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# Two Decade Trends in Birth Weight and Early Childhood Growth in Papua New Guinea

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*ABSTRACT* *At present, little is known about patterns of early growth* and development in foraging and small-scale horticultural populations. Moreover, still less is known about secular changes in growth in these populations. Data collected in 1967, 1976, and 1989 are presented for birth weight and subsequent growth to 5 years among Au forager-horticulturalists of Papua New Guinea. Despite the launching of health campaigns over the last two decades aimed at bettering the nutritional status of the Au, the data show that average birth weight has remained stable and low at just over 2600 g. Weight- and length-for-age also show no significant changes among traditional Au over the last 20 years, and remain on average, at just below the U.S. 5th percentile. Evidence for the start of a positive secular trend in birth weight and subsequent growth is seen, however, among a small group of Au children residing in households that have a source of wage income. These individuals show an increase of 150 g in birth weight, and over the subsequent 5 years of growth average 93 g heavier and 2.6 cm taller than Au children in traditional households. In addition to providing baseline data on child growth in a forager-horticulturalist society, the findings provide evidence for a secular trend newly underway, and suggest that health promotion campaigns alone without socioeconomic development may be insufficient in effecting change in growth status in rural communities.

# Intro-1

Reports of 30 years before (Sturt, 1972 and others):

Anguganak region of West Sepik, PNG

-early childhood malnutrition (68%)

-IMR (117 for m, 149 for f)

-BW (2.6 kg)

Health campaign by missionary and government

-basic sanitation and hygiene

-“aid post”: antimalarial, antibiotic, antihelminthic

-monthly patrol: anthropometric measurements

birth/death registration

No investigation for the effect of the campaign

# Intro-2

Missionary and government

→ socioeconomic stratification into the previously egalitarian society

Cash economy → better nutritional status ?

(e.g., Ulijaszek, 1993: mostly “yes”, a few “no”)

# Intro-3

Forager-horticulturalist society

- NS, BW ↓ IMR ↑

1970

Health campaign

Cash economy

1989

1. Baseline data for BW, W/A, H/A
2. Changes in BW and growth patterns over two decades
3. Effect of socioeconomic stratification on health

# The study population

The Au language group: n=10,000

- 150-850 m asl
- 44 villages (2-5 hamlets, 80-500)
- hot and humid
- foraging/hunting and slush-and-burn horticulture
- staple: sago and *tulip* leaves
- 2%: income generating occupations

  ~rice & canned foods; fatter/taller;

  neonate diet 5 months earlier
- malaria endemic

# Data collection

- by RJS (1967, 1976)
  - N=465 infants and toddlers (0-60 months), 1967
  - N=456 infants and toddlers (0-60 months), 1976
  - N=82 Birth weight (for those delivered during the period of fieldwork in 1967)
  - Only the children whose exact ages were known

- by DPT (1989)
  - N=729 infants and toddlers (0-60 months),
    monthly patrols over 20 villages
  - N=776 birth weight, 1988-89 (births during 16 months; birth books for <5 y in 1989), twin & stillbirths excluded

- No difference between W measured and that recorded from birth books)

## Results-1: No change in BW over two decades

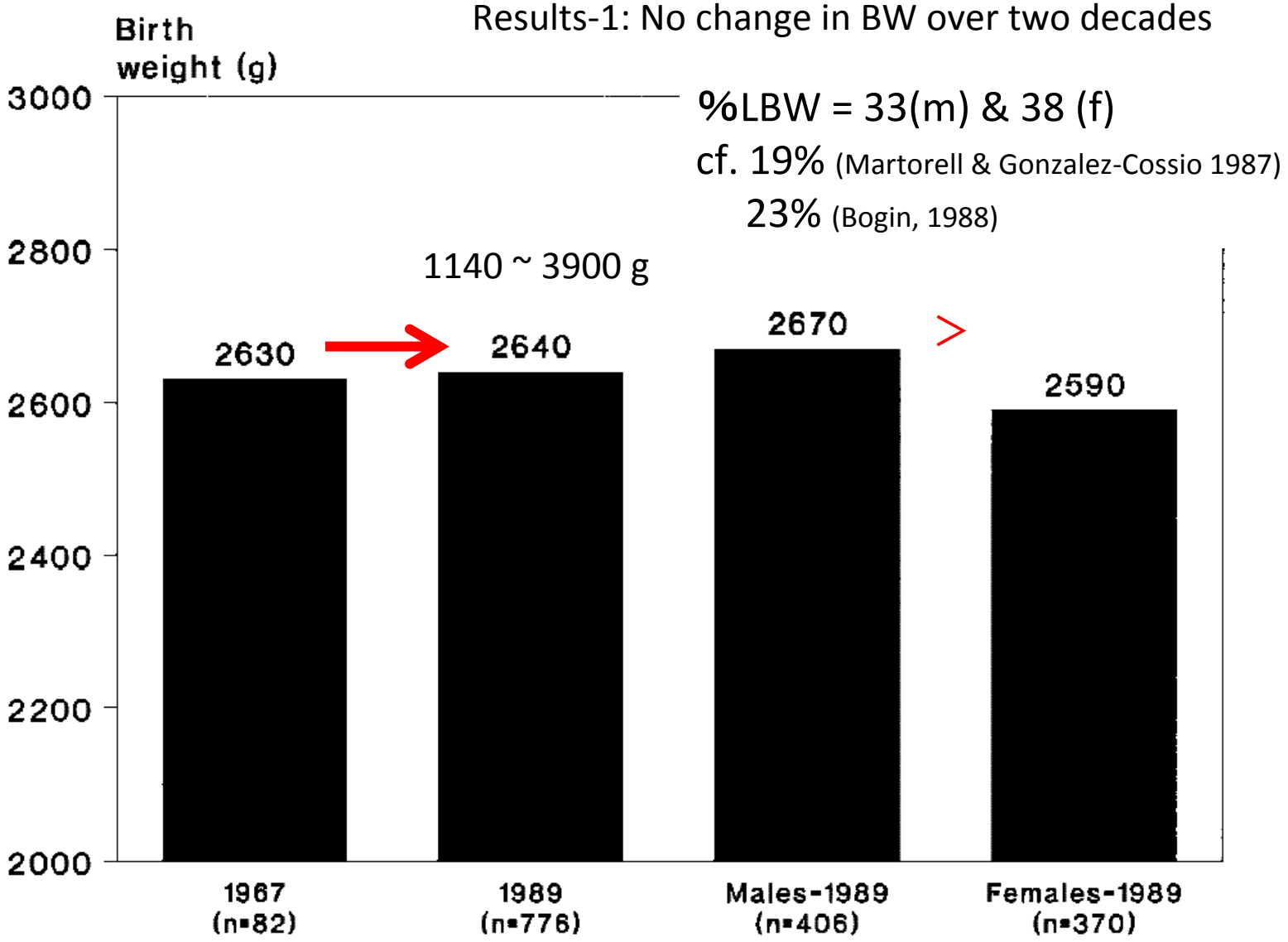



Fig. 1. Mean birth weight (g) among the Au in 1967 (combined-sex) and 1989 (combined-sex and sex-specific).

*TABLE 1. Populations with average birth weights below 2800*[1]

| Group/Location | n | Average birth weight (g) |
|---|---|---|
| Wapei of Papua New Guinea (PNG) | 63 | 2400 |
| Au of Papua New Guinea | 776 | 2640 |
| BaMbuti of Zaire | 40 | 2640 |
| Pitjantjatjara of So. Australia | 94 | 2650 |
| New Ireland Islanders of PNG | 393 | 2660 |
| Singapore/Kuala Lumpur Malaysians | 9862 | 2730 |
| Enga of PNG | 200 | 2750 |
| Rangoon Burmese | 6340 | 2770 |
| Quioco of Angola | 665 | 2780 |

[1]All data except Au are from Meredith (1970).

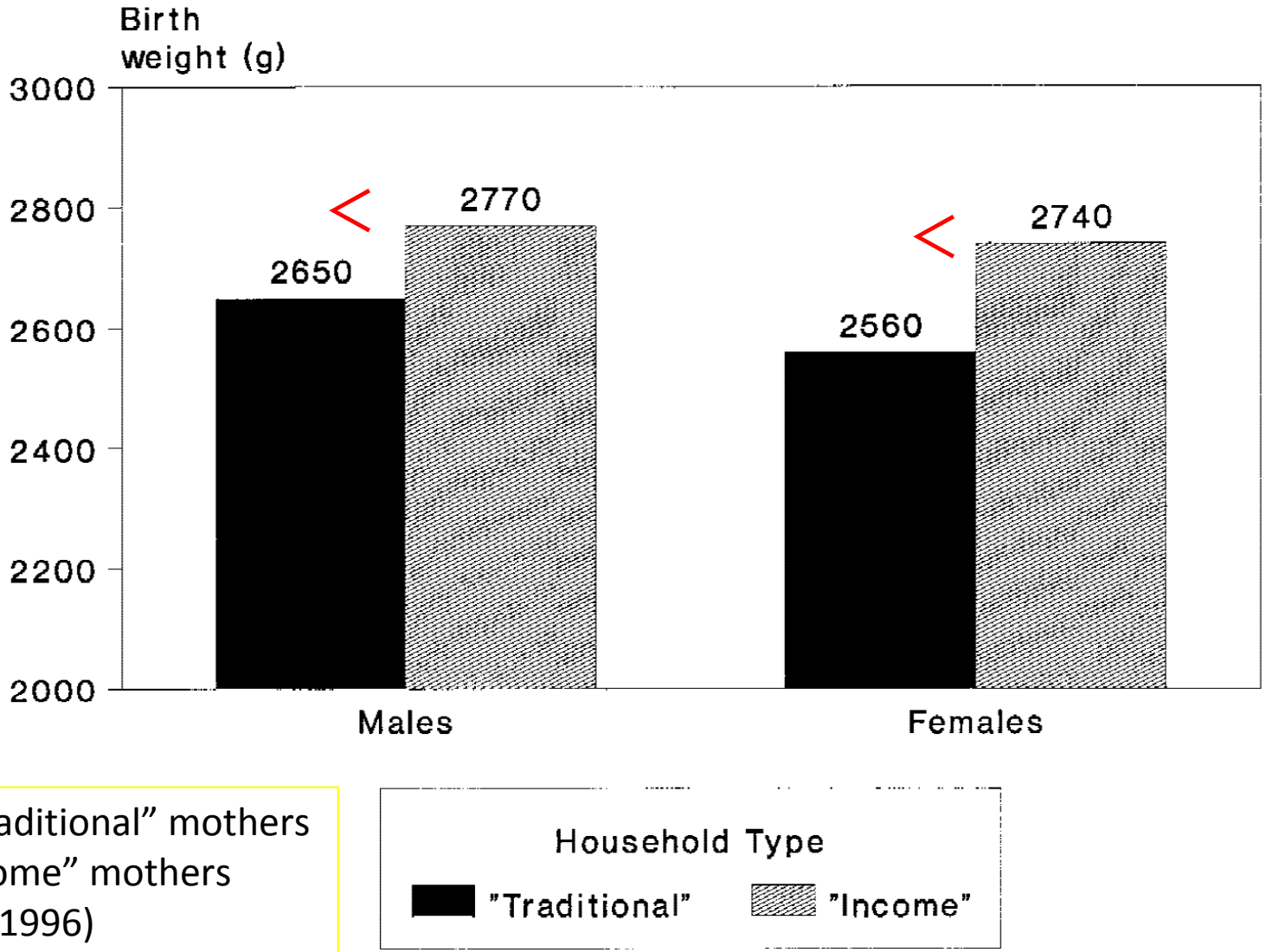
Wapei (2400 g: Wark and Malcolm 1969), Wosera (2540 g: Garner et al., 1994)

*TABLE 2. Birth weight (g) among the Au by birth order*

| Order | n | Mean | SD |
|---|---|---|---|
| 1 | 223 | 2450 | 437 |
| 2 | 142 | 2700 | 438 |
| 3 | 128 | 2760 | 471 |
| 4 | 103 | 2670 | 433 |
| 5 | 71 | 2700 | 411 |
| 6 | 66 | 2710 | 427 |
| 7+ | 43 | 2770 | 420 |

- Well-documented relationship between maternal pre-pregnancy weight/fatness and BW (Abrams and Laros 1986 and others)
-Tracer (1991): adiposity among the Au mothers declines with parity

→ decline of BW with birth order ?




366 “Traditional” mothers
46 “income” mothers
(Tracer 1996)

Fig. 2. Sex-specific mean birth weight (g) compared between “traditional” and “income-earning” households.

“Income-earning” households = the presence of at least one individual who earned a wage income by working for local missionaries or government agencies (Tracer 1997)

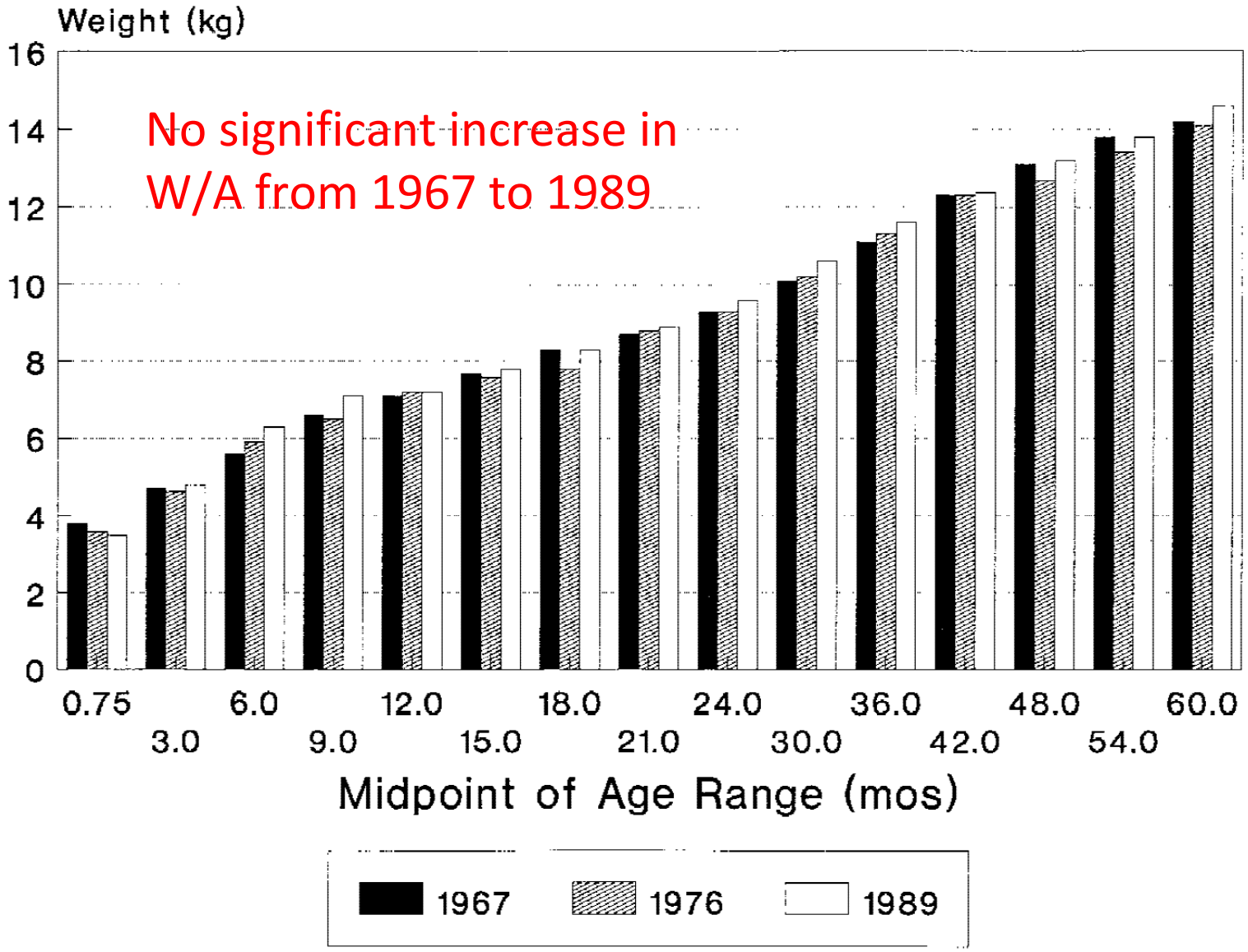



Fig. 3. Combined-sex mean weight-for-age (kg) among Au children ages 0–60 months in 1967, 1976, and 1989.

# Females

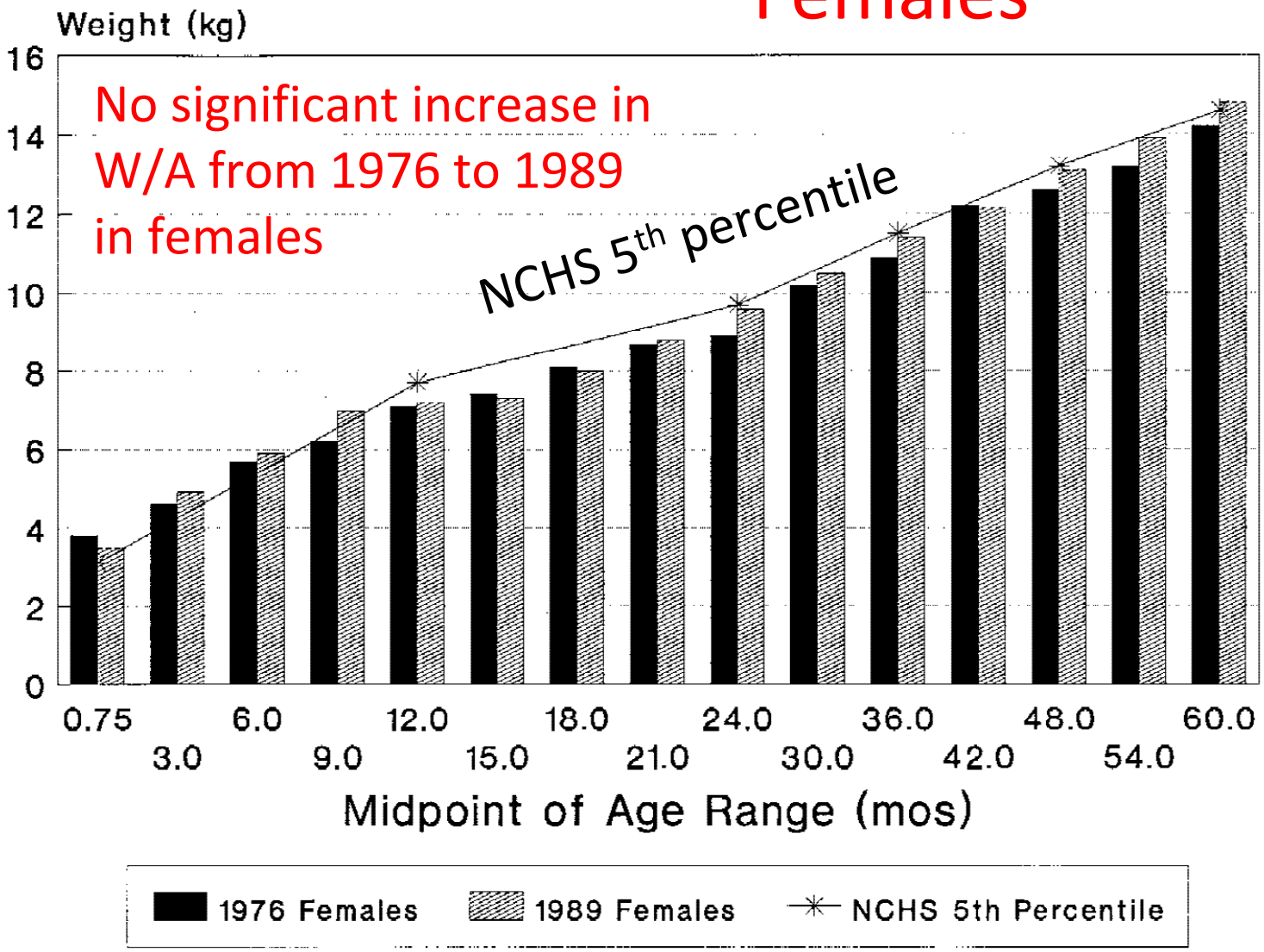



Fig. 4. Weight-for-age (kg) among females ages 0–60 months in 1976 and 1989. The NCHS 5th percentile is drawn in for comparison.

# Males

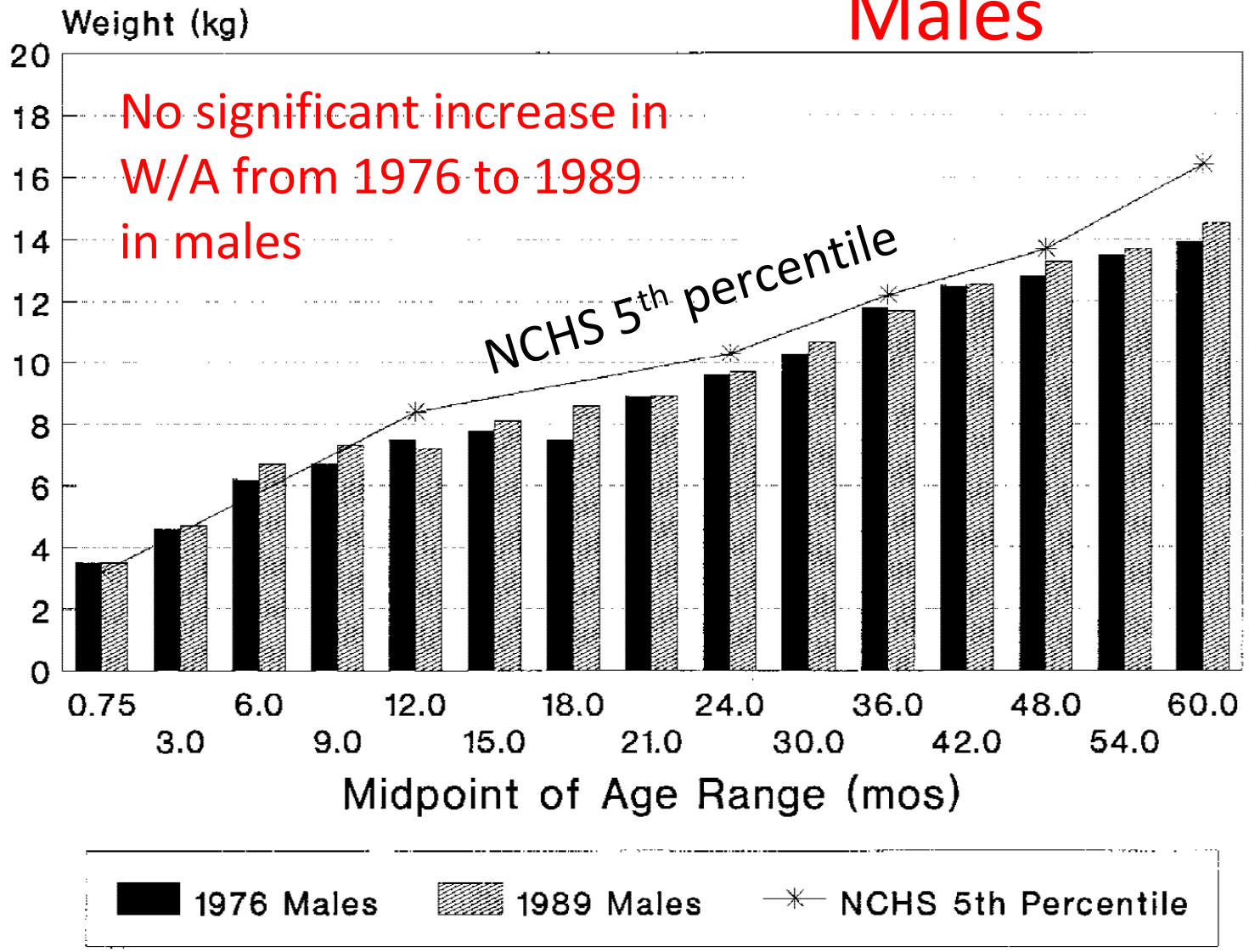



Fig. 5. Weight-for-age (kg) among males ages 0–60 months in 1976 and 1989. The NCHS 5th percentile is drawn in for comparison.

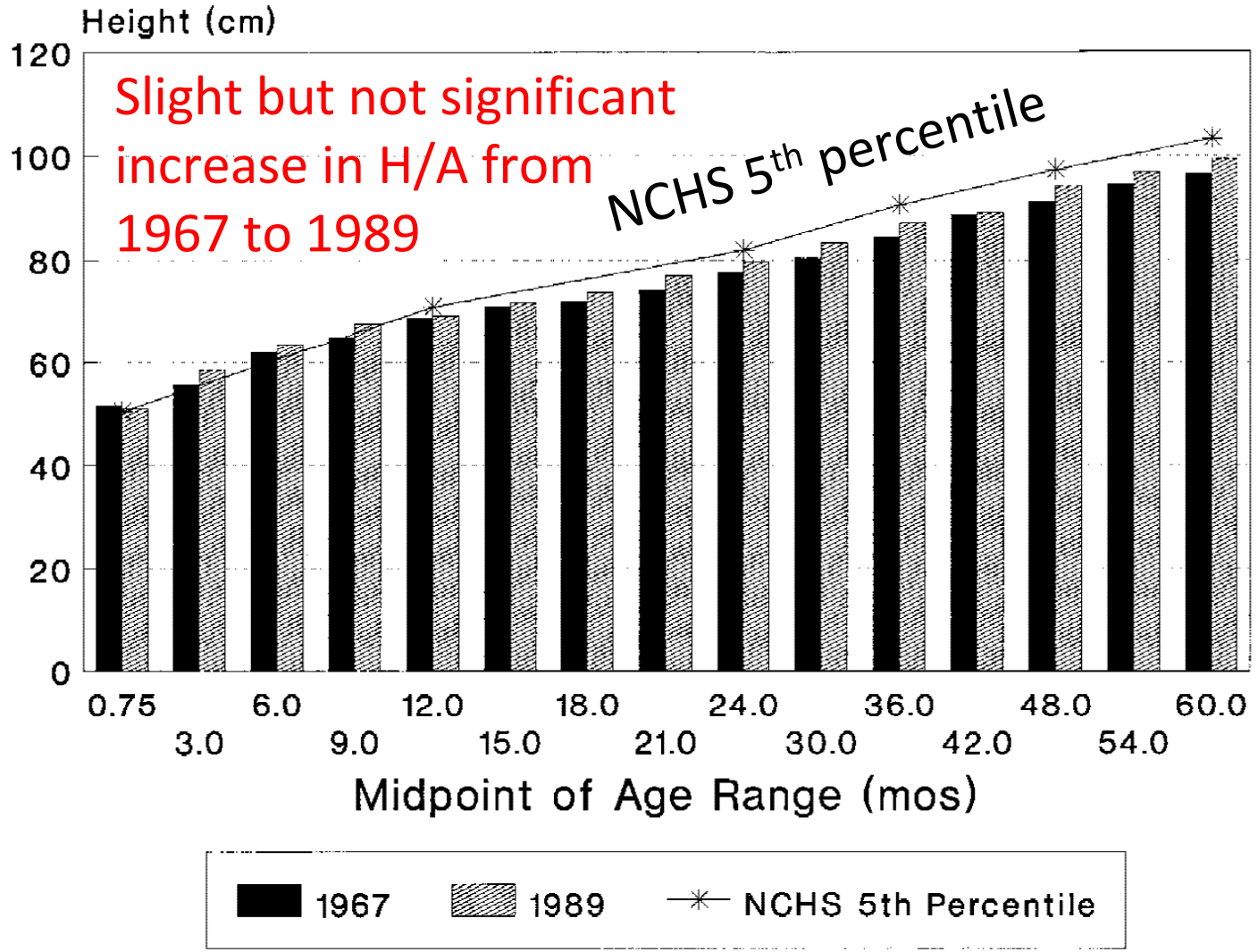


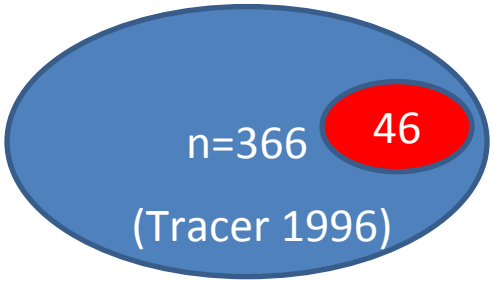

Fig. 6. Combined-sex mean height-for-age (cm) among Au children ages 0–60 months in 1967 and 1989. The NCHS 5th percentile is drawn in for comparison.

*TABLE 3. Weight-for-age (kg) among male children ages 0–60 months*

*TABLE 4. Weight-for-age (kg) among female children ages 0–60 months*

*TABLE 5. Height-for-age (cm) among male children ages 0–60 months*

*TABLE 6. Height-for-age (cm) among female children ages 0–60 months*




# Traditional < Income earning

*TABLE 7. Sex-specific weight-for-age (kg) and length-for-age (cm) in "traditional" and "income-earning" Au households (1989 survey)*

| Age (mos) | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| | Traditional | | Income-earning | | Traditional | | Income-earning | |
| | Wt | Ht | Wt | Ht | Wt | Ht | Wt | Ht |
| 1–3 | 3.98 | 54.56 | 4.53** | 51.73 | 4.04 | 55.16 | 4.33 | 56.10 |
| 4–6 | 6.05 | 64.02 | 6.30 | 61.50 | 6.00 | 63.81 | 5.96 | 62.60 |
| 7–9 | 6.93 | 65.58 | 7.55 | 70.90 | 6.54 | 64.04 | 7.08 | 67.53 |
| 10–12 | 7.03 | 67.90 | 8.11* | 68.80 | 7.14 | 70.73 | 7.80 | 70.36 |
| 13–18 | 7.92 | 72.20 | 9.32*** | 73.90 | 7.54 | 71.48 | 7.92 | 73.02 |
| 19–24 | 8.88 | 76.48 | 10.28*** | 80.97** | 8.48 | 75.75 | 10.70*** | 82.18*** |
| 25–30 | 10.21 | 80.55 | 11.38* | 83.87* | 9.79 | 81.83 | 11.01*** | 85.12* |
| 31–36 | 11.15 | 85.04 | 12.01* | 90.01* | 11.04 | 86.14 | 11.97* | 91.08** |
| 37–42 | 12.27 | 87.11 | 12.80 | 89.38 | 11.90 | 88.41 | 12.43 | 90.60 |
| 43–48 | 13.00 | 92.66 | 13.68 | 98.25* | 12.97 | 91.80 | 12.80 | 95.68* |
| 49–54 | 13.34 | 94.86 | 15.00** | 98.80* | 13.47 | 96.28 | 14.17 | 100.43** |
| 55–60 | 14.04 | 97.68 | 16.31*** | 104.83** | 14.49 | 99.62 | 15.52 | 102.71 |

Difference in sex-specific weight- and length-for-age between children in "traditional" and "income-earning" households significant (two-tailed t-test) at: *$P < 0.05$; **$P < .01$; ***$P < .001$.

"Income-earning" households = the presence of at least one individual who earned a wage income by working for local missionaries or government agencies (Tracer 1997)

# Summary of the findings

1. The Au of PNG had one of the lowest average BW of any population on record.

2. No change in BW over two decades

3. Individuals born to “income” households were heavier

Low BW: Gene or environment?

- Malaria and anemia? Brabin et al (1990) found that anemia in early pregnancy was related to risk of LBW
-Same gene but rich mothers heavier babies
-Effect of smoking ? See Table 8

*TABLE 8. Smoking habits among traditional and income-earning Au women*

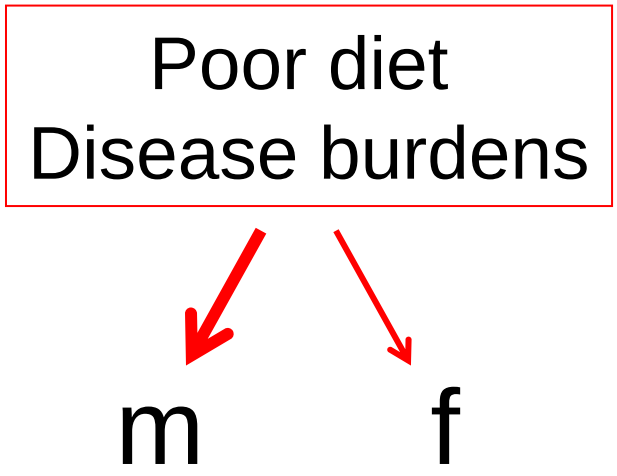
| | Smoke? | | |
|---|---|---|---|
| | Yes | No | Total |
| Traditional | 136 | 76 | 212 |
| Income-earners | 9 | 32 | 41 |
| Total | 145 | 108 | 253 |

Difference between groups significant ($P < .001$); Fisher's Exact Test.

Weight, fatness and BW -- <-> -- smoking (Garn, 1985)
"Traditional" mothers < "Income" mothers

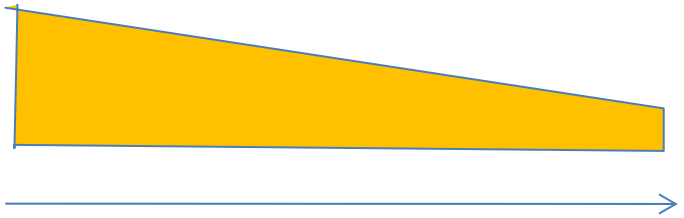
"Traditional" lean mothers: high carbohydrate diet + smoking
"Income" fat mothers: high fat/protein diet + Non smoking

"Female superiority hypothesis" (Stinson 1985):
Female are buffered to a greater degree against adverse environmental conditions



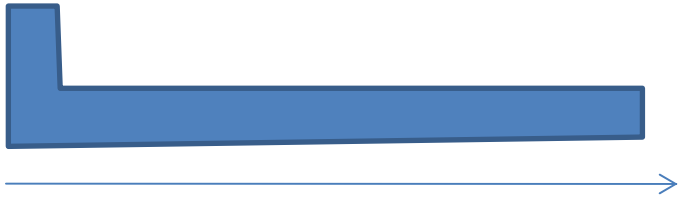

<u>Lack of sexual dimorphism in BW</u>:
Difference in BW between m and f in the Au < 100g
< other populations

"Maternal depletion syndrome": parity-specific decline in NS (Tracer 1991)



Parity

No parity-related change in BW (for birth order of 2 and higher)



Parity

⇔ Well-documented relationship between maternal pre-pregnancy weight/fatness and BW (Abrams and Laros 1986 and others)

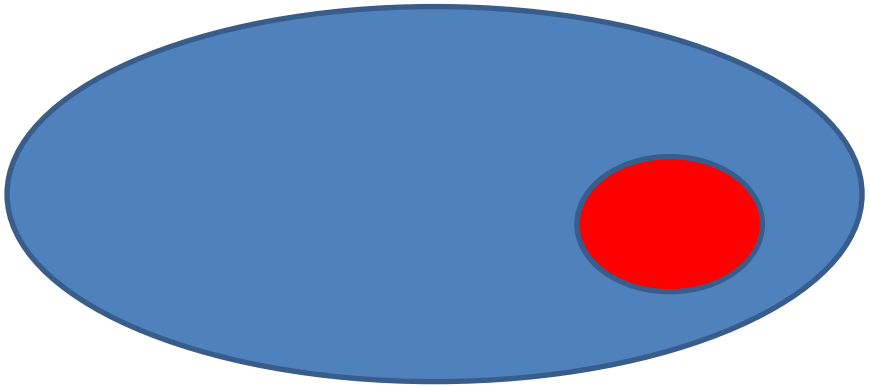
? Inverse correlation between maternal pre-pregnancy weight and gestational weight gain (Garner et al. 1994)

# Health campaign for two decades

BW: -
W/A: -
H/A: +

} < 5th percentile of NCHS

= 2600 g



BW:
W/A:
H/A:

} Income > Traditional

"non-disruptive" income earning opportunities

# International Health Perspectives

BW=2400 g
IMR= 100/1000
L0=55 y
PG=2%
TFR=5.0
Income=500US$
No Health Center
No road
No water supply
No electricity
No school fee
Indoor air-pollution
Smoking
Malaria
Dengue

"Health care"
"Modernization"