Variations in Height, Weight and Body Mass Index According to Generation, Place of Residence and Region in Palestinian Territories

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Abstract

Introduction: The relationship between second intifada and risk factors of chronic diseases was not studied before in Palestine

Aims: The aims of this study is to describe differences in height, weight and BMI between different generations of Palestinians who were born at different times in the armed conflict. Also we wanted to know whether weight and height in West Bank follow any social pattern.

Methods: This study was retrospective analysis of pooled data from many previous studies where participants reported their weight, height, place of residence, region in west bank and income.

Results: Almost 61% of our study were females. Among female 12.8% were born before first intifada, 6.4% around first Intifada and 80.8% were born around second intifada. For males; 12.2% before first intifada, 5.7% around first intifada and 82.9% around second intifada. The generation born around second intifada had 12 cm higher height relative to generation before first intifada, 5 cm more height relative to first intifada generation (p=0.001), whereas females born before intifada had 20 Kg more weight than the generation of second intifada (p<0.0001). In multiple regression model done for the second intifada generation weight and height were related to place of residence and income and age significantly.

Conclusion: Political conflict have detrimental consequence on Palestinians wellbeing

Introduction

Anthropometric measurements are useful tools that can be used by health professionals to assess human body dimensions including height and weight and it can be used to assess energy requirements and predict diseases such as cardiovascular diseases and diabetes mellitus. Average height of large number of humans could be indicative of welfare. Economists usually use human height to evaluate the impact of poor nutrition and health on economics of nations. Earlier keynote lecture by Robert F. Fogel showed that 17.5 centimeter height deficit for Norwegian male meant 71% higher risk of dying in their next period of life. Studies in some European countries reported on regional and generational differences in human height. Much of interest in countries like USA, Japan was given to male heights relative to females and children height. Also, countries differed in height reached by their citizens, for example average height of males from Montenegro was found to be 177 cm and sometimes 178 cm which is proclaimed to be the highest in Europe whereas heights of males in Herzegovina which is close to Montenegro is 175-176 cm. A genomic prediction model showed that genomics predictors are responsible for 40% of variation height and that actual height correlation with predicted height based on genomic predictors was 0.65. On other hand, socioeconomic (education, occupation and material health) status plays role in determining height, but this relationship is poorer for women from developing countries. On the other hand, political conflicts associated with violence could also impact human
height as was shown in other reports\textsuperscript{6}. Other factors that predict human height include nutritional factors, health, social inequality, protein quality in diet and total fertility which determines the amount of resources expended on per child and so small family size is important determinant of height\textsuperscript{7}.

On the other hand, weight is another important anthropometric measurement that is rapidly changing with obesity pandemic that is present globally\textsuperscript{6}. Bodyweight and body mass index (BMI) are anthropometric measurements that reflect human overall nutrition consumption and strictly related to human disease. Humans can be classified as underweight, normal weight overweight and obese based on BMI\textsuperscript{8}. It is well known that age is associated with increase in weight and BMI. Also, there is clear relationship between SES and obesity and that this relationship is based on gender. Lower SES is associated with higher rates in obesity in females more so than males\textsuperscript{9}.

Palestinians in the historical Palestine passed through different periods of political violence with associated stress and changes in financial resources. First Intifada broke in 1987 followed by Oslo Accords 1993 and then Second Intifada in 2000. All these political changes in the life of Palestinian people represented variation in stress and financial resources and their impact on Palestinian wellbeing was not compared before\textsuperscript{9, 10}.

Hence the goals of this study was to 1) To compare the height, weight and BMI of different political Palestinian generations 2) To compare the height, weight and BMI between different regional and places of residence of different social and political environments.

**Methods**

Data for this work was pooled from different studies including Food label study, Two parts nutrition literacy studies and Education MyPlate for Palestinian young students. Information on self-reported height, self-reported weight, BMI, place of residence (Refugee Camp, Village, City, Israeli citizens) or region (North and Middle Areas (including Nablus, Qalqilya, Tulkarem, Salfeet, Jenin along with following villages and refugee camps), Southern Area (Hebron and Bethlehem), Ramallah, Jerusalem and Israeli Arabs. Sometimes data was combined to increase number of participants. Different Generations was defined those who were before First Intifada (Group 1), those who were born between two Intifadas, those who were born at the time of Second Intifada.

**Statistics.**

Height, Weight and BMI were compared according to generation, region or place of residence using one way ANOVA. Comparisons were done based on gender and repeated for the generation who were born at time of second intifada.

Percent of people more than certain height values were calculated for different height cutoff points for each gender separately. The same calculations was done for Second Intifada generation. Also, BMI categories prevalence was calculated for males and females and repeated for second Intifada
Mixed model regression analysis was used to study correlates of height, weight and BMI. Data was analyzed utilizing SPSS 21.

Results

We included 523 participants in this study, among them we had only 123 male participants. Table 1 provides demographic variables for the study group.

Height

In table 2 we report significant height differences between Palestinian age groups. The group 1 who reflected people born around second Intifada is 12.1 cm taller than the group born before first Intifada and slightly less than 5 cm taller than the group who was born around first Intifada. Females height was not significantly different between age groups. In the generation of second intifada (less than 25 y), height was significantly different according to place of residence. Males form city were 10 cm shorter than ones from refugee camps, Refugee camp group was almost 5 cm higher than ones from villages, whereas no significant difference was found between females (Table 3). Also, the group that reported higher income had 7 cm increase in height, whereas in females less than 25 y there were no relationships to place, region or income. Table 4 shows the percent of participants higher than certain height cutoff values of note is that we had 117 female less than 150 cm in height, and that the trend of height was not different for group of 25 y and less than total sample. Although not significant, women with Israeli citizenship were the shortest and ones from Jerusalem were the tallest.

Multiple regression model for the generation of second intifada shows that increased age, being from city was associated with lower height in males, other variables such as income and region were not significantly related to height in final models. In females only income was significant predictor of height as low income was associated with lower height (Table 4)

Weight and BMI

Males were not significantly different in weight across age groups, but BMI was different, the highest BMI was for oldest generation and the lowest was for youngest (Table 2). For females, weight and BMI followed age trend, with women more than 34 y having almost 20 kilogram more than women of 25 or less y (Table 2).

In males less than 25 y there was no significant trend according to place of residence region, but males from refugee camp or from Ramallah and Jerusalem (combined) tended to be more overweight (Table 3). For females, being from village was associated with lower weight and BMI, whereas refugee and women with Israeli citizenship had higher BMI and weight, whereas region was not related to weight and BMI. (Table 3). No differences were reported according to region and income. In multiple regression model being from city was related to lower weight in males, whereas in females lower income was associated with increase in BMI (Table 4).
Discussion

Palestinians struggled with political injustice and social distress since creation of Israel in 1948. During 1967 another political turmoil happened when Israeli forces occupied the remaining Palestinian territories. Between 1967 and 1987, Israel became the dominating political power responsible for the health and wellbeing of the Palestinian People in Occupied Palestinian territories. From 1987 to 1993 the first Intifada happened and represented culmination of the Palestinian popular resistance against the Israeli Military Occupation. After Oslo Accords, PA became responsible for Palestinian dominant regions in the West Bank and Gaza Strip. During Oslo Accords there was increase in foreign aid, increase in international and non-governmental organizations that helped Palestinian Authority. After Oslo Accords, little progress was achieved which sparked second Intifada in 2000 which led to insecure, dangerous and more difficult living conditions for Palestinians. By 2003, 59% of Palestinians in West Bank and Gaza were living under poverty line with US$ 2.1 per day\(^\text{11}\). One study found that conflict related stress was associated with decrease in birth-weight. Many Palestinian women of reproduction age were not consuming enough meat, dairy, poultry at height of conflict. Imposing curfew was also associated with restricted access to healthcare\(^\text{11}\). In a longitudinal analysis that was performed on Palestinian population living in Occupied Palestinian territories, conflict did not show effect on access to health service among mothers and infants across socioeconomic conditions. However, in South and Central parts of West Bank intensity of conflict had negative impact on access to healthcare which provides evidence to regional differences in healthcare in Palestinian territories affected by conflict\(^\text{12}\).

On the other hand, regional differences could be in fact related to patriarchy differences in different regions of West Bank. Patriarchy is well-known determinant of women's health including women of childbearing age, particularly health seeking behavior and income that may affect food intake\(^\text{13-15}\).

Females and Males in refugee camps had gap in terms of weight and height with others from city and villages. Refugees represent 45.6% of Palestinian people. In the period from 2005-2010, mortality rates was the highest for refugees in Opt. (23.7 for refugees relative to 18.8 for West Bank) in 1000 childbirth. Which indicates deteriorating health conditions among refugees. However, Palestinians who are refugees tend to have education degree more than the rest of society (10.7% versus 10.4%) . However, economy of West Bank refugees yet better than other refugee in diaspora is rather fragile and unstable. Also, refugee camps employment is different according to the city, for example Jalazoun refugee camp which near Ramallah has high employment for Palestinian authority, while further refugee camps are not the same\(^\text{16}\).

Arabs in Jerusalem and Israel may have higher income and access to health care relative to West Bank, but also they have high rate of unemployment and crime rate. Although Arab Israeli males and Jerusalemite were taller, counterparts females were more obese or had higher BMI\(^\text{17}\).

The percent of males above 190 cm height was 3% which less that what was reported previously in European populations who went under conflict (5% in Kosovo), but this value is higher than in France.
However, 5.8% of our study males were under 160 cm which is unlike study from Kosovo, where no male was less than 160 cm. With regards to females, we have one female of 190 cm and 8 (2%) who are over 180 cm, whereas in Kosovo study no female was higher than 190 cm and only 1.2% of females were higher than 180 cm in Kosovo. However we have 6 females less than 140 cm and 117 below 150 cm which strikingly different than Kosvo where no female was less than 150 cm. At the same time, we have high rate of underweight women (52 females or 13%) whether those females were born with low birthweight needs investigation.

In this study we show that age especially in females was associated with large weight gap between the three generation (+ 20 Kg) between the generation before intifada and the one who were born around second intifada. The weight gain with age showed dependence on gender, race and socioeconomic status in Cardia study. Exposure to war trauma is associated with posttraumatic stress (PTSD) and emotional disorders in adults and children. The generation who were born before first intifada were exposed to political trauma in their adult life, past year PTSD was associated with higher obesity risk (OR 1.51, 95% CI 1.18, 1.95), but this was not different between males and females. The relationship between PTSD and obesity was supported by systematic review done by Bartoli et al. It is well-known that weight gain with years is associated with higher risk for CVD.

It is not well understood why the group from refugee camp had higher height than cities and villages. It is assumed that refugee camps during second intifada drew the attention of medical aid organizations more so than other regions in Palestine, due to concentration of fights in these spots. This could partially explain the provision of more healthcare for pregnant Palestinian women and their infants in refugee camp which could have been translated into have higher heights. Another explanation is that the group of students who came refugee camp may represent some social section of the population in refugee camp who care about education and can afford it, not the rest of population and hence this could be a bias in representation. This need further studies, but may reflect complex relationship between socioeconomic status and chronic human nutrition. This is consistent with our finding that males who have higher income where in fact higher than the rest of the sample among the second intifada generation. This is consistent with previous literature which supports that socioeconomic status in fact affect growth standards which itself could affect education attainment.

This study is not without limitation including the use of self-reported height and weight. However, self-reported height and weight are highly correlated with measured height and weight and one study. Minor under-estimation of body weight is present that may lead to some study bias. Also, this study is cross sectional in its design with pooling of data from many studies, which may lead to minor discrepancies in categorizing data.

In summary, in large sample of Palestinians, we report 12 cm difference in height between different generations of Palestinians who were born during different times of political conflict, this was for males, but females who endured the trauma of second intifada as young adults had extra 20 Kg weight relative
to younger generation who were infants or children during the second intifada. Also, we report differences in height, weight, BMI according to place of living and socioeconomic status. More studies are needed to understand the impact of second intifada on generations of Palestinians and their risk for diseases.

**Declarations**

**Ethical Approval and Consent to participate:** The research was conducted in accordance with Declaration of Helsinki and approval from the IRB at An Najah National University was obtained before conducting the study. Informed consent was obtained from participants.

**Consent for publication**

All the study authors read and approved the manuscript for publication

**Data Availability and material**

The datasets generated and/or analyzed during the current study are not publicly available due [being kept confidential for future work] but are available from the corresponding author on reasonable request.

**Competing interest**

None

**Funding**

None

**Author Contributions:**

NN designed the study, collected data, analyzed data and wrote the manuscript. M.T obtained IRB approval, MB reviewed manuscript and provided scientific feedback

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Tables

Table 1: Comparison of Study Variables according to Gender
| Variable          | Males       | Females     | t-test, p-value |
|-------------------|-------------|-------------|-----------------|
| Age (y)           | 23.6±9.4    | 23.5±8.7    | 0.08, 0.94      |
| Weight (Kg)       | 74.1±15.5   | 61.1±13.9   | 8.7, p< 0.0001  |
| Height (cm)       | 175.2± 9.5  | 161.7±14.3  | 9.7, p< 0.0001  |
| BMI               | 24.1± 4.4   | 23.4±8.9    | 0.90, p=0.33    |
| Work              |             |             |                 |
| No                | 55 (51.9%)  | 143 (45.7%) | Chi=2.48, p=0.29|
| Yes               | 46 (43.6%)  | 161 (51.4%) |                 |
| Place             |             |             | Chi=5.0, p= 0.16|
| City              | 32 (36%)    | 87 (31.1%)  |                 |
| Village           | 48 (53.9%)  | 139 (49.6%) |                 |
| Refugee Camp      | 9 (10.1%)   | 45 (16.1%)  |                 |
| Arab Israeli      | 0 (0)       | 9 (3.2%)    |                 |
| Region            |             |             | Fisher= 4.19, p=0.3|
| North             | 62 (70.5%)  | 200 (74.9%) |                 |
| South             | 15 (17.0%)  | 25 (9.4%)   |                 |
| Ramallah          | 10 (11.4%)  | 35 (13.1%)  |                 |
| Jerusalem         | 1 (1.1%)    | 4 (1.5%)    |                 |
| Arab Israeli      | 0           | 3 (1.1%)    |                 |
| Smoking           |             |             | Chi=7.1, p=0.008|
| No                | 55 (76.4%)  | 174 (89.2%) |                 |
| Yes               | 17 (23.6%)  | 21 (10.8%)  |                 |

Table 2: Difference in height, weight, BMI according to generation, place, region and income
### Total Sample Males

| Age                  | Height  | Weight       | BMI          |
|----------------------|---------|--------------|--------------|
| Less or equal to 25 y| 176.4± 8.7 | 73.2± 15.1 (100) | 23.4±3.8 (99) |
| 25-34 y              | 164.3± 5.6 | 72.7± 18.5 (7)   | 26.8± 5.9 (7)  |
| 34 or more           | 171.8±12.2 | 80.8± 16.2 (15)  | 27.5± 5.2 (15) |
| F=7.06, p=0.001      | F=1.6, p=0.20 | F=7.9, p=0.001  |   |

### Total Sample Females

| Age                  | Height  | Weight       | BMI          |
|----------------------|---------|--------------|--------------|
| Less or equal to 25 y| 161.0±15.5 | 58.2±11.0 (316) | 21.9±3.8 (311) |
| 25-34 y              | 162.5±7.8   | 65.1±15.4 (25)  | 24.5±4.7 (25)  |
| 35-45 y              | 162.8±5.3   | 78.0±16.5 (50)  | 28.9±5.4 (50)  |
| F=0.79 p=0.45        | F=59.2, p<0.0001 | F=64.5, p<0.0001 |   |

### Less than 25 y group Males

| Place                | Height  | Weight       | BMI          |
|----------------------|---------|--------------|--------------|
| City                 | 171.2±8.9   | 72.8±15.9 (32)  | 24.9±5.0 (31)  |
| Village              | 175.2±9.8   | 73.3±16.1 (48)  | 23.8±4.3 (48)  |
| Refugee Camp         | 181.3±11.2  | 81.4±10.4 (9)   | 25.0±4.3 (9)   |
| F=4.2, p=0.02        | F=1.2, p=0.32 | F=2.9, p=0.06  |   |

### Region

| Region               | Height  | Weight       | BMI          |
|----------------------|---------|--------------|--------------|
| North and Middle     | 173.3±10.1 (61) | 73.5±16.6 (62) | 24.5±4.7 (61) |
| South                | 178.5±8.8 (15)  | 70.5±12.8 (15) | 22.2±3.8 (15) |
| Jerusalem and Ramallah | 174.6±10.4 (11) | 80.4±12.6 (11) | 26.3±4.3 (11) |
| F=1.7, p=0.19        | F=1.2, p=0.31 | F=2.9, p=0.06  |   |

### Income

| Income | Height | Weight | BMI |
|--------|--------|--------|-----|
| 0      | 173.7±7.9 (23)A | 71.2 15.6 (23) | 23.6 3.8 (24) |
| 1      | 177.7±7.2 (22)  | 73.5 14.8 (22) | 23.1 3.6 (22) |
| 2      | 180.3±7.9 (19)B | 76.0 16.4 (19) | 23.3 4.2 (19) |
| F=3.9, P=0.025     | F=0.07, p=0.94 | F=0.5, p=0.61  |   |

### Less than 25 y group Females
| Place            | Average Height (± SD) | Body Mass (± SD) | BMI (± SD) |
|------------------|-----------------------|------------------|-----------|
| **City**         | 164.4±7.2 (87)        | 66.9±17.9 (87)   | 24.6±6.0 (87) |
| **Village**      | 162.7±7.0 (138)       | 59.0±11.3 (136)  | 22.2±3.8 (136) |
| **Refugee Camp** | 162.0±5.7 (45)        | 63.8±14.3 (44)   | 24.3±5.2 (44)  |
| **Israeli**      | 163.3±4.0 (9)         | 64.3±8.9 (9)     | 24.1±3.4 (9)   |
|                  | F=1.6, p=0.19         | F=5.8 p=0.001    | F=5.3, p=0.001 |

| Region           | Average Height (± SD) | Body Mass (± SD) | BMI (± SD) |
|------------------|-----------------------|------------------|-----------|
| **North and Middle** | 162.7±6.9            | 61.9±15.1 (196)  | 23.3±5.2  |
| **South**        | 163.2±5.3            | 61.5±14.5 (25)   | 22.6±4.0  |
| **Ramallah**     | 164.2±4.8            | 62.3±11.8 (35)   | 22.9±3.8  |
|                  | 167.3±4.4            |                  |           |
| **Jerusalem**    | 160.0±3.0            | 63.4±14.0 (4)    | 23.5±3.4  |
| **Israeli**      | F=1.9, p=0.11        | 74.7±4.0 (3)     | 29.2±2.0  |
|                  | F=0.64, p=0.64       | F=1.3, p=0.29    |           |

| Income (shekel)  | Average Height (± SD) | Body Mass (± SD) | BMI (± SD) |
|------------------|-----------------------|------------------|-----------|
| **Less than 2000-3000** | 163.4 ± 8.3 (111)  | 59.0 ± 12.4      | 22.1 ± 4.1 (110) |
| **2000-4000**    | 160.5 ±13.0 (77)     | 57.1 ± 10.2      | 21.8 ± 3.8 (76)  |
| **3000-6000**    | 156.3 ± 31.2 (54)    | 58.1 ± 9.2       | 21.9± 3.1 (51)   |
| **More than 6000** | 180 (1)              | 85               | 26.2       |
|                  | F=2.4, p=0.07        | F=2.3, P=0.07    | F=0.5, p=0.70 |

Table 3: Percentage of Study Participants with specific height limits
| Height in cm | Percentage of Male ≤ 25 y above corresponding height | Percentage of Total Males above corresponding height | Percentage of Female ≤ 25 y above corresponding height | Percentage of Total Females above corresponding height |
|-------------|-----------------------------------------------------|-----------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|
| ≥ 190       | 3                                                   | 3.2                                                 | 0.31                                                 | 0.3                                                   |
| ≥ 180       | 47                                                  | 42.6                                                | 1.88                                                 | 2                                                     |
| ≥ 170       | 77                                                  | 70.5                                                | 14.40                                                | 14.4                                                  |
| ≥ 160       | 96                                                  | 94.2                                                | 69.00                                                | 70.5                                                  |
| ≥ 150       | 100                                                 | 100                                                 | 98.10                                                | 98.5                                                  |
| ≥ 140       |                                                     |                                                     | 98.40                                                | 98.7                                                  |
| ≥ 130       |                                                     |                                                     | 100.00                                               | 100                                                   |

Table 4: Multiple regression models for the predictors of height, weight and BMI
| Variable      | Males           | Females         |
|---------------|----------------|----------------|
|               | Height B±SE    | Weight B±SE    | BMI B±SE    |
| Age           | -3.3± 1.0**    | -3.1±2.3       | -0.25±0.59  |
|               | F=9.8, p=0.006 | F=1.8, p=0.2   | 0.18, 0.68  |
| Place         |                |                |             |
| City          | -36.5±12.8*    | -71.7±28.4*    | -13.5±7.2   |
| Village       | -8.5± 7.9      | 4.0±17.4       | 3.58±4.42   |
| Refugee Camp  | Ref            | Ref            | Ref         |
|               | F=6.4, p=0.008 | F=4.0, p=0.035 | F=0.85, p=0.48 |
| Region        |                |                |             |
| North         | -6.8±8.0       | -3.1±17.6      | 0.82±4.5    |
| South         | -9.6±7.3       | -38.8±2.4*     | -9.4±4.1*   |
| Ramallah      | -20.5±9.4*     | -21.2±20.7     | -0.91±5.2   |
| Jerusalem     | Ref            | Ref            | Ref         |
|               | F=1.1, p=0.36  | F=1.1,p=0.37   | F=2.36, p=0.12 |
| Income (shekel)|                |                |             |
| Less than 2000-3000 | 35.6±18.4       | 65.9±40.7      | 11.9±10.3   |
| 2000-4000     | 4.05±14.1      | -9.0±31.2      | -3.4±7.9    |
| 3000-6000     | Ref            | Ref            | Ref         |
|               | F=0.5, p=0.6   | F=2.2, p=0.14  | F=2.63, p=0.09 |
| Females       |                |                |             |
| Age           | -0.37 ± 0.41   | 0.6± 0.6       | 0.33± 0.20  |
|               | F=0.83, p=0.37 | F=1, p=0.32    | F=1.7, p=0.1 |
| Place         |                |                |             |
| City          | -14.9± 10.6    | -17.7± 15.7    | -2.68 ± 5.32 |
| Village       | -4.6 ± 10.6    | -14.9 ± 15.7   | -4.24 ± 5.32 |
| Refugee Camp  | -2.9 ±  5.7    | -0.4 ±  8.4    | 0.7 ± 2.9    |

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| Arab Israeli | Ref   | Ref   | Ref   |
|-------------|-------|-------|-------|
|             | F=1.0, p=0.40 | F=0.3, p=0.8 | F=2.7, p=0.1 |
| Region      |       |       |       |
| North       | -5.1 ±  6.1 | -17.7± 15.7 | -5.7±  3.1 |
| South       | -3.2 ±  9.2 | -14.9 ± 15.7 | -5.0±  4.5 |
| Ramallah    | 0.13±  7.3 | 0.42±  8.4 | -1.7 ±  3.7 |
| Jerusalem   | Ref    | Ref    | Ref    |
|             | F=1.3, p=0.30 | F=1.3, p=0.28 | F=1.5, p=0.11 |
| Income (shekel) |       |       |       |
| Less than 2000-3000 | -17.5± 22.6 | 11.0 ± 33.6 | 7.5± 11.4 |
| 1 2000-4000   | -20.1± 17.7 | -34.4± 26.2 | -7.6±  8.9 |
| 2 3000-6000   | -23.3± 14  | -20.6 ± 20.7 | -1.7 ±  7.0 |
|              | Ref    | Ref    | Ref    |
|              | F=3.8, p=0.013 | F=1.6, p=0.19 | F=1.3, p=0.09 |