

# The influence of high altitude on the anticipated childhood growth Taif city- Saudi Arabia 2018: A cross sectional study.

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## Abstract

Optimal child growth is a crucial goal that should be pursued to guarantee a healthy life for the individuals in a population with a good quality of life. For this purpose, any risk factors that may disturb or affect the normal growth pattern should be recognized. Living at a high altitude is suggested to be one of these factors. In this study, we aimed to explore if there is a relationship between living in high altitude cities like “Taif” and children’s growth.

Our population was randomly selected from children whose ages range from 5 to 18 years old and who live in “Taif” city. A total of 277 children were included in this study. Information about their anthropometric measurements were collected and compared to the Saudi national growth standard.

Results showed that both weight and height of boys were significantly higher than the Saudi national growth standard. And for girls, the weight was significantly higher while the height did not differ significantly from the Saudi national growth standard. These findings do not support the hypothesis that living in high altitude cities like “Taif” can affect child’s growth negatively in terms of height and weight.

**Keywords:** Children, Growth, High altitude, Hypoxia, Weight, Height.

*Accepted on March 16, 2018*

## Background

Optimal child growth is a crucial goal that should be pursued to guarantee a healthy life for the individuals in a population with a good quality of life [1]. Many researchers have investigated the growth of children living at high altitude, but the magnitude of high altitudes hypoxia effect on child growth is still not clear [2,3].

Most investigators working in the Andes have found that growth in height and weight is delayed compared to low altitude. Growth at high altitude represents the response to a complex set of environmental conditions, and it is difficult to determine the extent to which any size difference between high and low altitude populations is due to the effect of hypoxia. However, not all morphological structures appear to be equally affected during growth at high altitude [4].

For example, Frisancho and Baker suggest that the growth of the chest dimensions may be accelerated while height and weight appear to be slowed [5].

It is also possible that different stages of the life cycle may be unequally affected during development at high altitude. Periods of rapid growth such as adolescence may be more severely modified than periods of more leisurely growth such as childhood. The extent to which these responses are conditioned by the reduced oxygen pressure of high altitude is unclear. Other factors such as the limited energy availability in the Andean high-altitude ecosystem, a distinct genetic potential, or a combination of these may be responsible [4].

On the other hand, some studies reported that children living in high altitude may have larger bodies (weight and height) compared to those living in low altitude cities [6].

Taif is a city in Mecca Province of Saudi Arabia at an elevation of 1,879 m (6,165 ft) on the slopes of Sarawat Mountains (Al-Sarawat Mountains). It has a population of 993,800 people [7].

Our aim was to find out if the high altitude at “Taif” city affects the growth of children in order to open the way for further researches to obtain the optimum health care and avoid any growth-related problems in Kingdom of Saudi Arabia.

## Objectives

This study was conducted to find out if there is a relationship between living in high altitude cities like “Taif” and children’s growth at this city.

## Subjects and Methods

A total of 277 children from Taif city were screened during July 2017. This included 133 males (48%) and 144 females (52%).

For those children, we took the measurements of weight to the nearest 0.25 kg and height to the nearest 0.25 cm. Two body scales and 2-meter sticks were used for this purpose. We needed to measure the height of the parents to rule out the genetic predisposition for the short stature.

Data was collected using a questionnaire form during a face to face interview and was entered into the database using a computer.

Questions related to various diseases that may affect the growth and questions about the nutritional state, life style, parents' education level, and maternal health during pregnancy were also included in the questionnaire.

Included subjects were children from the age of 5 to 18 years living in Taif, with good nutritional and good socio-economic status. Any child less than 5 years old or not living in "Taif" or has been diagnosed with any disease that may interfere with the normal growth was excluded.

All the data was analyzed by SPSS program and compared to the previous studies and to the Saudi and National standards.

We chose to conduct a cross sectional study during July 2017 on a sample of 277 children of both genders. That's been calculated through taking the numbers of all children from the age of 5 till 18 and we found that they represent around 23.32% of the total population of Saudi Arabia. Then, we applied this finding on the total population of Taif city. Finally, we took the numbers and calculated the sample size with a confidence level of 95%.

### Data collected

The questionnaire was consisted of several parts to cover the following data items; weight, height, BMI, age, nationality, parental heights, current health status and diseases, number of family members, parents' occupation and educational level, total family income, dietary and exercise habits, marriage of relatives, weight and physical changes for puberty, appetite, and tendency for infections. Questions about maternal and fetal health were included such as antenatal care visits, maternal infections and rashes, gestational diabetes occurrence, and radiation exposure during pregnancy.

### Statistical analysis

Data were statistically described in terms of frequencies (number of cases) and valid percentages for categorical variables. Mean, standard deviations, minimum and maximum were used to describe numerical variables. Comparison of numerical variables between the subgroups was done using one-way ANOVA. One-sample t-test was used to compare the height and weight of study subjects to the age-relevant values in the Saudi standard growth curves. P values less than 0.05 were considered statistically significant. All statistical calculations were done using computer program IBM SPSS (Statistical Package for the

Social Science; IBM Corp, Armonk, NY, USA) release 21 for Microsoft Windows.

## Results

### Participants' characteristics

A total of 277 children were involved in this study. Of these children, 133 (48%) were males and 144 (52%) were females.

Their ages ranged from 5 to 18 years with a mean ( $\pm$  SD) value of  $9.3 \pm 3.48$  years and a medial (IQR) value of 9(6) years. No significant difference ( $p=0.513$ ) was found between the mean age of males ( $9.4 \pm 3.57$  years) and that of females ( $9.2 \pm 3.41$  years).

Physical characteristics were assessed through taking body measurements.

The participants' heights ranged from 97 to 180 cm with a mean ( $\pm$  SD) value of  $133.19 \pm 18.09$  cm. No significant difference ( $p=0.906$ ) was found between the mean height of males ( $135.16 \pm 18.21$  cm) and that of females ( $131.38 \pm 17.86$  cm) (Figure 1).

As for body weight, the minimum value recorded was 12.7 kg while the maximum was 88 kg. The mean ( $\pm$  SD) value was  $31.86 \pm 14.84$  Kg. The same as height, there was no significant difference ( $p=0.429$ ) between the mean weight of males ( $33.33 \pm 15.39$  kg) and that of females ( $30.5 \pm 14.23$  kg) (Figure 2).

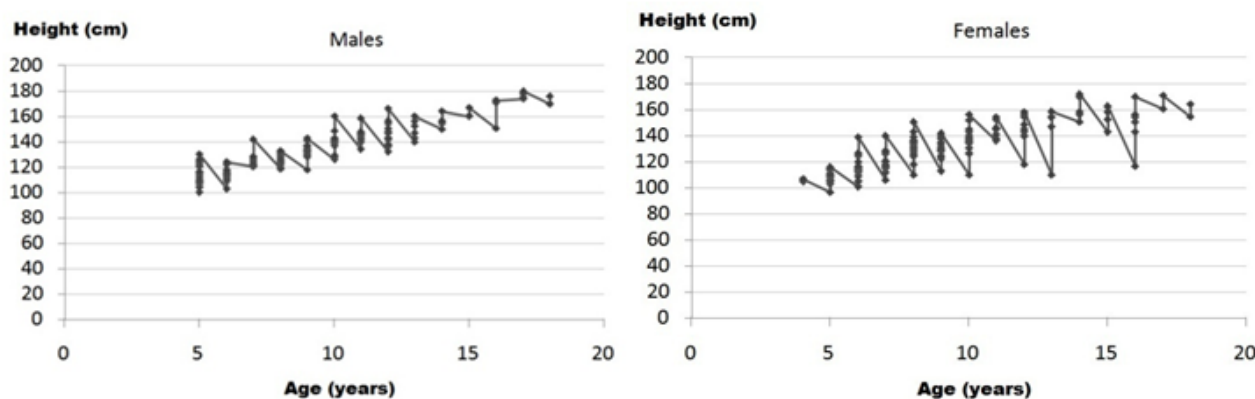
The BMI values were calculated and found to be ranging from 9.2 to 31.91  $\text{kg/m}^2$  with a mean ( $\pm$  SD) value of  $16.99 \pm 3.9$   $\text{kg/m}^2$ . The same as height and weight, BMI didn't differ significantly ( $p=0.828$ ) between males ( $17.29 \pm 3.98$   $\text{kg/m}^2$ ) and females ( $16.72 \pm 3.82$   $\text{kg/m}^2$ ).

Arm circumference was measured for all the subjects and the values were found to fall between 11.3 and 36 cm with a mean ( $\pm$  SD) value of  $20.49 \pm 3.99$  cm with no significant difference between males and females ( $p=0.223$ ).

### Comparing height and weight to the standard measures of children and adolescents in Saudi Arabia

Regarding height, the average height of boys ( $135.16 \pm 18.21$  cm) was found to be significantly higher ( $p=0.047$ ) than the age-relevant value extracted from the standard growth chart (132 cm) [8].

On the other hand, no significant difference ( $p=0.357$ ) was



**Figure 1.** Participants' height measurements.

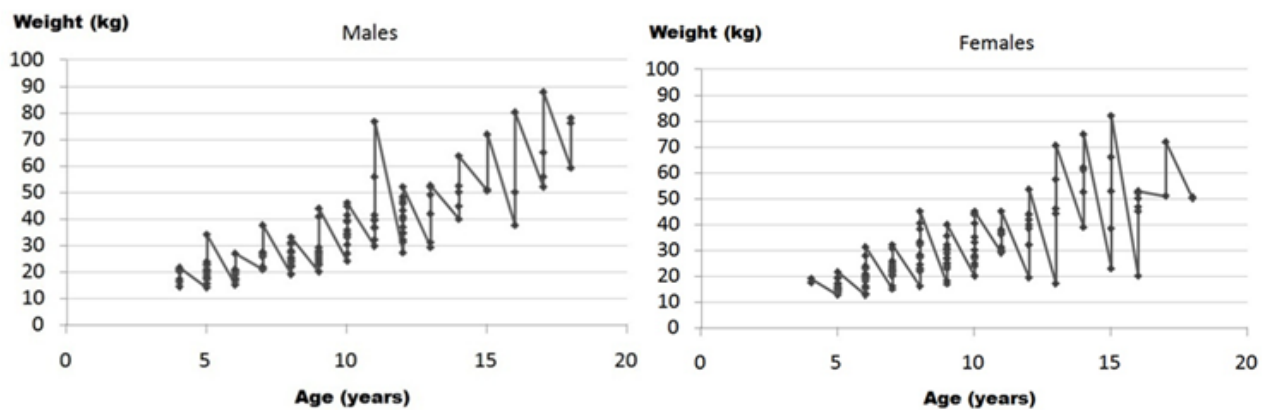


Figure 2. Participants' weight measurements.

found between the average height of the girls included in the study ( $131.38 \pm 17.86$  cm) compared to the age-relevant value extracted from the standard growth chart (130 cm).

While regarding the body weight, the average weight of boys in the study ( $31.86 \pm 14.84$  Kg) was significantly higher than the age-relevant value extracted from the standard growth chart (28 kg),  $p < 0.001$ .

The same was reported in girls as the average body weight ( $30.5 \pm 14.23$  kg) was significantly higher than the age-relevant value extracted from the standard growth chart (27 kg),  $p = 0.004$ .

#### Parental weight and height

Parental height was considered as important information to exclude genetic predisposition of short stature of children. Both mother's and father's height measurements were recorded where the mean ( $\pm$  SD) value for the fathers' heights was  $170.23 \pm 8.05$  cm while the mothers was  $158.3 \pm 6.87$  cm. The maximum value recorded for father's height was 189 cm while the minimum was 125 cm. The maximum value recorded for the mother's height was 186 cm while the minimum was 109 cm.

The participant's current health status was also important to be taken into consideration. They were asked if they suffer from any diseases and the following was found; 2 (0.7%) had sickle cell disease, 12 (4.3%) had asthma, 4 (1.4%) had anemia, 2 (0.7%) had food intolerance, 1 (0.4%) had diabetes, 1 (0.4%) had kidney disease, and 48 (17.3%) had other diseases.

No significant differences were found between the heights ( $p = 0.067$ ), weights ( $p = 0.078$ ) or BMI ( $p = 0.359$ ) of children who have any diseases and those who are diseases-free.

Regarding nationality, 244 (88.1%) of participants were Saudi while 33 (11.9%) were of other nationalities. The participants were also asked about their place of residence and it was found that those who were living in Taif were 257 (92.8%), those who were living in other high-altitude cities were 19 (6.9%) while only one participant (0.4%) was not living in a high-altitude city. The duration of residence ranged from 1 to 18 years with a mean ( $\pm$  SD) value of  $13.94 \pm 6.07$  years.

The number of family members was collected. The most prevalent was families with 5 members (74 participants, 26.7%). This was closely followed by 19.5% having 4 family members. More details are shown in the Table 1.

Table 1. Showing the number of family members in each participant.

Number of family members	Frequency	Percent
2.00	1	0.4
3.00	13	4.7
4.00	54	19.5
5.00	74	26.7
6.00	50	18.1
7.00	34	12.3
8.00	20	7.2
9.00	15	5.4
10.00	6	2.2
11.00	5	1.8
12.00	1	0.4
13.00	3	1.1
14.00	1	0.4
Total	277	100.0

#### Occupation and educational level of parents

Regarding the father's occupation, 40.1% were military members, 23.8% were teachers, 7.2% were engineers, 4% were physicians, 2.9% were involved in free works and 22% occupy other positions. Regarding the father's education, 51.3% hold a bachelor's degree, 44.4% were high school graduates, while 4.3% held a Masters or PhD degree.

Regarding the mother's occupation, 67.5% were homemakers, 0.7% were engineers, 8.7% were physicians, 20.6% were involved in free works and 2.5% occupy other positions. Regarding the mother's education, 56.7% held a bachelor's degree, 39% were high school graduates, while 4.3% held a Masters or PhD degree.

#### Socioeconomic status

As for the total family income, the number of participants who had average income ranging from 5000 to 15000 SR was 168 (60.6%). Those who had high total family income (more than 15000) were 89 (32.1%) participants, while those who had low total family income (less than 5000) were 20 (7.2%) participants.

The economic status of families (expressed as total income) showed no significant effect on children's height ( $p = 0.071$ ), weight ( $p = 0.055$ ) or BMI ( $p = 0.079$ ).

A total of 150 participants (54.2%) live in a house owned by the family while 127 (45.8%) lived in a house that was rented. Regarding the number of rooms in the house, 14 (5.1%) lived in

a house that had 2 rooms or less. 189 (68.2%) lived in a house that had 3 - 5 rooms, while 74 (26.7%) lived in a house that had more than 5 rooms.

### **Eating, drinking and exercise habits**

Information about the participants' eating habits was also collected by asking them about their favorite foods and how many times per day the participant consumed them. These were the largest group of findings for each category. Cereals were consumed with more than 3 meals per day by 38.6% of the participants. Fruits and vegetables were consumed with more than 3 meals per day by 29.6% of the participants. 35.4% of the participants consumed fast foods once per day. Packed food was not preferred with the largest group making up around 29.2% of the participants don't eat it. 48% of the participants consumed meat with more than 3 meals per day. As for the sweets, these were consumed once daily by 23.8% of the participants. More details are found in the Table 2.

Drinks consumption included in the diet was also considered. The following was found to be the most prevalent percentages. Pasteurized milk was consumed to travel purposes by 32.9% followed by 29.6% who consumed it more than 3 times daily. Fresh milk was consumed to travel purposes by 47.3%. Soft

**Table 2.** Showing the frequency and the percent of the daily consumption of each food type regarding the participant.

Food Type	Number of meals in a Day	Frequency	Percent
Cereals	One meal	57	20.6
	2 meals	49	17.7
	3 meals	43	15.5
	More than 3 meals	107	38.6
	Don't eat	21	7.6
	Total	277	100.0
Vegetables and fruits	One meal	29	10.5
	2 meals	64	23.1
	3 meals	47	17.0
	More than 3 meals	82	29.6
	Don't eat	55	19.9
	Total	277	100.0
Fast food	One meal	98	35.4
	2 meals	73	26.4
	3 meals	26	9.4
	More than 3 meals	17	6.1
	Don't eat	63	22.7
	Total	277	100.0
Packed Food	One meal	65	23.5
	2 meals	32	11.6
	3 meals	29	10.5
	More than 3 meals	70	25.3
	Don't eat	81	29.2
	Total	277	100.0
Meats	One meal	58	20.9
	2 meals	26	9.4
	3 meals	35	12.6
	More than 3 meals	133	48.0
	Don't eat	25	9.0
	Total	277	100.0
Sweets	One meal	66	23.8
	2 meals	36	13.0
	3 meals	42	15.2
	More than 3 meals	95	34.3
	Don't eat	38	13.7
	Total	277	100.0

drinks were consumed to travel by 46.6%. Natural juices were consumed once per day by 27.8% while tea and coffee were consumed to travel by 54.2%. More details are shown in the Table 3.

Exercise habits were also tracked. The participants were asked about different exercise forms and the number of times per week the participants would engage in them. The participants going for a walk were divided as follows according to the frequency; 14.8% went for a walk once per week, 2.2% twice per week, and 14.1% three times per week while 24.5% never went for walks. 44.4% of the participants claimed to go for walks daily. Participants were also asked about playing football to which they claimed that 7.6% played once per week, 1.4% twice per week, 20.9% three times per week, 18.4% daily while 51.6% never played football on regular basis. The last form of exercise was swimming. 10.5% of the participants claimed to swim once per week, 2.9% swam twice per week, 13.79% three times per week, 27.1% daily while 45.5% never went for a swim. More details are shown in the Table 4.

### **Relatives marriage**

There participants were asked if the family includes relative's marriage. 34.7% answered yes while 65.3% answered no. More details are shown in the Table 5.

**Table 3.** Showing the frequency and the percent of the daily consumption of different kind of drinks.

Type of Drink	Number of drinks in a Day	Frequency	Percent
Pasteurized milk	Once	67	24.2
	Twice	18	6.5
	Three times	18	6.5
	More than 3 times	82	29.6
	To travel	91	32.9
	0	1	0.4
	Total	277	100.0
Soft drinks	Once	64	23.1
	Twice	32	11.6
	Three times	28	10.1
	More than 3 times	23	8.3
	To travel	129	46.6
	0	1	0.4
	Total	277	100.0
Fresh milk	Once	61	22.0
	Twice	19	6.9
	Three times	19	6.9
	More than 3 times	45	16.2
	To travel	131	47.3
	0	2	0.7
	Total	277	100.0
Natural juices	Once	77	27.8
	Twice	35	12.6
	Three times	51	18.4
	More than 3 times	55	19.9
	To travel	59	21.3
	Total	277	100.0
Tea/ coffee	Once	53	19.1
	Twice	21	7.6
	Three times	19	6.9
	More than 3 times	33	11.9
	To travel	150	54.2
	0	1	0.4
	Total	277	100.0

**Table 4.** Showing the type and the frequency of each exercise that had been done by the participants weekly.

Type of Exercise	Number of times doing exercise in a week	Frequency	Percent
A walk to exercise	Once per week	41	14.8
	Twice per week	6	2.2
	Three times per week	39	14.1
	Daily	123	44.4
	Never	68	24.5
	Total	277	100.0
Play football	Once per week	21	7.6
	Twice per week	4	1.4
	Three times per week	58	20.9
	Daily	51	18.4
	Never	143	51.6
	Total	277	100.0
Swim	Once per week	14	5.1
	Twice per week	6	2.2
	Three times per week	48	17.3
	Daily	12	4.3
	Never	197	71.1
	Total	277	100.0
Ride a bike	Once per week	29	10.5
	Twice per week	8	2.9
	Three times per week	38	13.7
	Daily	76	27.4
	Never	126	45.5
	Total	277	100.0

### Weight changes

The participants were asked if they experienced weight changes recently and 74.7% claimed that they did not, while 25.3% said that they did experience weight changes. More details are shown in the Table 6.

### Frequent chronic infections

The participants were asked if they suffered from frequent chronic infections, to which 21.7% answered yes and 78.3% said no.

The participants' appetite was also questioned. It was found that 9% had above average appetite, 63.9% had average appetite, and 27.1% had below average appetite. More details are shown in the Table 7.

The participants were asked about their prenatal health. This was evaluated by asking about the antenatal care visits and maternal health during pregnancy. It was found that 209 (75.5%) of the participants' mothers had been to antenatal care visits. Regarding maternal infections, 209 (75.5%) claimed that there was none. Regarding maternal skin rashes, 262 (94.6%) claimed that there was none.

Regarding gestational diabetes, 191 (39.7%) had a history of gestational diabetes, 24 (8.7%) were controlled. Regarding gestational hypertension, 101 (36.5%) had a history of gestational diabetes, 16 (5.8%) were controlled. As for radiation exposure during pregnancy, 22 (7.9%) claimed that they were exposed to radiation while they were pregnant while 255 (92.1%) were not exposed to radiation. More details are shown in the Table 8.

The duration of pregnancy was also recorded. A total of 206 (74.4%) children were delivered as full-term babies, 50 (18.1%)

were delivered post-term while 21 (7.6%) were delivered pre-term. More details are shown in the Table 9.

The weight at delivery was also recorded where 50 (18.1%) participants were less than 2500 g at delivery, 171 (61.7%) weighed between 2500 and 3000 g at delivery, 49(17.7%) weighed between 3000 and 4000 g at delivery, while 7 (2.5%) weighed more than 4000 g at delivery. More details are shown in the Table 10.

**Table 5.** Showing the prevalence of consanguinity among all participants.

Relatives Marriage	Frequency	Percent	Valid Percent
Valid	No	181	65.3
	Yes	96	34.7
	Total	277	100.0

**Table 6.** Showing how many participants noticed change in weight.

Weight changes	Frequency	Percent	Valid Percent
Valid	No	207	74.7
	Yes	70	25.3
	Total	277	100.0

**Table 7.** Assessing the appetite of each participant in which 9% have above the average appetite and 27.1% have a low appetite.

Appetite	Frequency	Percent	Valid Percent
Above average	25	9.0	9.0
Average	177	63.9	63.9
Low	75	27.1	27.1
Total	277	100.0	100.0

**Table 8.** Showing different antenatal risk factors that developed during the pregnancy of each participant in which 24.5% of the mother participant were not followed up regularly and 24.5% had infection during pregnancy.

Antenatal risk factors	Frequency	Percent
Antenatal care visits	No	68
	Yes	209
	Total	277
Maternal infection	No	209
	Yes	68
	Total	277
Maternal skin rash	No	262
	Yes	15
	Total	277
History of gestational diabetes	yes controlled	24
	yes not controlled	86
	no	167
	Total	277
History of gestational hypertension	yes controlled	16
	yes not controlled	85
	no	176
	Total	277
Radiation exposure during pregnancy	yes	22
	no	255
	Total	277

**Table 9.** Showing 7.6% of participants were preterm and 18.1% were post term.

Duration of pregnancy	Frequency	Percent
Full term	206	74.4
Post term	50	18.1
Pre-term	21	7.6
Total	277	100.0

Data about how the participants were fed after birth was also collected and it was found that 55 (19.9%) of the participants

**Table 10.** Showing the weight of each participant after delivery 18.1% were less than 2500 g and 2.5% were more than 4000 g.

Weight at delivery	Frequency	Percent
2500 to 3000 g	171	61.7
3000 to 4000 g	49	17.7
Less than 2500 g	50	18.1
More than 4000 g	7	2.5
Total	277	100.0

**Table 11.** Showing the type of feeding of each participant in which only 11.9% were exclusively breast feeding while 19.9% were only on bottle feeding.

Feeding types	Frequency	Percent
Bottle Feeding	55	19.9
Breast feeding	33	11.9
Mixed feeding	189	68.2
Total	277	100.0

**Table 12.** Showing the family history of short stature.

Family short stature	Frequency	Percent
No	182	65.7
Yes	95	34.3
Total	277	100.0

depended on bottle feeding, 33(11.9%) were breast fed, while 189 (68.2%) depended on mixed feeding. More details are shown in the Table 11.

The family's stature was also evaluated, and it was found that 95 (34.3%) had short stature while 182 (65.7%) had normal stature. More details are shown in the Table 12.

After applying the weight, height and body mass index of each child on the Saudi standard growth charts, the correct percentile was determined, and the results shown:

Regarding weight, more than half of the children (51.3%) are in the mid-area of the curve (26<sup>th</sup> to 75<sup>th</sup> percentiles) with the largest proportion (29.6%) in the third quartile (51<sup>st</sup> to 75<sup>th</sup> percentile).

The same was reported for height, as 40.8% of the children are in the mid-area of the curve (26<sup>th</sup> to 75<sup>th</sup> percentiles) with the largest proportion (23.1%) in the third quartile (51<sup>st</sup> to 75<sup>th</sup> percentile).

And for BMI, almost half of the children (47.3%) were in the mid-area of the curve (26<sup>th</sup> to 75<sup>th</sup> percentiles) while the largest proportion (24.2%) was in the second quartile (26<sup>th</sup> to 50<sup>th</sup> percentile). More details are shown in the Tables 13.

**Tables 13.** Show the exact weight and height and BMI in which percentile after applying it on growth chart.

Weight percentile		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 3 percentile	7	2.5	2.5	2.5
	from 3 to 5	5	1.8	1.8	4.3
	from 6 to 10	11	4.0	4.0	8.3
	from 11 to 25	19	6.9	6.9	15.2
	from 26 to 50	60	21.7	21.7	36.8
	from 51 to 75	82	29.6	29.6	66.4
	from 76 to 90	42	15.2	15.2	81.6
	from 91 to 95	24	8.7	8.7	90.3
	from 96 to 97	6	2.2	2.2	92.4
	above 97	21	7.6	7.6	100.0
Total		277	100.0	100.0	
Height percentile		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 3 percentile	9	3.2	3.2	3.2
	from 3 to 5	5	1.8	1.8	5.1
	from 6 to 10	6	2.2	2.2	7.2
	from 11 to 25	17	6.1	6.1	13.4
	from 26 to 50	49	17.7	17.7	31.0
	from 51 to 75	64	23.1	23.1	54.2
	from 76 to 90	48	17.3	17.3	71.5
	from 91 to 95	36	13.0	13.0	84.5
	from 96 to 97	10	3.6	3.6	88.1
	above 97	33	11.9	11.9	100.0
Total		277	100.0	100.0	
BMI percentile		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	below 3 percentile	5	1.8	1.8	1.8
	from 3 to 5	3	1.1	1.1	2.9
	from 6 to 10	18	6.5	6.5	9.4
	from 11 to 25	49	17.7	17.7	27.1
	from 26 to 50	67	24.2	24.2	51.3
	from 51 to 75	64	23.1	23.1	74.4
	from 76 to 90	48	17.3	17.3	91.7
	from 91 to 95	11	4.0	4.0	95.7
	from 96 to 97	3	1.1	1.1	96.8
	above 97	9	3.2	3.2	100.0
Total		277	100.0	100.0	

## Discussion

It is still questionable if living in high altitude can negatively affect children's growth in terms of height and weight especially during the early childhood when the growth rate is at its maximum [9].

And accordingly, this cross-sectional study was conducted on children living in "Taif" city as an example of a high-altitude city in order to examine the effect of high altitude on children growth. A face to face questionnaire was filled-in for 277 children. In addition, body measurements including height, weight, and BMI and arm circumference were taken for these children. The research question was answered by comparing the mean values of body measurements of those children (mainly weight and height) to the standard growth curves of Saudi children developed by El-Mouzan et al. [8].

Results of the current study showed that the body weights of boys and girls were significantly higher than the age-relevant values in the standard growth curves ( $p < 0.001$  and  $p = 0.004$  respectively).

The same as body weight, height of boys was significantly higher than the Saudi national growth standard ( $p = 0.047$ ). On the other hand, no significant difference ( $p = 0.357$ ) was found between the average height of girls compared to the age-relevant value extracted from the standard growth chart.

Results of our study can be supported by a previous study that has been conducted in Bolivia, 1982 on school age children to find that, the effect of high altitude on children growth is small if compared to that of other environmental and genetic factors [10].

However, our findings are against the results of several previous studies which revealed that living in high altitude cities can affect child's growth negatively in terms of height and weight.

This includes a study conducted on Tibet population which showed that living in high altitude might result in delay in the growth especially in height regardless of socioeconomic, nutrition and disease, and the effect on weight could be limited but they only covered children from the birth till the age of 3-year-old [11].

This is also against the findings reported in a study has been done in Abha, Saudi Arabia 1995 among children varying from the age of 6 to 14 and they found that children who lives in Abha has lower weight, height and weight for height ratio in comparison to NCHS growth standard. But they did not assess the relation of these results to the socioeconomic state or the genetic predisposition or nutritional state of the child [12].

## Conclusion

Results of the current study showed that living in "Taif" as an example of high altitude city did not affect children growth negatively in terms of height and weight. And accordingly, additional research in other high-altitude cities is required in order to further affirm or deny this hypothesis and identify any other factors that might affect the optimum growth rate of children in Saudi Arabia.

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