

# Well-nourished Women in a Solomon Islands Society with a Biased Sex Ratio

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## **Abstract :**

*This study reports on the growth and nutritional status of females in Roviana (population 12 235), Solomon Islands, where there are fewer surviving females than males in all age groups (male/female = 1.10; Solomon Islands Government 2000). Anthropometric measurements were performed for 1243 voluntary participants from seven villages. The results showed that females were better nourished than males; weight-for-age z-scores, for instance, were better for females than those for males throughout all age groups, with statistical significance in the following age groups: younger than 5 years, 10–14 years and 15–19 years. The same pattern was also observed for adults. Results suggest that gender inequality might not be caused by social discrimination.*

**Keywords:** *missing women, gender inequality, gender ratio, Solomon Islands*

## **Introduction**

Despite the fact that the ratio of males to females is nearly equal in European countries, the gender ratio inequality in a number of Asian countries are high; e.g., the male/female gender ratios in China and India are 1.07 and 1.08, respectively<sup>1,2</sup>. This suggests that there are 60–100 million “missing women” in these countries. It has been generally assumed that neglect, lack of care, and insufficient provision of food for females caused more female deaths, resulting in subsequent imbalance. There is, however, a new debate that the gender imbalance in Asia may have not been caused by social discrimination but, rather, is related to biological factors<sup>3</sup>.

Further research is needed to measure the health and social status of females (neonates to elderly) to answer whether social behaviours or biological (or both) affect a female’s survival. For this purpose, assessing physical growth and nutritional status is important because they are metrics which reflect the health status or risk of death as well as sufficiency of food provision<sup>4,5</sup>.

This study reports on the growth and nutritional status of females in the Solomon Islands, a country that is representative of the imbalance between genders. We then discuss the causes of gender inequality of surviving individuals. The Solomon Islands are one of the least developed countries in the world<sup>6</sup> and have been characterized as having the high male-to-female ratio<sup>7</sup>.



**Table 1: Comparisons of anthropometric measures of males and females assessed based on age groups (mean  $\pm$  S.E.)**

Age group (years)	Sex	N	Height (cm)	Weight (kg)	Body Mass Index (BMI: kg/m <sup>2</sup> )	Mid-upper-arm circumference (cm)	Skinfold thickness (mm)
20–39	M	191	167.1 $\pm$ 0.5	64.0 $\pm$ 0.7	22.9 $\pm$ 0.2	29.0 $\pm$ 0.2	21.7 $\pm$ 0.7
	F	184	156.3 $\pm$ 0.4	58.9 $\pm$ 0.8	24.1 $\pm$ 0.3	27.8 $\pm$ 0.3	43.0 $\pm$ 1.3
40–59	M	102	165.0 $\pm$ 0.6	66.1 $\pm$ 1.2	24.3 $\pm$ 0.4	29.6 $\pm$ 0.3	29.3 $\pm$ 1.2
	F	96	152.7 $\pm$ 0.5	59.4 $\pm$ 1.1	25.5 $\pm$ 0.5	29.4 $\pm$ 0.4	53.3 $\pm$ 2.0
$\geq$ 60	M	43	160.2 $\pm$ 1.0	59.2 $\pm$ 2.1	23.0 $\pm$ 0.7	27.3 $\pm$ 0.5	25.6 $\pm$ 2.0
	F	36	151.6 $\pm$ 1.1	51.1 $\pm$ 2.2	22.1 $\pm$ 0.8	27.0 $\pm$ 0.9	40.2 $\pm$ 3.4
	Sig. e		<0.0001	<0.0001	<0.01	<0.0001	<0.0001
	Sig.		<0.0001	<0.0001	<0.05	N.S.	<0.0001
	Sig.		<0.0001	<0.01	N.S.	N.S.	<0.001

**Table 2: Comparisons of Anthropometric Measurements of Male and Female Children assessed based on age groups (mean  $\pm$  S.E.)**

Age group (years)	Sex	N	Height-for-age z-score (HAZ)	Weight-for-age z-score (WAZ)	Body-mass-index z-score (BMIZ)	Mid-upper-arm circumference (cm)	Skinfold thickness (mm)
<5	M	76	N.A.	-1.76 $\pm$ 0.19	N.A.	N.A.	N.A.
	F	70	N.A.	-1.16 $\pm$ 1.41	N.A.	N.A.	N.A.
5–9	M	78	-1.51 $\pm$ 0.11	-1.48 $\pm$ 0.10	-0.67 $\pm$ 0.09	17.2 $\pm$ 0.2	13.7 $\pm$ 0.4
	F	73	-1.60 $\pm$ 0.11	-1.41 $\pm$ 0.12	-0.85 $\pm$ 0.09	17.2 $\pm$ 0.2	14.2 $\pm$ 0.4
10–14	M	80	-1.81 $\pm$ 0.10	-1.90 $\pm$ 0.13	-1.13 $\pm$ 0.17	19.9 $\pm$ 0.2	15.5 $\pm$ 0.6
	F	107	-1.60 $\pm$ 0.10	-1.28 $\pm$ 0.12	-0.49 $\pm$ 0.09	21.4 $\pm$ 0.3	22.8 $\pm$ 1.1
15–19	M	55	-1.75 $\pm$ 0.11	-1.69 $\pm$ 0.15	-0.88 $\pm$ 0.13	24.6 $\pm$ 0.3	17.9 $\pm$ 0.9
	F	52	-1.43 $\pm$ 0.10	-0.91 $\pm$ 0.15	-0.13 $\pm$ 0.12	24.7 $\pm$ 0.3	34.9 $\pm$ 1.6
	Sig.		N.A.	<0.05	N.A.	N.A.	N.A.
	Sig.		N.S.	N.S.	N.S.	N.S.	N.S.
	Sig.		N.S.	<0.001	<0.01	<0.0001	<0.0001
	Sig.		<0.05	<0.01	<0.0001	N.S.	<0.0001

## Methods

### Study Site

Research was conducted in the in Roviana, Western Province, Solomon Islands. The gender ratios of the province and of Roviana were 1.12 (population = 62 739) and 1.10 (12 235) respectively, in the latest



national census of 1999<sup>7</sup>. It is notable that an imbalance was observed throughout all age groups (every 5 years), including neonates (<1 year old), infants (<5 years old), children, adults, and the elderly (85+ years old). Because this census may have contained unexpected biases, we conducted a detailed demographic survey in three villages. Our results were consistent with the national census (ratio = 1.08; N = 2088). In this society, both males and females engaged in subsistence such as fishing, horticulture, and gathering, cash earning activities, and house-keeping. Males were conventionally recognized as leaders in communities, but females were also allowed to participate in decision making. Therefore, females did not face with severe discrimination in daily life.

### *Anthropometric Research*

Anthropometric measurements were performed in seven villages. A total of 1243 individuals participated in this study and written informed consent was obtained from each participant or his/her parent or legal guardian in case of children. Body height was measured to the nearest 1 mm using a field anthropometer (TTM, Japan) and weight to the nearest 0.1 kg using a portable digital scale (Tanita BF-522, Japan). Mid-upper-arm circumference was measured to the nearest 1 mm using a plastic tape measure. Skinfold thickness was measured to the nearest 0.2 mm using a caliper (GPM, Switzerland). For infants less than 5 years of age, only body weight was measured. All measurements were performed by the same investigator (TF) following the standard protocol<sup>8</sup>.

The following anthropometric indices were assessed: (1) body-mass index (BMI, kg/m<sup>2</sup>) for nutritional status as well as the sum of triceps and sub-scapular skinfold thicknesses for measurement of body fat in adults; (2) height-for-age z-score (HAZ) and weight-for-age z-score (WAZ) for growth; (3) BMI z-score (BMIZ) for nutritional status; (4) mid-upper-arm circumference for development of muscle and fat and (5) the sum of triceps and sub-scapular skinfold thickness for measurement of body fat in children. Standardization of measurements (i.e., z-score calculation) for children was performed using CDC/WHO 2000 as a reference. Student's t test was performed using SAS version 9.1 (SAS Institute Inc., U.S.) to detect statistically significant differences between males and females.

## **Results**

The nutritional status of adults was assessed based on age group and gender (Table 1). BMIs of females were higher than those of males in all age groups except for elders ( $\geq 60$  years old). Skinfold as a measurement of body fat was much thicker in females than males. These results indicated that adult females were better nourished than males. In case of nutritional status of children, the z-scores indicated better growth of girls than those of boys (Table 2). For example, WAZ was better for girls than that for boys throughout all age groups, although the difference was not statistically significant for the 5–9 age group. Height-for-age and BMIZ were better in girls than those for boys in the 10–14 and 15–19 age groups. At 5–9 years of age, girls were similar to boys; HAZ and BMIZ were slightly lower for girls than for boys in this group, but the differences were not statistically significant. Arm circumference and skinfold thickness indicated that girls accumulated body fat more rapidly than boys.



## Discussion

The results of this study indicated physically better grown females than males in Roviana society. Females were not at risk of death, even though the number of surviving females was smaller than males in this study population. These results are reliable because a large number of individuals participated in this study (more than 10% of Roviana speakers). Although we did not measure height, arm circumference and skinfold thickness of infants, WAZ, which is the most reliable measure of growth at this age, was higher for females than that for males. We concluded, therefore, that girls were also better grown in this age group.

The social responses to young girls are critical as per the interpretation. In particular, we need to consider the possibility that female babies are cared for poorly and do not survive to be included in the census or participate in anthropometric studies, and accordingly, this may have biased the results. For this point, we rely on experience and observation over a long period of fieldwork. Roviana is one of the most Christianized societies in the Solomon Islands, and to our knowledge, there have been no cases of female-biased infanticide. In addition, we have never seen substantial disadvantages placed on female lives or survival in adult food consumption<sup>9</sup>, providing treatments for illnesses<sup>10</sup>, or labour division and activity time<sup>11</sup>. Although Roviana is a male-oriented society, property rights have a matrilineal bias<sup>12</sup>, which indicates that females have good access to their rights over resources and properties. They are also involved in social activities and decision making<sup>13</sup>. It is therefore natural to presume that girls are provided with enough food and care.

Therefore, we suspect that there is a biological reason for the high male to female ratio in the study population. Oster<sup>3</sup> suggested that Asian gender inequality of surviving individuals (i.e., women missing in poor countries) could be mostly explained by unequal birth ratio induced biologically by maternal infection with hepatitis B virus (HBV) rather than social discrimination against females. This analysis was based on comparisons of ratios in several societies but not on clinical experiments; but other studies had suggested that hepatitis B carriers had high testosterone concentrations and thus had more sons<sup>14</sup>. This pattern of gender ratio has been reported from several societies<sup>15</sup>, including the Solomon Islands, which is also known as one of the hyperendemic areas for HBV<sup>16</sup>.

In conclusion, this study found that females were well-grown and nourished, even in the Solomon Islands, where a smaller number of females survive compared to males. This result may conflict with the conventional understanding that gender imbalance has been caused by discrimination such as neglect and unequal food provision<sup>1,2</sup>. Therefore, further studies are necessary to identify the real factors causing gender imbalances in this study population and to reconsider the effect of poverty on females.

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