | TOTAL | DHA as %en |
| European Union | 3420 | 6.0 | 170.1 | 2.1 | 0.3 | 5.2 | 8.9 | 0.4 | 5.2 | 198 | 0.052 |
| Australia & New Zealand | 3170 | 3.8 | 145.4 | 4.3 | 3.9 | 9.0 | 5.3 | 0.5 | 11.5 | 184 | 0.052 |
| USA & Canada | 3650 | 7.1 | 187.6 | 4.7 | 0.2 | 11.9 | 7.3 | 0.1 | 1.8 | 221 | 0.055 |
| China | 2970 | 10.0 | 267.3 | 0.6 | 0.8 | 3.4 | 9.4 | 0.3 | 6.3 | 298 | 0.090 |
| Japan | 2810 | 10.3 | 446.9 | 1.2 | 0.1 | 4.8 | 5.3 | 0.1 | 4.6 | 473 | 0.152 |
| Africa | 2353 | 0.7 | 61.4 | 0.7 | 0.4 | 0.9 | 0.3 | 0.3 | 2.9 | 60.9 | 0.023 |

Estimated daily intakes of ARA and DHA by adults by Gross National Income of country

| GNI (No of countries) | | Adult median daily ARA intake mg/d | Adult median daily DHA intake mg/d |
|--------------------------|-----|---------------------------------------|---------------------------------------|
| High income | 42 | 216.4 | 174.7 |
| Upper middle | 50 | 154.0 | 107.8 |
| Lower middle | 53 | 86.7 | 118.5 |
| Low income | 30 | 39.1 | 41.3 |
| | | | |
| Total | 175 | 135.1 | 118.4 |

Per capita dietary intakes of ARA, DHA and % energy in Gross National Income countries 2-4 in Africa and Asia

| Africa | | | | |
|---------------|------------|---------|------------|---------|
| GNI | ARA mg/day | ARA %en | DHA mg/day | DHA %en |
| Upper middle | 150 | 0.045 | 98.6 | 0.043 |
| Lower middle | 62.8 | 0.023 | 118 | 0.044 |
| Low | 42.1 | 0.016 | 48.4 | 0.052 |
| Asia | | | | |
| Upper middle | 230 | 0.067 | 262 | 0.079 |
| Lower middle | 119 | 0.040 | 264 | 0.079 |
| Low | 38.2 | 0.014 | 142 | 0.052 |

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Per capita daily DHA intake (%en and mg/day) among developing countries
 highest to lowest based on %en DHA

| Countries | Per capita daily intake of DHA (%en) | Per capita daily intake of DHA (mg/day) |
|----------------------|--------------------------------------|---|
| Maldives | 0.475% | 1409 |
| Antigua and Barbuda | 0.223% | 580 |
| China, Hong Kong SAR | 0.186% | 675 |
| Kiribati | 0.186% | 618 |
| China, Macao SAR | 0.167% | 528 |
| Malaysia | 0.166% | 528 |
| Rwanda | 0.008% | 20 |
| Nepal | 0.008% | 23 |
| Uzbekistan | 0.006% | 18 |
| Guinea-Bissau | 0.006% | 15 |
| Lesotho | 0.004% | 12 |
| Tajikistan | 0.003% | 8 |
| Afghanistan | 0.003% | 7 |
| Ethiopia | 0.003% | 7 |

High

Low

Per capita daily ARA intake (%en and mg/day) among developing countries on %en ARA intake

| Countries | Per capita daily intake of ARA (%en) | Per capita daily intake of ARA (mg/day) |
|----------------------|--------------------------------------|---|
| China, Hong Kong SAR | 0.121% | 437 |
| Antigua and Barbuda | 0.111% | 289 |
| Maldives | 0.111% | 329 |
| French Polynesia | 0.087% | 281 |
| China, Macao SAR | 0.085% | 270 |
| Bahamas | 0.082% | 235 |
| Malaysia | 0.079% | 252 |

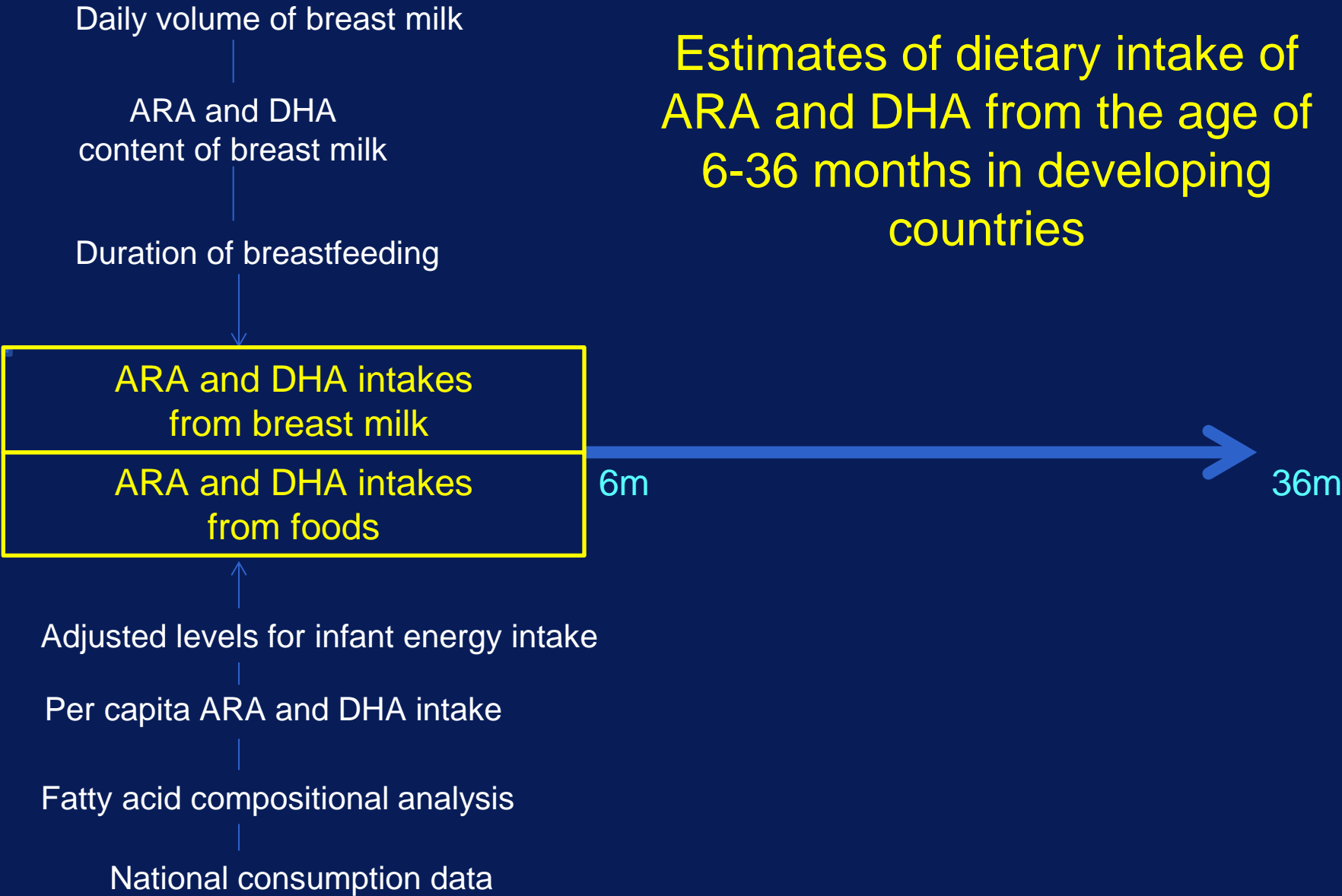
High

| | | |
|---------------|--------|----|
| Nepal | 0.013% | 36 |
| India | 0.012% | 33 |
| Malawi | 0.011% | 27 |
| Mozambique | 0.010% | 25 |
| Ethiopia | 0.010% | 24 |
| Guinea-Bissau | 0.009% | 24 |
| Rwanda | 0.007% | 18 |

Low

What is the estimated dietary intake of ARA and DHA in developing countries during the age period of 6-36 months?

Estimates of dietary intake of ARA and DHA from the age of 6-36 months in developing countries



Median (range) daily dietary intake of ARA and DHA in low income regions (GNI 2-4) during period 6-36 months of age

| Region | ARA intake BM / Food (mg/ day)* | DHA intake BM / Food (mg/day)** |
|-------------------------------|---------------------------------|---------------------------------|
| North Africa | 54.3 (53-62) | 47.3 (47-65) |
| Sub-Saharan Africa | 62.5 (49-76) | 52.9 (26-120) |
| South East Asia, | 68.4 (62-84) | 101.6 (36-119) |
| Southern Asia | 76.1 (57-137) | 73.0 (33-371) |
| Western Asia | 53.6 (45-55) | 30.8 (29-35) |
| Central Asia | 63.8 (38-77) | 28.2 (14-35) |
| Caribbean and Central America | 52.5 (49-65) | 51.9 (38-64) |
| South America | 76.3 (60-95) | 38.6 (24-98) |
| | | |
| All Regions | 63.7 (38-137) | 48.8 (14-371) |

*p=0.001; **p=0.04;

Estimation of ARA and DHA dietary intakes (BM/Food) in 6-36 month children living in 76 developing countries

| Gross National Income (GNI) | Median (range) daily intake of ARA from BM/Food mg /day | Median (range) daily intake of DHA from BM/Food mg/day |
|--------------------------------|--|---|
| Upper middle | 68.3 (38-137) | 42.9 (14-371) |
| Lower middle | 63.1 (49-95) | 51.5 (24-120) |
| Low | 61.5 (50-92) | 50.1 (28-121) |
| Total | 63.7 (38-137) | 48.8 (14-371) |

Estimation of ARA and DHA dietary intakes in 6-36 month children living in 76 developing countries

| Gross National Income (GNI) | Median duration of breastfeeding (months) | Median (range) daily intake of ARA from BM/Food mg /day | Median (range) daily intake of DHA from BM/Food mg/day |
|-----------------------------|---|---|--|
| Upper middle | 14.7 (7-25) | 68.3 (38-137) | 42.9 (14-371) |
| Lower middle | 18.1 (7-24) | 63.1 (49-95) | 51.5 (24-120) |
| Low | 20.8 (17-37) | 61.5 (50-92) | 50.1 (28-121) |
| Total | 18.9 (7-37) | 63.7 (38-137) | 48.8 (14-371) |

Estimation of ARA and DHA dietary intakes from complementary foods in 6-36 month children living in 76 developing countries

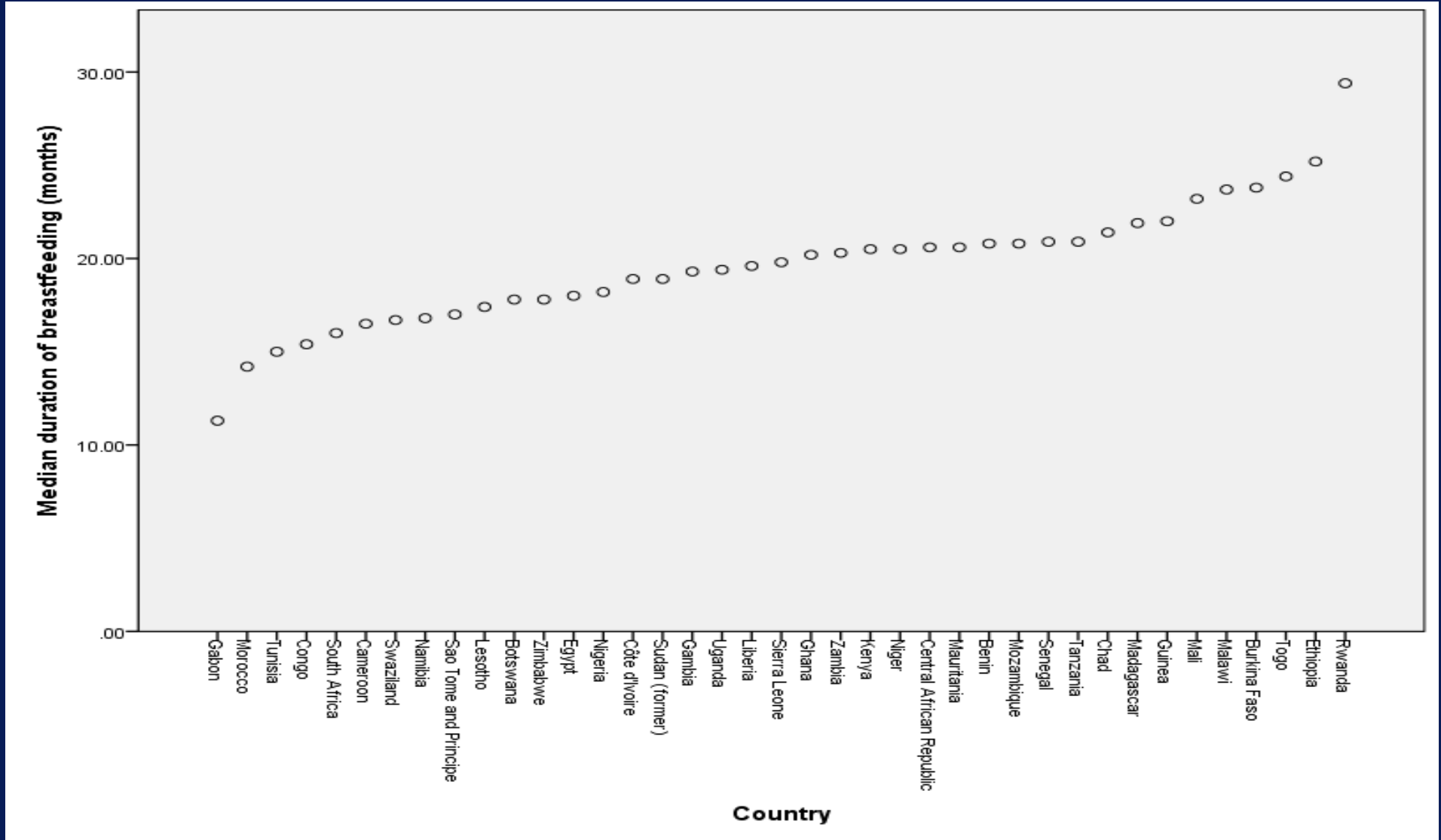
| Gross National Income (GNI) | Median (range) daily intake of ARA from Complementary Food (No breast milk) mg /day | Median (range) daily intake of DHA from Complementary Food (No breast milk) mg/day |
|-----------------------------|---|--|
| Upper middle | 34.6 (21-67) | 23.7 (10-175) |
| Lower middle | 19.1 (5-61) | 16.5 (3-80) |
| Low | 8.9 (1-22) | 9.6 (0.7-65) |
| Total | 17.9 (1-67) | 14.6 (0.7-175) |

Comparison of developing small islands and landlocked countries for median duration of breast feeding (months) and dietary DHA and ARA intakes (mg/day) during the period of 6-36 months of age.

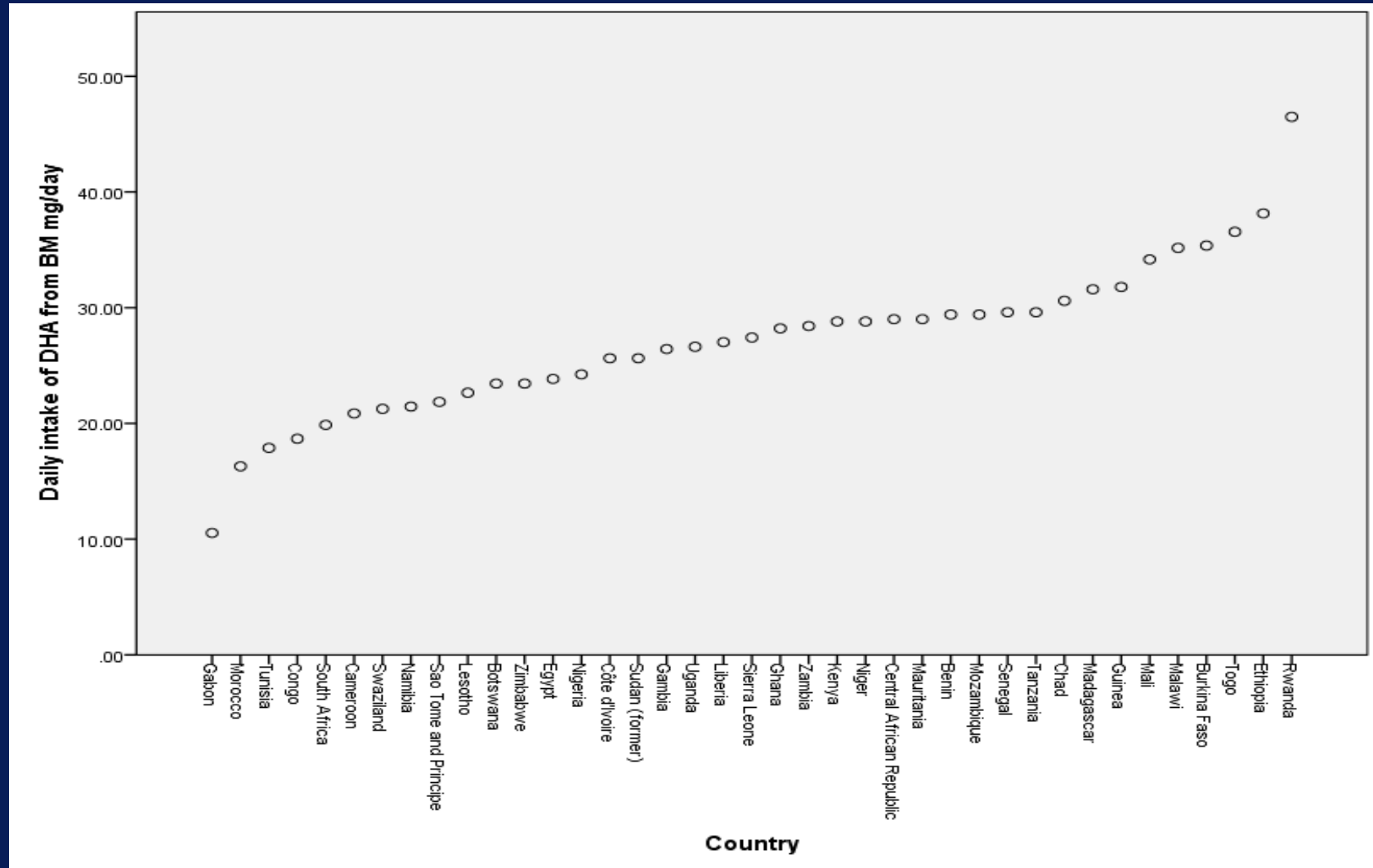
| | Median duration of breast feeding | Median daily intake of ARA from breast milk and foods | Median daily intake of DHA from breast milk and foods* | Median daily intake of ARA from breast milk | Median daily intake of DHA from breast milk | Median daily intake of ARA from foods (no BM) | Median daily intake of DHA from foods (no BM)* |
|---|-----------------------------------|---|--|---|---|---|--|
| Small developing island N 10 | 18.3 (7-25) | 63.7 (50-137) | 54.9 (36-371) | 37.6 (3-59) | 24.4 (2-38) | 21.2 (6-61) | 32.7 (9-175) |
| Landlocked country N 23 | 18.9 (8-34) | 63.83 (38-92) | 35.7 (14-65) | 39.4 (6-84) | 25.6 (4-55) | 12.9 (1-56) | 8.1 (0.7-27) |

Mann Whitney U test *p<0.01

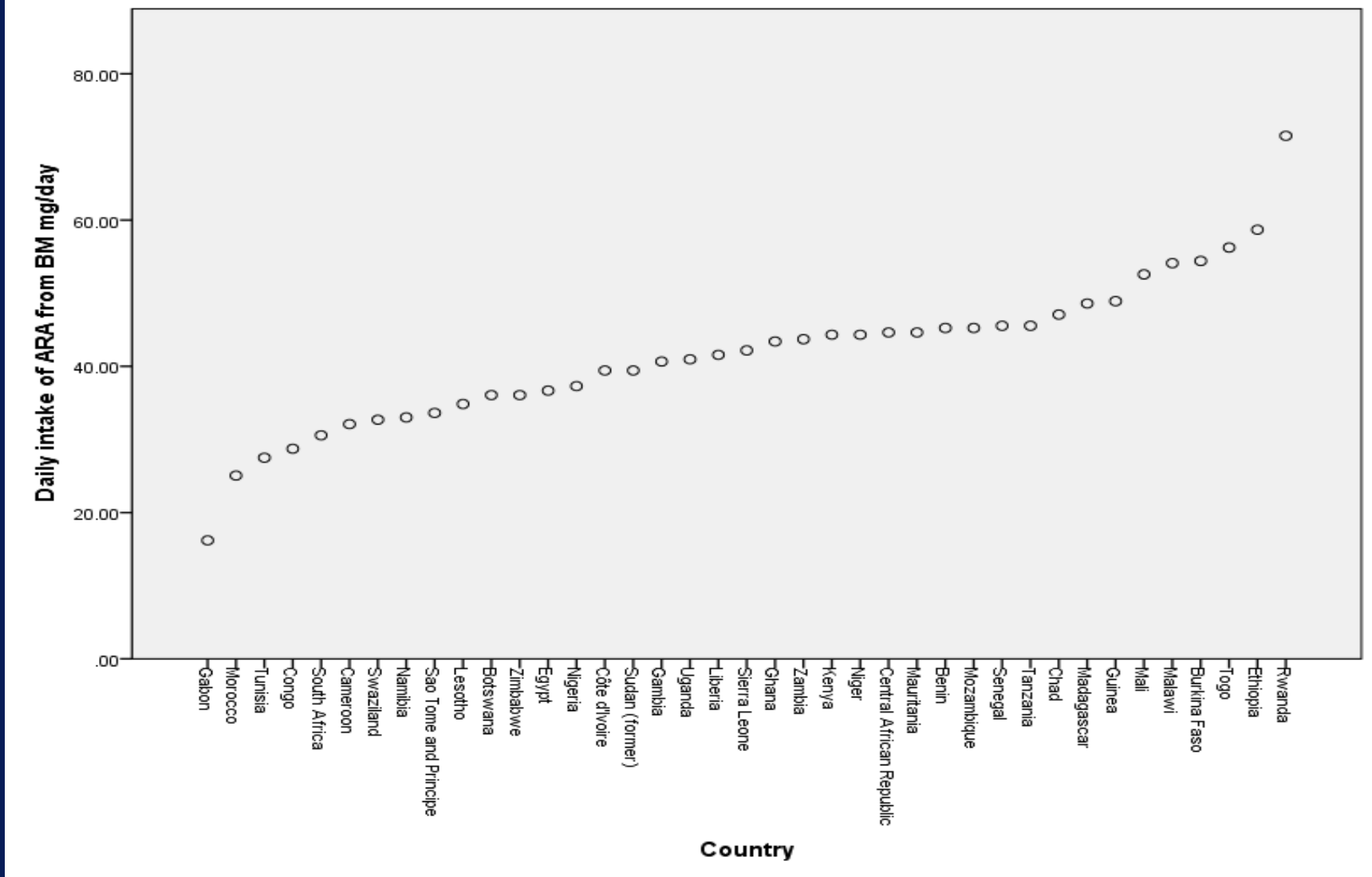
Median duration of breastfeeding (months) in 39 African countries



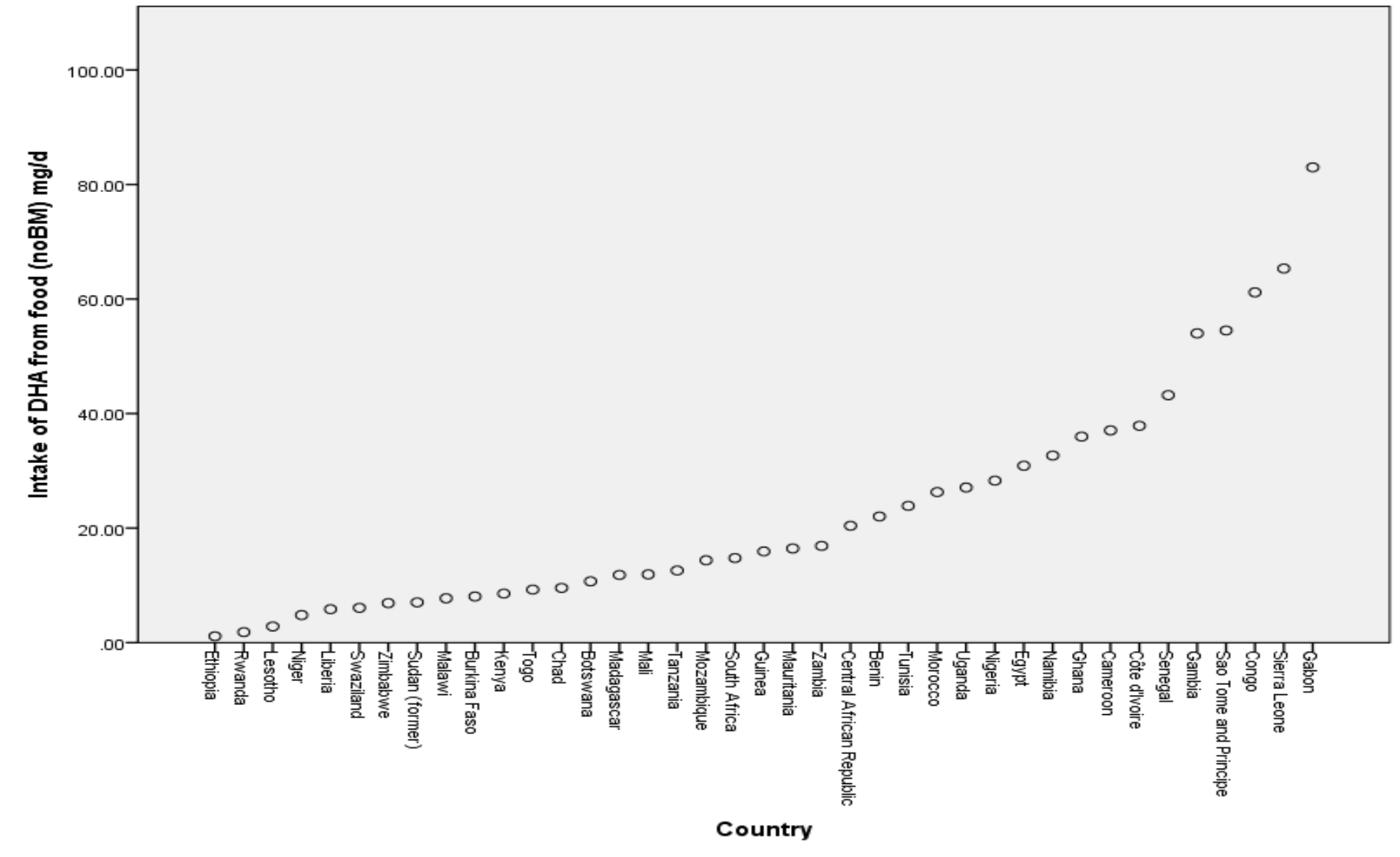
Median daily intake of DHA from breast milk (BM), age 6-36 months, in 39 African countries



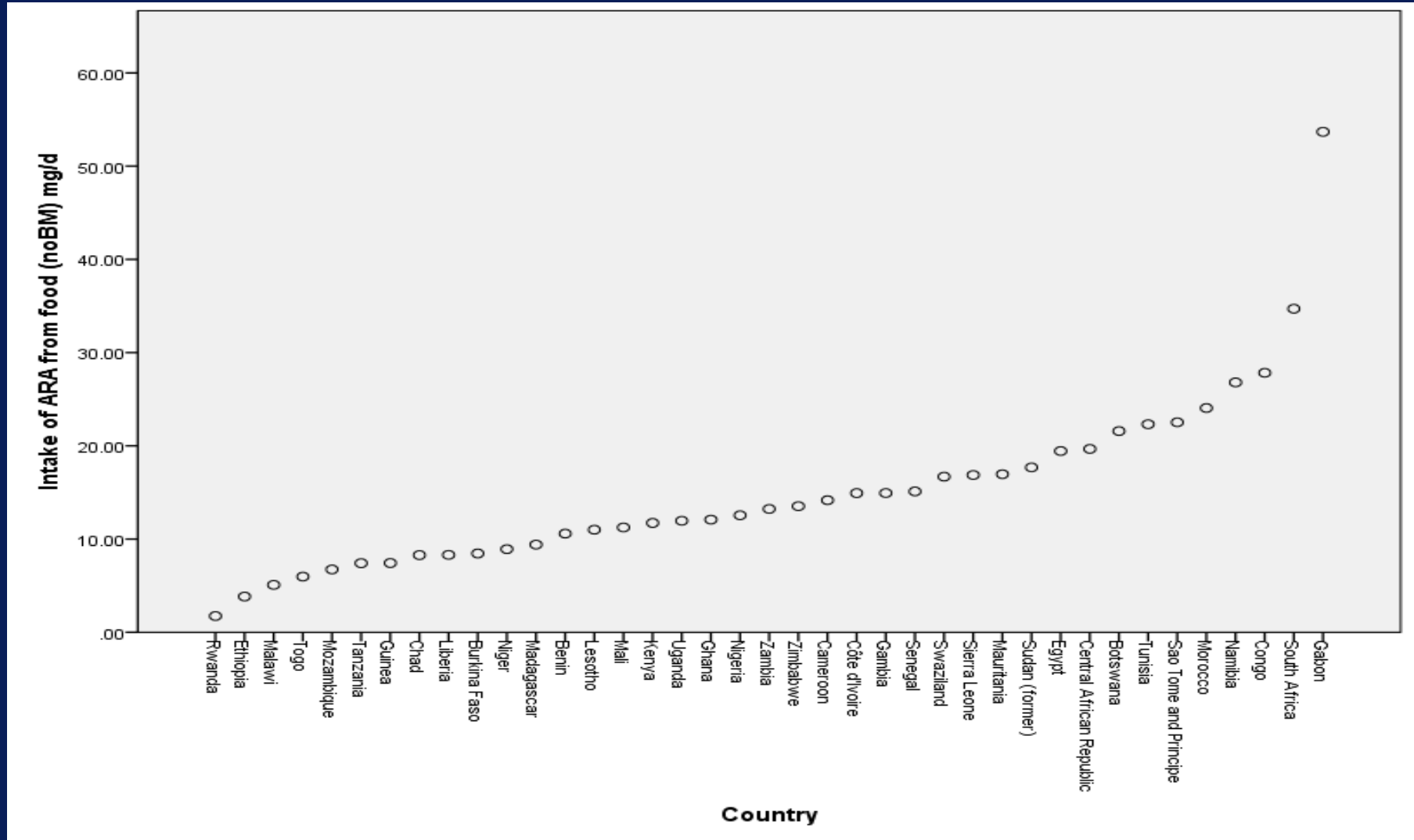
Median daily intake of ARA from breast milk (BM), age 6-36 months, in 39 African countries



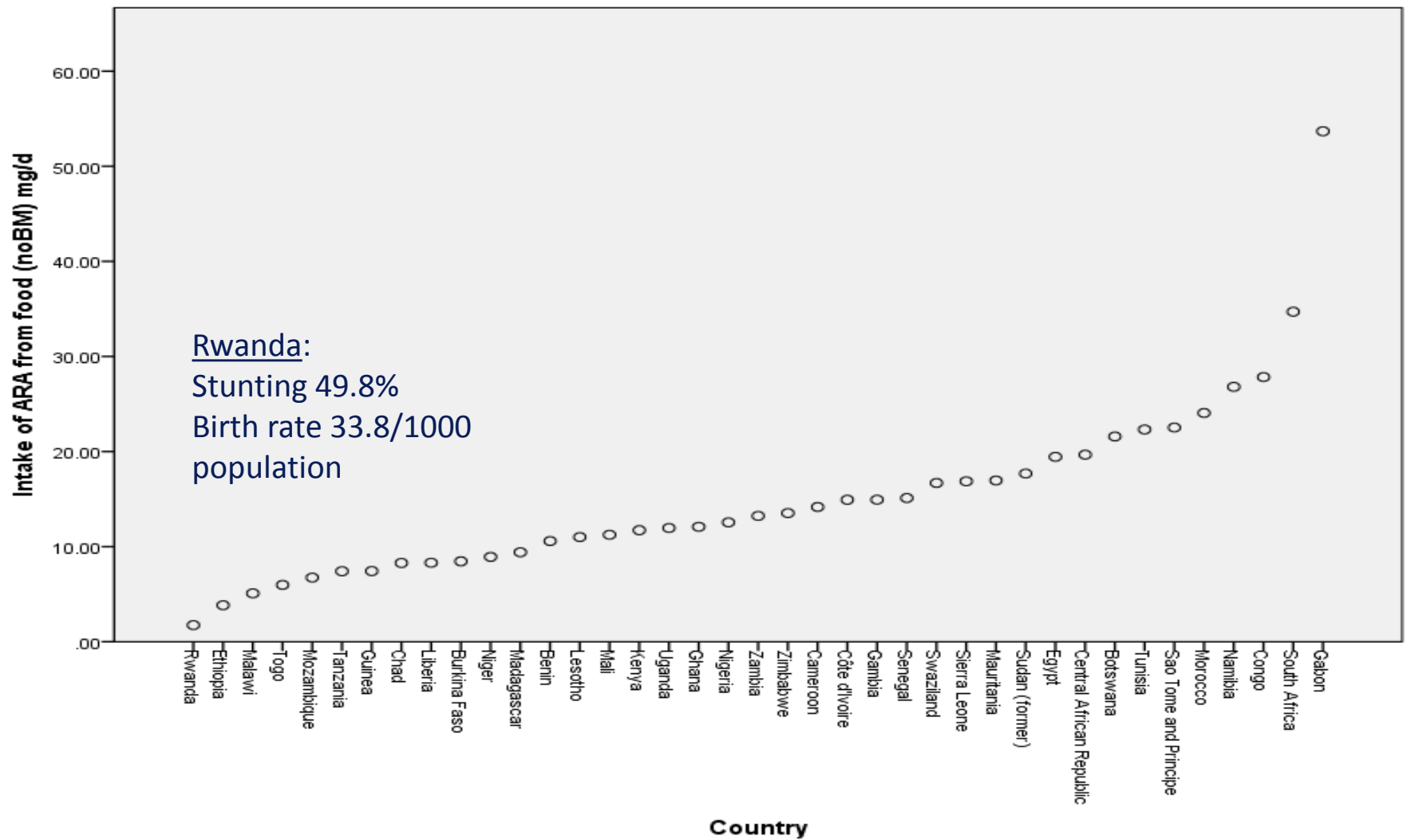
Daily intake of DHA (mg/day) from complementary food in 39 African countries



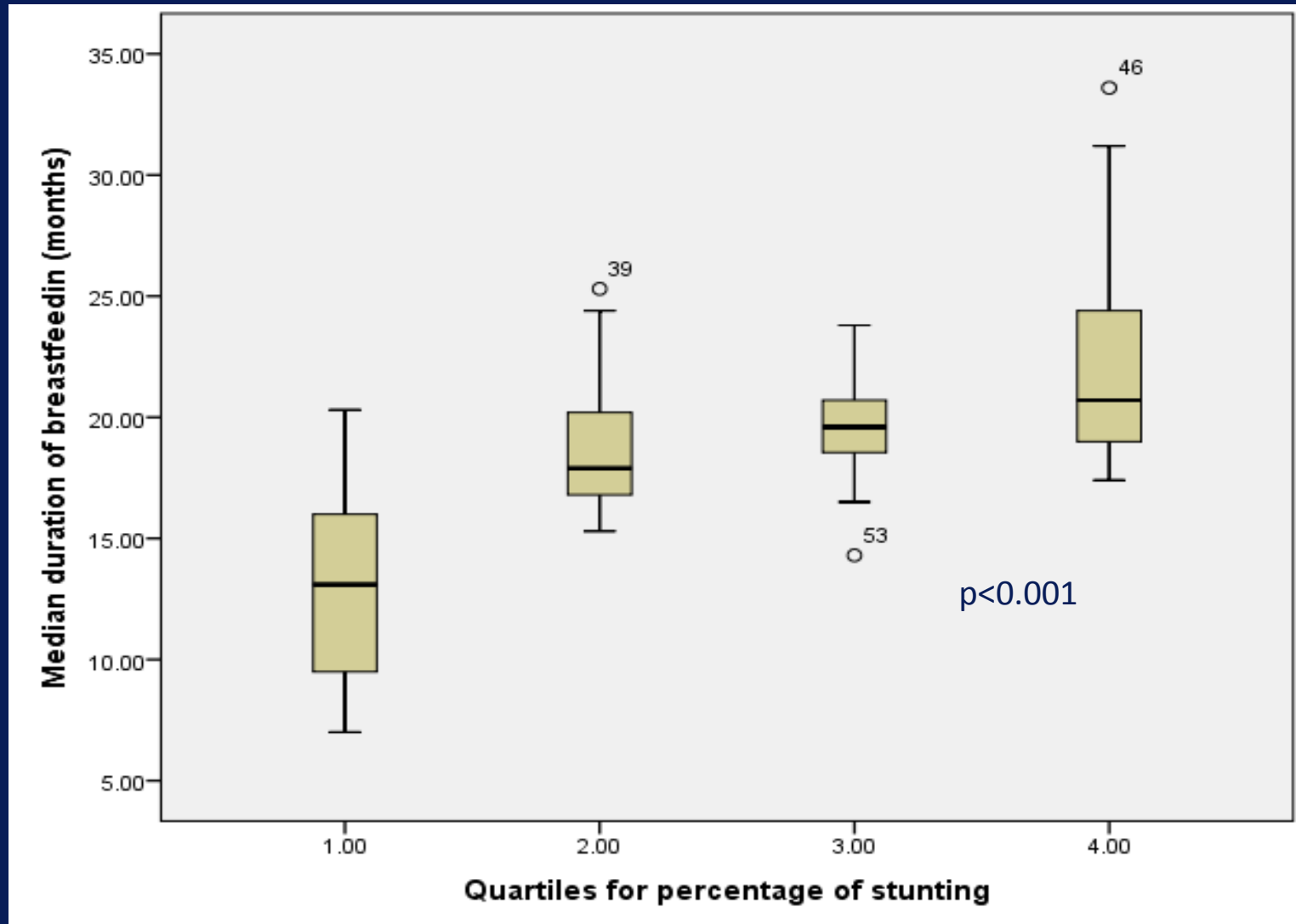
Daily intake of ARA (mg/day) from complementary food in 39 African countries



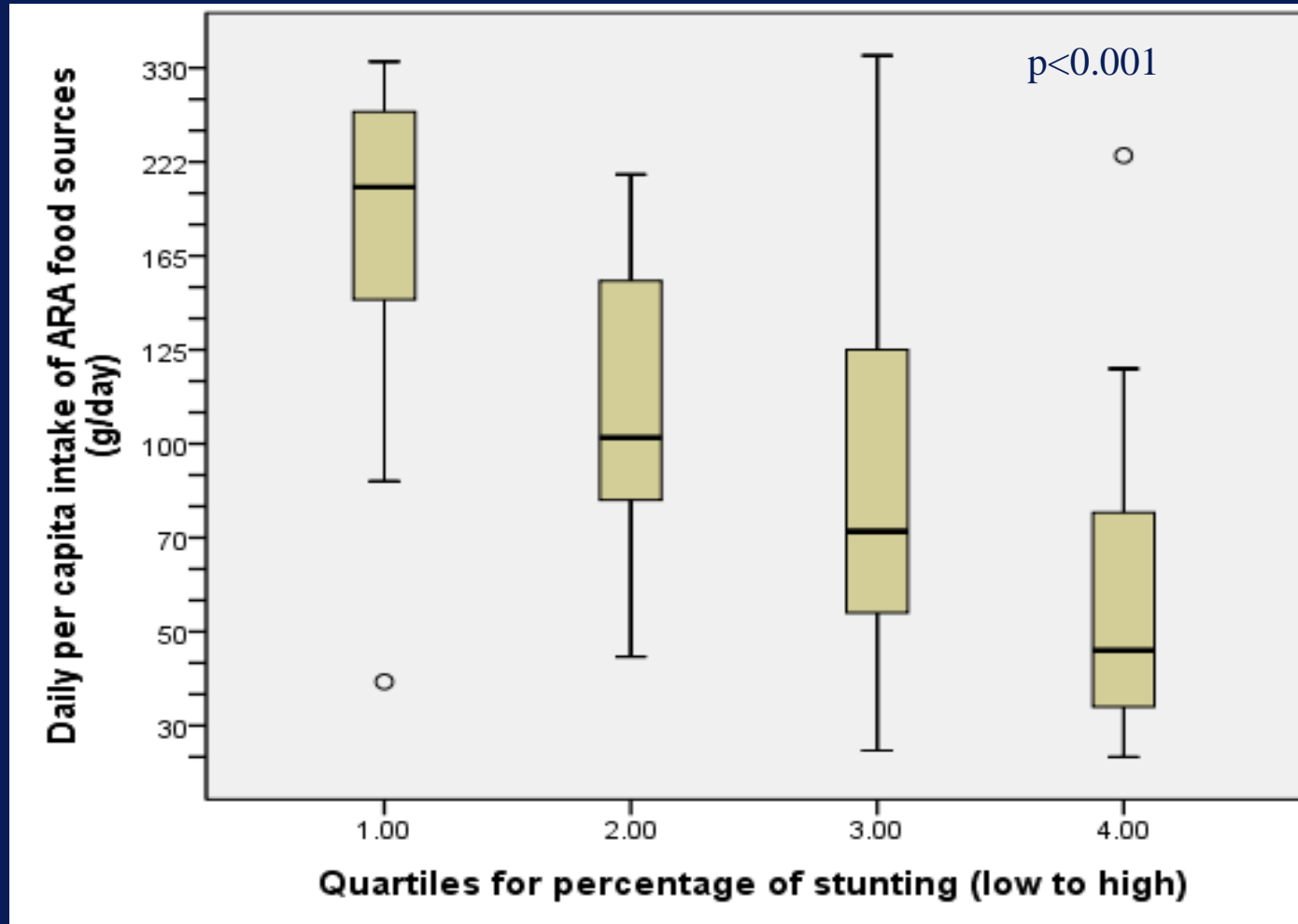
Daily intake of ARA (mg/day) from complementary food in 39 African countries



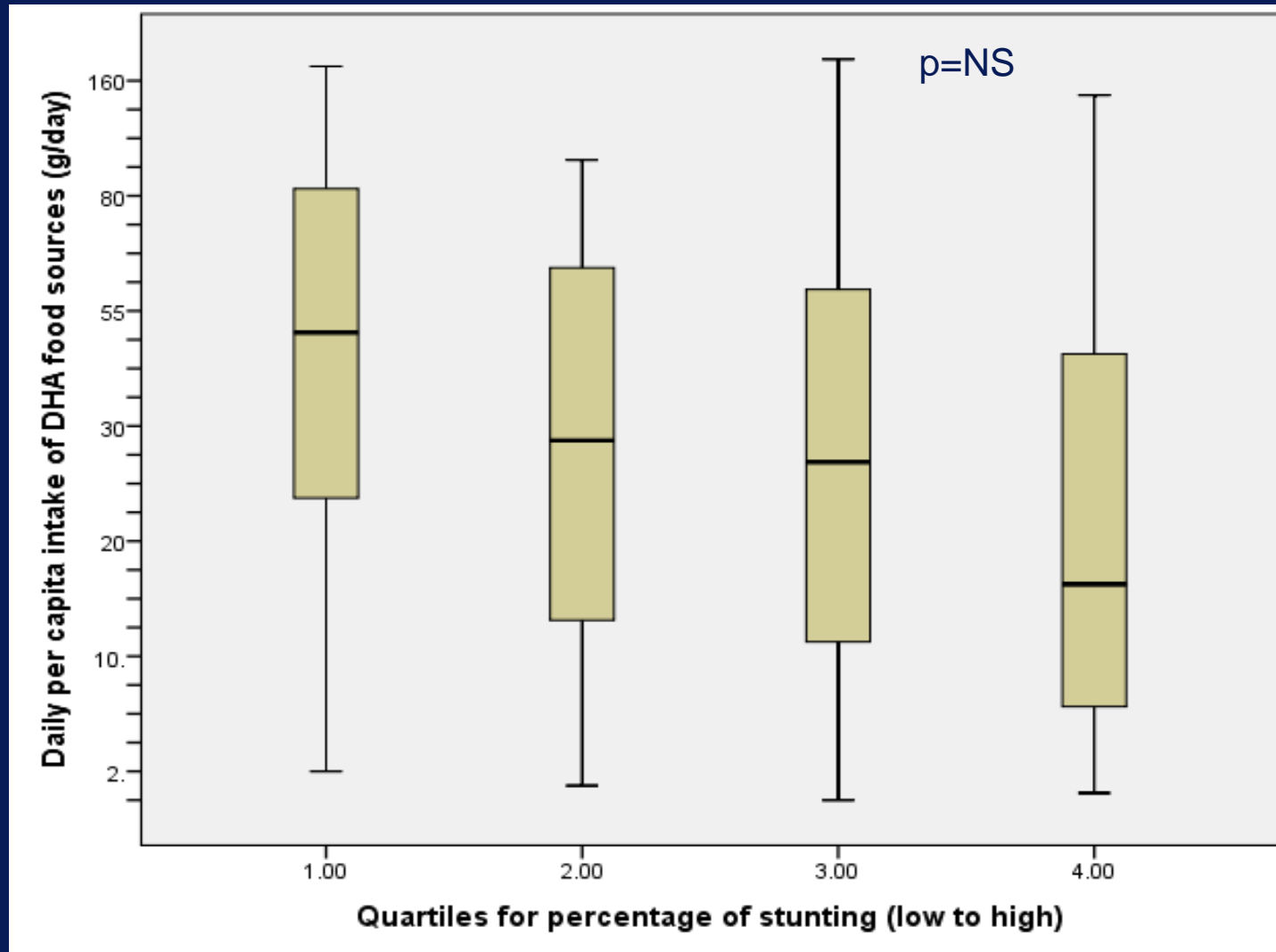
Relationship of median duration of breastfeeding to percentage of stunting in 115 medium to low income countries



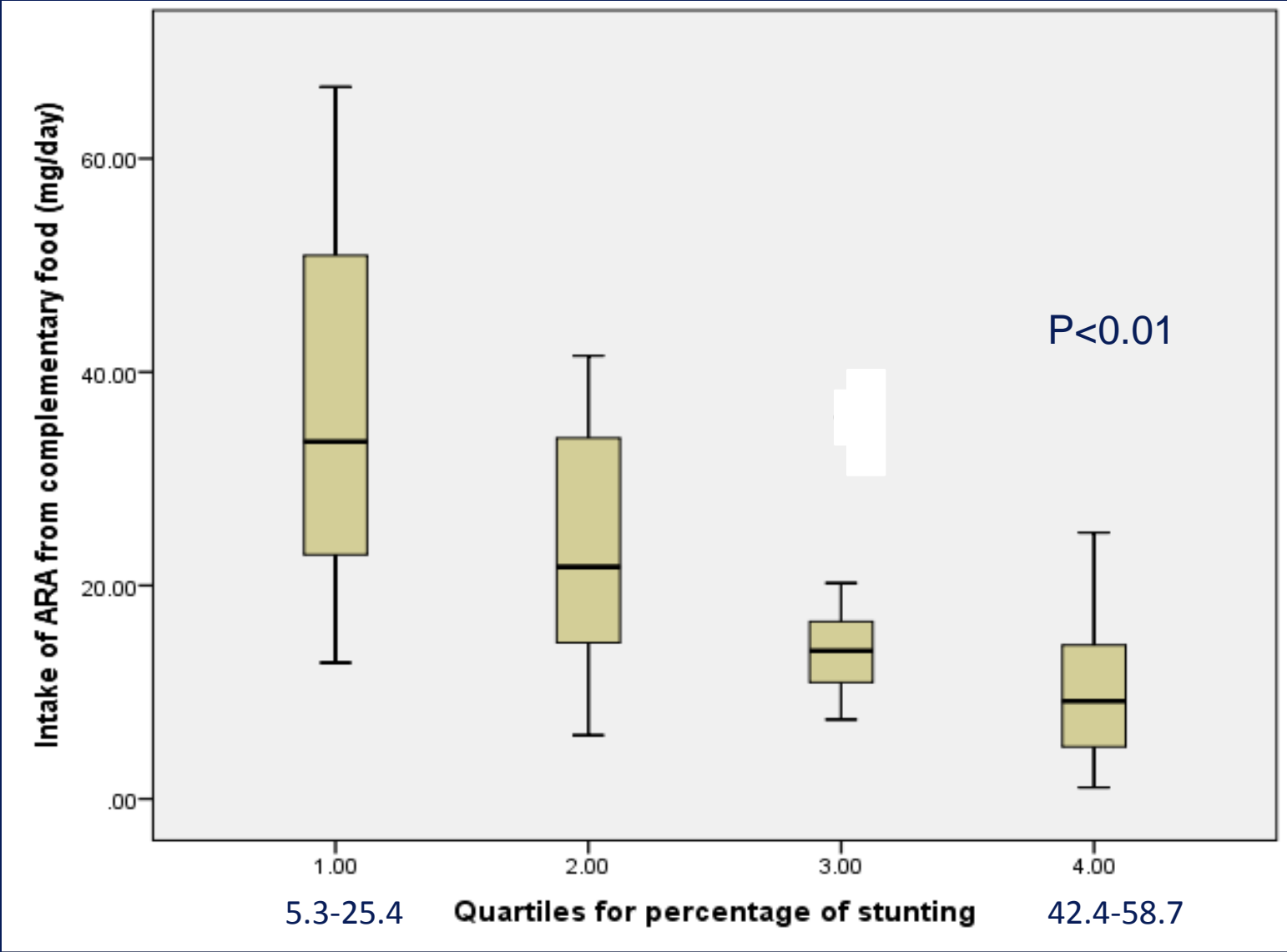
Relationship of daily per capita intake of ARA food sources to percentage of stunting in 115 medium to low income countries



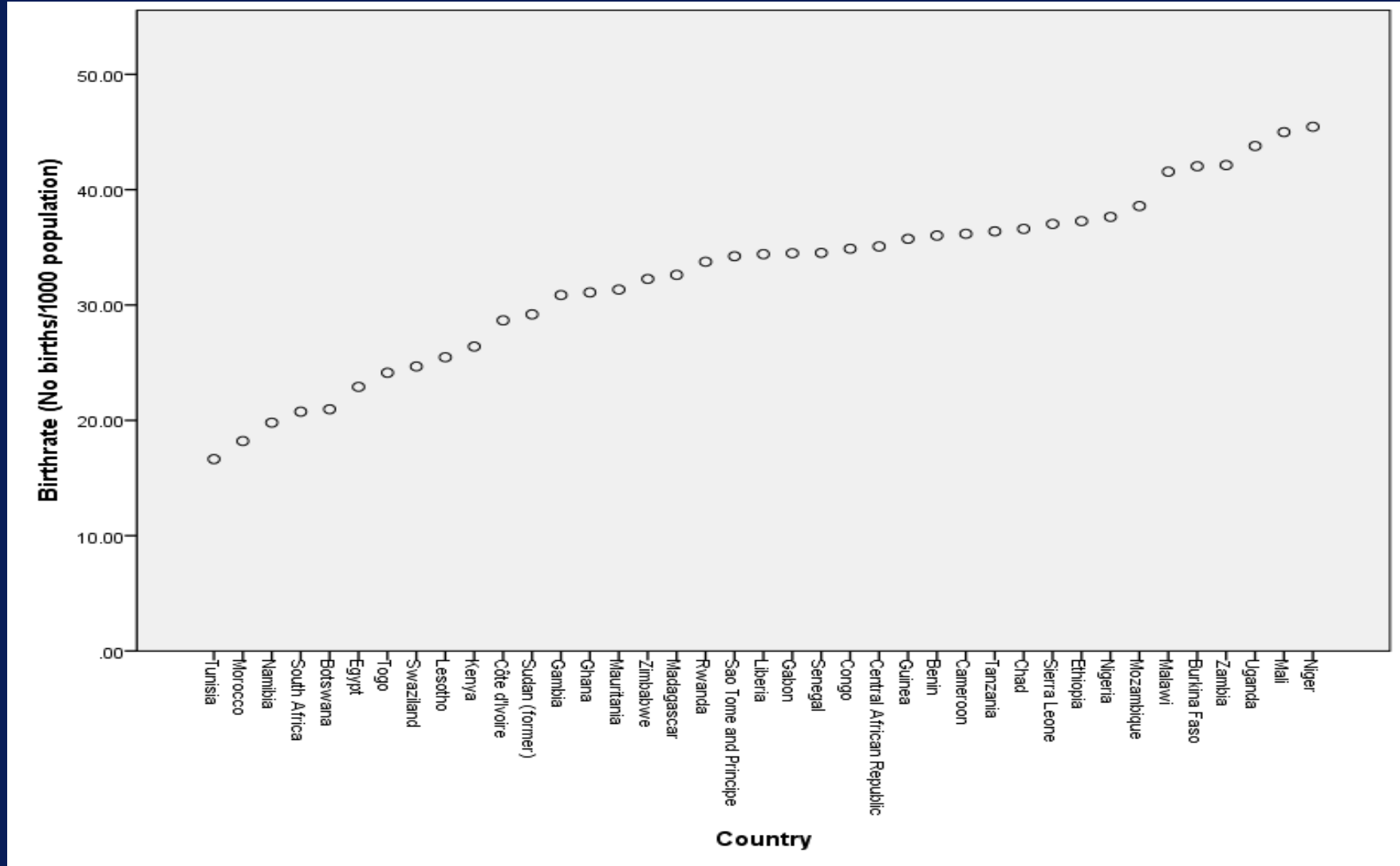
Relationship of daily per capita intake of DHA food sources to percentage of stunting in 115 medium to low income countries



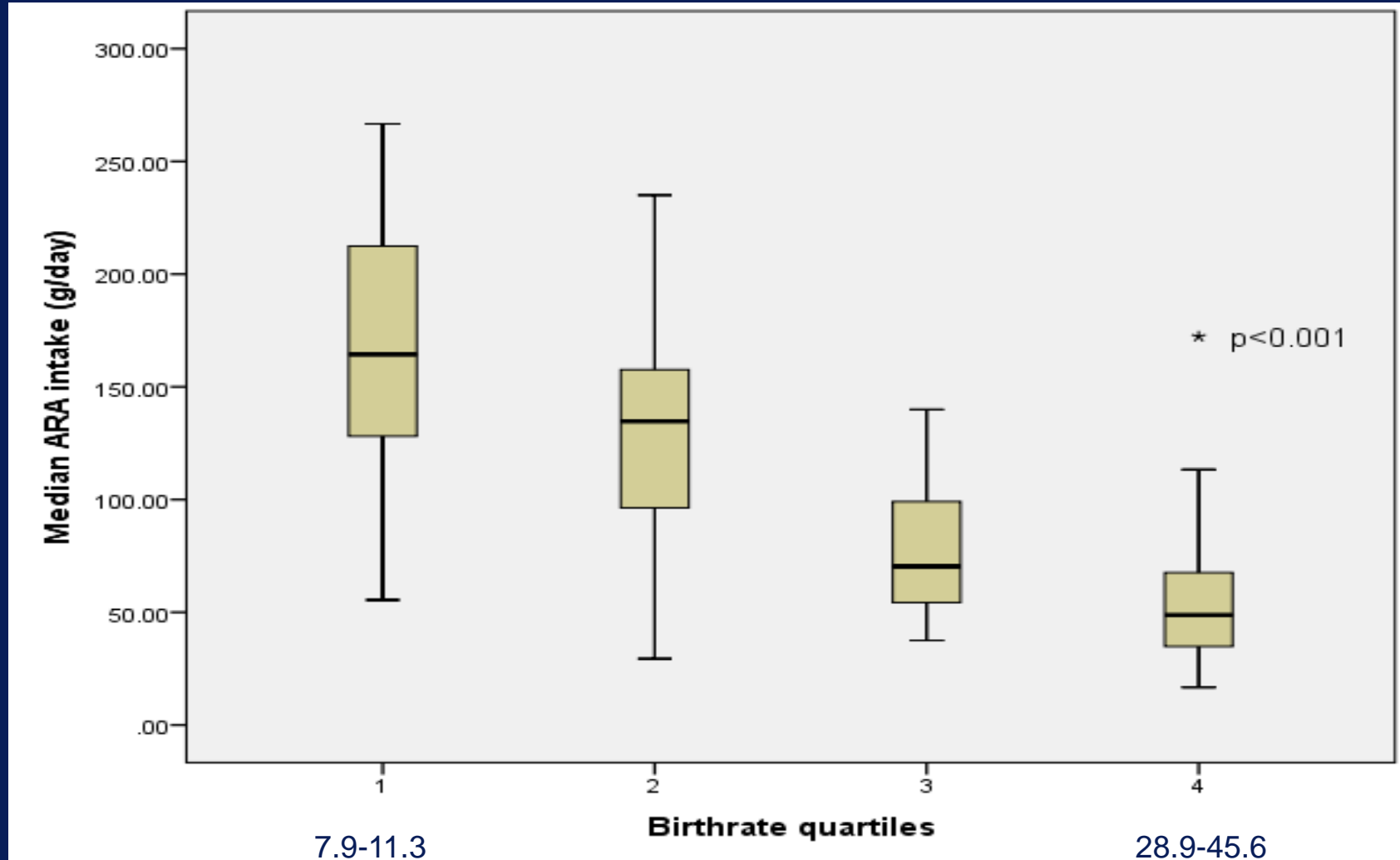
In 74 developing countries relationship of median daily intake of ARA from complementary foods to percentage of stunting



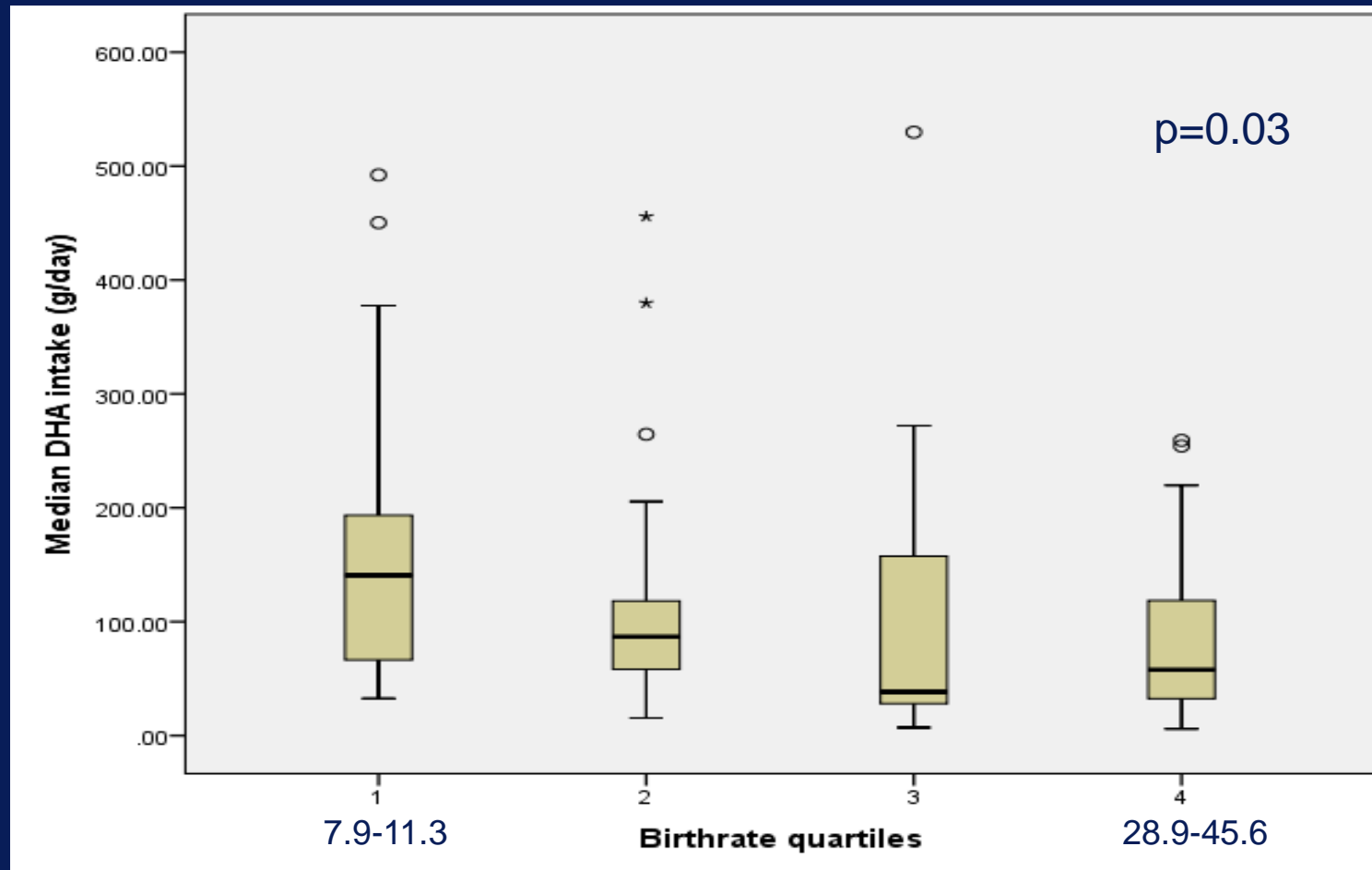
Variation in birth rates across 39 African countries



In developing countries relationship of per capita median daily ARA intake to birth rate quartiles
(birth rate n births/1000 population)



In developing countries relationship of per capita median daily DHA intake to birth rate quartiles (birth rate n births/1000 population)



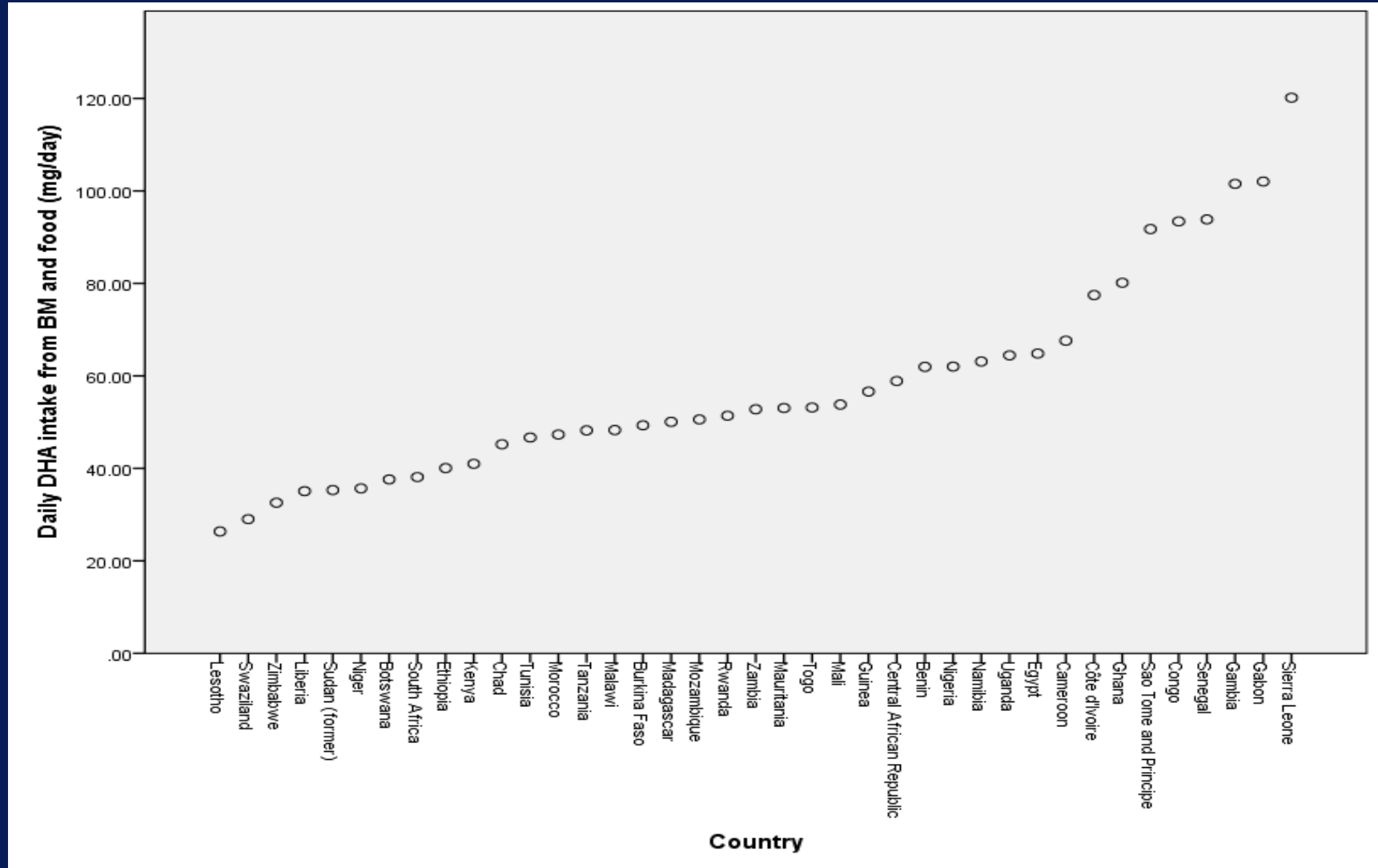
Conclusions

- Scientific evidence indicates that DHA and ARA are important nutrients throughout life
- FAO data shows wide variation worldwide in dietary intake of both DHA and ARA at the population level
- Breast milk is a crucial source of DHA and ARA for all infants but particularly for those living in low income countries
- Complementary foods are currently a poor source of DHA and ARA especially in many low income countries

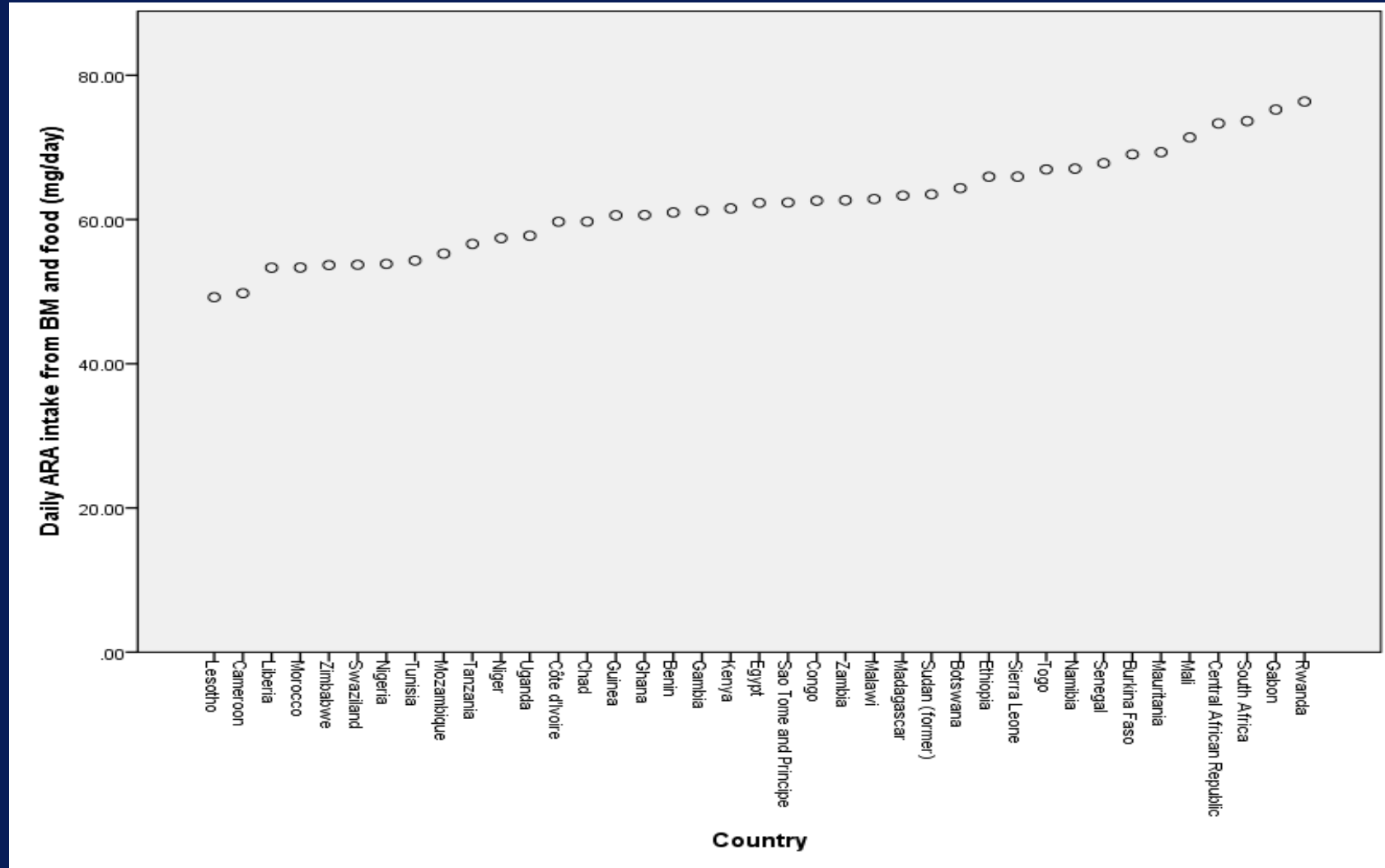
Conclusions

- There needs to be a “safety net” for dietary ARA and DHA (and also other key nutrients) to protect those infants who are living in countries where the national income is low, the availability of ARA and DHA food sources is limited and birth rates are high.
- Research activities and future public health policies on DHA and ARA need to focus on the needs of the most vulnerable infants

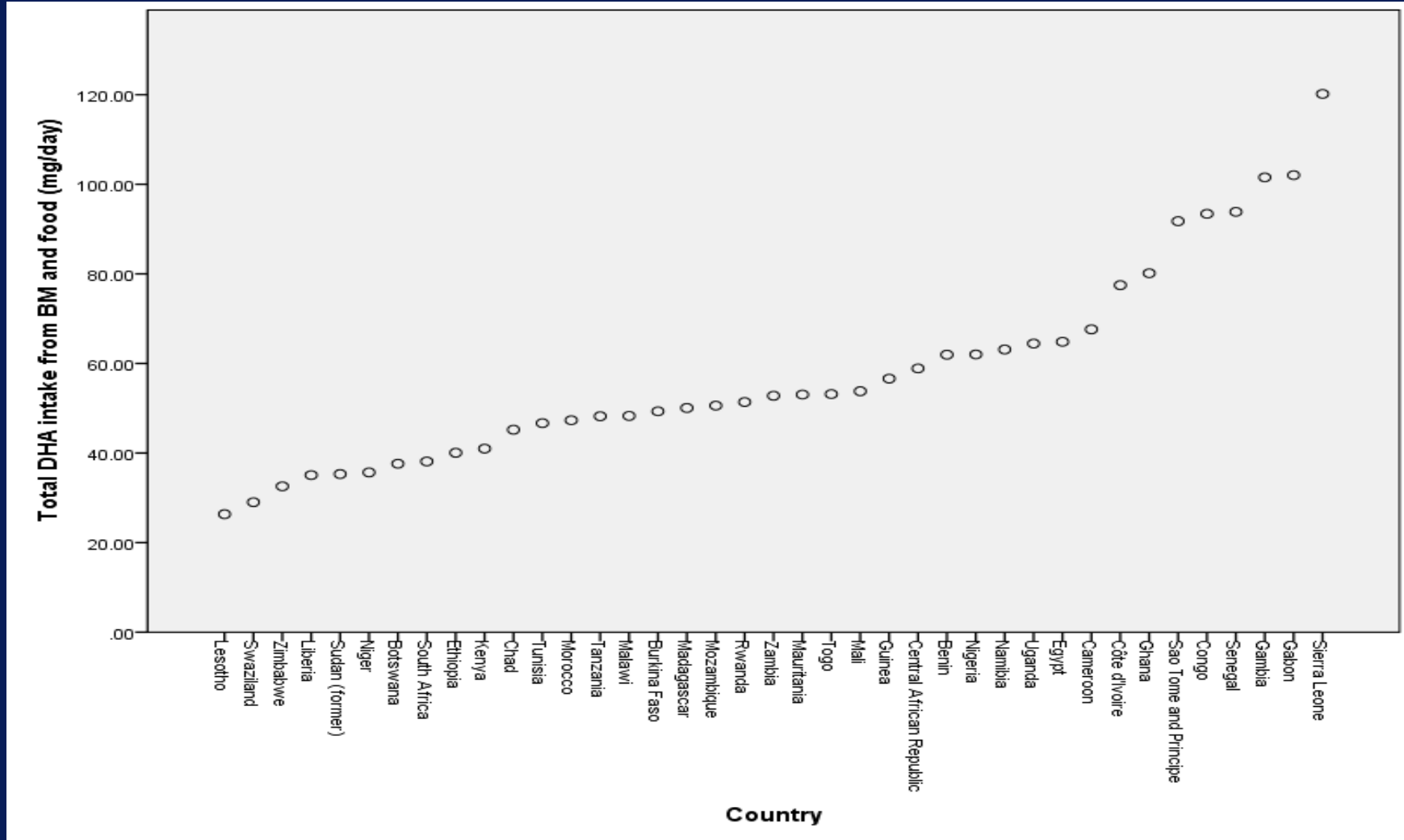
Median daily intake of DHA from breast milk (BM) and complementary foods, age 6-36 months, in 39 African countries



Median daily intake of ARA from breast milk (BM) and complementary foods, age 6-36 months, in 39 African countries



Median daily intake of DHA from breast milk (BM) and complementary foods, age 6-36 months, in 39 African countries



In 74 developing countries relationship of median daily intake of DHA from complementary foods to percentage of stunting

