

1 **An Epidemiologic Study of the Process of Changes in Anthropometric Indices**
2 **in Children Under 24 Months based on Gender differences in Kohgiluyeh and**
3 **Boyer Ahmad Province, Southwest Iran 2017-18: An Incidental Phenomenon**
4 **or a Gender Inequality?**

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30 **Abstract**

31 **Background:**

32 An assessment of the process of changes in growth indices of children based on gender
33 differences not only does provide the required information of the child's growth pattern, rather it

۳۴ also prepares the ground for a dynamic comparison of gender differences as a sensitive indicator
۳۵ of gender discrimination. The current research has been designed and implemented for depicting
۳۶ the growth patterns of children under two years old.

۳۷ **Methods:**

۳۸ Through a secondary analysis based study, the health files of 1336 children under 2 years old
۳۹ (700 boys and 636 girls) in the maternal and child health care system in Kohkiluyeh and Boyer
۴۰ Ahmad Province in 2017 were analyzed in terms of the nutritional status and in view of
۴۱ underweight and skinniness (wasting) and stunting (stunted growth) based on WHO
۴۲ standardization indicators.

۴۳ **Results:**

۴۴ The average difference of weight, height and head circumference of male and female children in
۴۵ the early days of their birth were respectively 67 g, 0.36 and 0.37 cm. Although z standardized
۴۶ score charts for average weight, height, and head circumference did not show a significant
۴۷ difference in the course of two-year period among boys and girls, the percentage ratio of boys as
۴۸ compared to girls in low weight at birth, six months, one year and two years old are respectively
۴۹ 0.98, 1.7, 12.4 and 1.5 for weight loss index 2.4, 1.73, 2.9 and 1.9, and for the short height
۵۰ (stunted growth) indexes 1.3, 1.48, 1.4 and 1.6, and for the head circumference index 0.48, 2.27,
۵۱ 1.56 and 1.6, and these indicate a constant gap between the boys with low weight, skinny and
۵۲ low head circumference measure and girls.

۵۳ **Discussion and conclusion:**

۵۴ In spite of the closeness of weight, height and head circumference differences in newborn girls
۵۵ and boys, their growth difference over the two-years period was associated with boys'
۵۶ superiority. In other words, boys had a more desirable growth trend than girls in terms of

۵۷ averaging indices. On the other hand, the percentage of male children with low weight, wasting
۵۸ and short height in the whole course of the study was more than female subjects. The research
۵۹ findings not only lay an emphasis on the gap between boys and girls in view of the studied
۶۰ indices, but also underlines the fact that in epidemiological studies, comparisons of averages are
۶۱ not an appropriate approach for comparing populations, and this in turn reveals the urgent need
۶۲ to pay more attention to frequency-based indicators. The recent attitude shift that has occurred
۶۳ among Iranian families in terms of giving much care to girls as compared to boys against the
۶۴ previous inverted approach seems to be one of the most important justifications for this
۶۵ difference in growth trend.

۶۶ **Keywords:** Anthropometric Indices, Children under 2 years, Kohgiluyeh and Boyer Ahmad
۶۷ Province, Gender Justice

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۷۰ **2-Background:**

۷۱ The first two years of birth are regarded as one of the most sensitive periods of life, which, in addition to
۷۲ its periodical importance, is also of a predictive value. The importance of this period is to such an extent
۷۳ that the mortality rate of children under one year is considered to be one of the most important indicators
۷۴ of the development of societies. Besides displaying the nutritional status of a child, growth monitoring
۷۵ can play a vital role in the diagnosis of growth impairment and diseases with nutritional basis in the early
۷۶ stages of life [1,2].

۷۷ The studies that have been conducted regarding the growth indices show improvements in these indicators
۷۸ over the past decades. Mercedes de onis et al. have detected a declining trend in the underweight index in
۷۹ the East Asian region between 1999 and 2015 [3]. The improvement of mortality rate in the general infant
۸۰ population and sucklings in Iran is an alternative evidence that substantiates this claim [4-6]. Despite the

٨١ observed improvement, attention to gender differences is another important point that might be forgotten
٨٢ in light of the overall improvement of the indicators. Differences that are sometimes inevitable and in
٨٣ some cases can be avoided (including health inequality). On the other hand, the study of the growth
٨٤ indices trend based on gender differences versus spot attitude, will be able to show the differences with a
٨٥ more reliable approach. Current research was designed due to the lack of a comprehensive report on the
٨٦ growth indices of children under two years within a two-years period in the study area, and was
٨٧ implemented via comparing standardized indicators in male and female children to explain the possible
٨٨ differences.

٨٩ **3- Methods:**

٩٠ The research area with a population of about 700,000 and an area of 16,249 square kilometers is located
٩١ in the southwest of Iran, and is home to roughly 1 percent of the population and the country's total area.
٩٢ With an average birth rate of 0.76%, almost 10,000 new births are annually registered in this region. Sex
٩٣ ratio at birth is 1.2 and in the general population is one [7].

٩٤ The current research has been designed as a secondary analysis of the information of health files of
٩٥ 1336 children under 2 years in the maternal and child health care system in 2017. Study protocol was
٩٦ approved by the Ethic Committee of the School of Public Health, Yasuj University of medical sciences
٩٧ (Ir.yums.REC.1394.78). The records were selected randomly from the record files of health homes and
٩٨ centers of the province keeping the balance between the urban and rural population ratios. Those records
٩٩ with did have more than 10% lost data and their completion was not possible were excluded.

١٠٠ Data collection tools that have been used in this research include observation forms (checklists) and, in
١٠١ necessary cases, interviews with the mothers of these children. In Primary Care System, weighing is done
١٠٢ in terms of grams (with 100 g accuracy), height and head circumference are measured based on
١٠٣ centimeter (with half cm precision) and using standard instruments of the Islamic Republic of Iran's care
١٠٤ system and the measurement is conducted by experienced care experts.

100 The collected data were processed by spss software and the standard anthropometric indices based on the
106 formulas provided by the World Health Organization according to the Z score and the final classification
107 based on three indicators of weight for age, weight for height and height for age, respectively describing
108 LBW, stunting, and short height, were analyzed according to formulas 1 to 10 as follows [8- 12].

109 Z score or standard deviation classification system:

110 *equation 1 : z score weight or head circumference = $\frac{\text{observed value} - \text{median of reference population}}{\text{standard deviation of reference population}}$*

111 *equation 2: z score length = $\frac{(\text{length}/M)^L}{L * s}$*

112 *equation 3: z score weight for length = $\frac{(\text{weight}/M)^L - 1}{L * s}$*

113 *equation 4: z score > -2: no stunting*

114 *equation 5: - 3 < z score ≤ -2: modrate stunting*

115 *equation 5: z score ≤ -3: sever stunting*

116 *equation 6: z score > 1.6: over weight*

117 *equation 7: - 1.6 < z score ≤ 1.6: healthy weight*

118 *equation 8: - 2 < z score ≤ -1.6: under weight*

119 *equation 9: - 3 < z score ≤ -2 : modrate wasting*

120 *equation 10: z score ≤ -3: sever wasting*

121

122

123

124 **4- Results:**

125 From 1336 children, (47.6%) 636 were girls and (52.4) 700 were boys.

126 Table 1 shows the mean distribution, standard deviation, and the differences in weight, height, and head
127 circumference of the children under study based on gender differences.

128 Average difference of the weight of boys and girls at early days of birth was only 67 grams. With the
129 increase in age this difference showed also an increasing trend, insofar as from the first month to the 24th
130 month, the average weight difference between boys and girls was about 350 grams. Changes in the mid-

131 range and interquartile range between the boys and girls in the first few months started with a soft trend
132 and continued with a relatively constant 400g difference from the fourth month onwards.

133 Average difference in height between male and female children was 0.36 cm at birth. In the whole course
134 of two years period, boys' height increased by 1.2 cm as compared to that of the girls. Although the
135 average height at birth was equal in both male and female groups, the average height of boys retained its 1
136 cm superiority up to 24 months from the first month onward.

137 Average head circumference of the studied children at birth showed a difference of 0.37 cm in boys as
138 compared to the girls. As the children's age increased, this difference in growth showed an increasing
139 trend, insofar as from the first month to the 18th month, the difference continued with 0.7 cm superiority
140 of boys as compared to the girls.

141 By and large and in view of gender comparison, despite the closeness of weight, height and head
142 circumference differences between boys and girls at birth, their growth difference over the two-years
143 period substantiates boys' superiority.

144
145 According to the findings of Table 2, the prevalence of low weight at birth in both genders was 3.9%,
146 and this ratio for the boys and girls under study was respectively 3.8 and 3.9. Nevertheless, at the end of
147 two years, the weight ratio in both genders got fixed at 3.8, but this stability was due to an increase in the
148 prevalence of underweight for male infants (4.8%) and a decrease in the prevalence of underweight
149 among female infants (3.14%).

150
151 According to the findings of table 3, the prevalence of wasting at-birth has been estimated to be 18.7% in
152 boys and 7.7% in girls. In view of the severity, 12% of boys suffered minor wasting (weight loss), 4.86%
153 suffered moderate wasting and 1.4% suffered severe weight loss. The corresponding numbers in girls for

104 the mentioned indicators were respectively 3.5, 2.2 and 1.8 percent. To put it otherwise, this index was
100 better for girls than boys at all levels at birth. In both genders, the gradient trend of wasting changes in
106 view of different months of child growth shows a decreasing trend, though the rate of these changes in
107 boys is more steep. In other words, the rate of improvement of weight index in boys during the two-years
108 period is more desirable than the girls who are involved in the study. At 2 years, the prevalence of overall
109 wasting in boys was estimated to be 16.8% and in girls 8.47%.

160
161 The prevalence of stunting among boys and girls were estimated to be respectively 7 and 5.35%. Minor
162 stunting in males and females was respectively 5.5 and 3.6, while severe stunting was respectively 1.4%
163 and 1.3%. Generally speaking, stunting among boys is more prevalent than girls. The process of minor
164 and severe changes in stunting in both boys and girls has shown an increasing trend over the course of
165 two years. It is worth noting that the increase in gradient in boys is more steep as compared to girls. Said
166 differently, severe stunting in boys gets worsened with age increase.

167
168 The prevalence of microcephaly (minor and severe) at birth were estimated to be respectively 0.8
169 and 1.73% for boys and girls. At the end of two years, the prevalence of microcephaly for boys
170 and girls was estimated to be 1.28 and 0.78 percent. To state the matter in different words, this
171 percentage showed increase in boys and decline in girls.

172 Trend charts of weight, height, and head circumference indices for age in both male and female
173 sexes do not show any significant difference. Although the wider base of the charts for boys
174 gender group demonstrates more heterogeneity in weight and height for male infants. On the
175 other hand, heterogeneity and instability of measurements in head circumference in the female
176 gender group are more sensible than that of boys.

177 During the whole period of monitoring, the average weight, height and head circumference in
178 boys were more than girls.

179 The weight difference for age in boys as compared to girls began with 67 grams at birth and this
180 process continued with a steep trend line up to four months and after then it continued with a
181 more level tone until the end of two years.

182 The difference of average height for age at birth started with a difference of 0.37 cm between
183 boys and girls and reached the heighest degree of difference within five-months with a steep
184 trend line, then the process of difference reduction continued up until 15 months and from 15
185 months to the end of two years the increasing trend did start again.

186 The average difference of head circumference for age at birth showed a 0.36 cm difference, and
187 this trend continued up to six months and after undergoing through a mild process the same trend
188 continued from six months to fifteen months, and from 18 months onward, the changes in the
189 average head circumference speeded up. By fitting the third degree model, the average of head
190 circumference was predicted from 18 months to the end of two years, that indicates an increase
191 in the average of head circumference of boys as compared to girls.

192 During the whole course of monitoring, weight loss in boys was more prevalent than girls. While
193 early postnatal wasting in male infants is more than that of female infants (the male to female
194 ratio of wasting is 2.4), this gap has declined up to 15 months (at 12 months, the male to female
195 ratio of wasting is 2.3), insofar as this difference at 24 months reached its minimum possible
196 (male to female ratio of wasting is 1.9).

197 During the whole course of monitoring, weight loss in boys was more prevalent than girls. While
198 early postnatal wasting in male infants is more than that of female infants (the male to female

199 ratio of wasting is 2.4), this gap has declined up to 15 months (at 12 months, the male to female
200 ratio of wasting is 2.3), insofar as this difference at 24 months reached its minimum possible
201 (male to female ratio of wasting is 1.9).

202 During the entire course of growth, short stature in boys was more prevalent than girls. Indicator
203 gap ratio at birth (male to female ratio) was 1.3. This ratio showed a continuous increase in the
204 course of the year, insofar as at 7 months the male to female ration of short stature reached 1.9.
205 After a slight decrease, this index took an increasing trend again and at the end of two years, the
206 ratio of short male infants as compared to female infants reduced to 1.6.

207 During the whole course of growth, microcephaly was more prevalent among boys than girls.
208 The early postnatal microcephaly was lower in boys as compared to girls. The gap in the
209 percentage of microcephaly as separately for male and female infants has had an increasing trend
210 up to seven months and has started to decline from nine months and continued its declining trend

211 **Discussion:**

212 The standardized chart (Z score) for weight, height, and head circumference indices in both
213 groups showed the same pattern, which did not show a significant difference with the
214 standardized child development pattern (WHO). Growth trend based on three indicators of
215 average weight, height and head circumference for age in all periods of measurement showed
216 better growth in boys than girls. (Table 1, Chart 1). According to the indicators of estimation of
217 prevalence of underweight, wasting, short stature and microcephally, in all periods of
218 monitoring, the male infants were is undesirable conditions as compared to female infants
219 (Tables 2-5 and Charts 2-6).

۲۲۰ Research findings indicated **the proximity of the weight for age index** at birth in male and
۲۲۱ female infants studied in this research (Chart 1). To put it otherwise, no relationship has been
۲۲۲ observed between gender and birth weight. In the study conducted by Tusi et al., gender did not
۲۲۳ have any significant relationship with birth weight, height and head circumference. Furthermore,
۲۲۴ in the study conducted by Ali Malayeri (Jodipour) et al., in Sistan, the weight difference between
۲۲۵ male and female newborns was not statistically significant [13, 15]. These findings are not in line
۲۲۶ with WHO reports and several other studies that suggested that female newborns were at the risk
۲۲۷ of underweight [16, 17].

۲۲۸ As the age increased, the gradient of this index increased more and more between boys and girls,
۲۲۹ insofar as in a relatively uniform manner at all times, the average weight of boys was higher than
۲۳۰ that of girls. This finding is consistent with the results of several other studies [18, 19, 20, 21]. It
۲۳۱ is important to note that in comparison of groups and populations, the reliance on the average
۲۳۲ index for comparative remarks is confronted with certain problems. Although the average weight
۲۳۳ of male infants in all periods has been higher than that of the girls, underweighted male infants
۲۳۴ in all stages of growth have been more than the female underweighted infants, and this shows the
۲۳۵ practical nature of frequency indicators compared to average based indices in population
۲۳۶ comparison.

۲۳۷ While the rate gradient of changes in **male underweighted infants** was steeper in all points of
۲۳۸ the two years period as compared to female infants, the gradient of the changes in the average
۲۳۹ weight of the boys was the same in comparison to the girls in the whole follow-up period.
۲۴۰ Ayatollah et al., have studied the growth trend of 256 newborns and reported the highness of the
۲۴۱ growth rate of male infants as compared to female infants in the first year and the uniformity of

۲۴۲ growth rate from the first year onwards. In an alternative study the increasing trend in weight in
۲۴۳ ten days and thirty days was related to maleness [9, 19].

۲۴۴ **The average height for age** of newborn infants showed a less than half a centimeter difference
۲۴۵ in the male newborns as compared to baby girls. In several other studies, the neonatal height of
۲۴۶ male newborns was reported to be higher than girls [14, 22, 23]. With the increase in the age of
۲۴۷ infants, this growth difference showed an increasing trend, insofar as from 1 month to 24
۲۴۸ months, the height difference of 1 cm continued with male infants' superiority over the female
۲۴۹ infants. Generally speaking, the boys' height increase as compared to girls is significantly
۲۵۰ different over the entire two-years period of suckling. The current finding is consistent with the
۲۵۱ results of other studies in the later stages of the development of children and adolescents,
۲۵۲ including a longitudinal study (cohort study) in a region of Korea on a group of children of 6
۲۵۳ years old and up the average of this index was higher in boys than in girls to the ultimate height
۲۵۴ growth (173.5 and 160.5 cm respectively), which is consistent with the results of the cross-
۲۵۵ sectional study of 2007 in Korea [24, 25]. In all postnatal growth stages the average height of
۲۵۶ boys has been one cm more than that of girls. On the other hand, despite the fluctuation in the
۲۵۷ ratio of weight loss in different periods, in all courses, the ratio of underweighted male children
۲۵۸ was higher than that of the girls.

۲۵۹ **The average of head circumference for age** at birth showed a slight difference in male
۲۶۰ newborns compared to the female newborns. This finding is consistent with the results of several
۲۶۱ other studies and this difference has been statistically significant in the study by Ali Malayeri et
۲۶۲ al. [14, 23, 26]. As the age of children increased, this growth difference showed an increasing
۲۶۳ trend, insofar as after the first month to one and half years, the difference in growth between

۲۶۴ male suckling infants as compared to the female ones continued with a stable height of 0.7 cm.
۲۶۵ Many other similar studies have also confirmed this finding [18, 19, 20, 21].
۲۶۶ Generally speaking, despite the closeness of **weight, height and head circumference difference**
۲۶۷ between male and female newborn infants, their growth difference over the two-years period has
۲۶۸ recorded the superiority of boys. Some of the WHO standard growth charts show the difference
۲۶۹ between the two genders [18, 19, 20, 21]. But the noticeable point in this study is the persistence
۲۷۰ and stability of significant differences in the indicators discussed as regards boys compared to
۲۷۱ girls and the increase in the difference gradient from 9 months onwards. In Iran the mother are
۲۷۲ advised to use supplement nutrition from 4-6 months, and more than 90% of infants will benefit
۲۷۳ from supplement from about six months. This shows the correlation between the period of using
۲۷۴ supplement and the increase in the difference in growth rates. The similarity of temporal and
۲۷۵ spatial conditions provides researchers little justification for justifying the observed pattern. In
۲۷۶ other words, unsystematic attention to child nutrition, especially male infants, in the family, and
۲۷۷ even lack of attention to childhood care, can explain the wide range of changes and differences
۲۷۸ observed if they do not explain all the differences.
۲۷۹ The findings of the current research showed that **the prevalence of underweight for age** at birth
۲۸۰ was nearly four percent in both sexes, and this ratio was almost the same for male and female
۲۸۱ newborns, which is consistent with the results of the Ayatollahi's study that was conducted in
۲۸۲ Maku (3.9%), but it is inconsistent with the study that has been conducted by Ali Malayeri et al.
۲۸۳ both in frequency (9.3%) and in gender (male and female, respectively 10.9% and 7.7%).
۲۸۴ Moreover, according to the UNICEF 2013 report, this indicator is of 15 percent prevalence in the
۲۸۵ world in under 5 age group and reaches 25 percent in South Asian countries [6, 9, 14].
۲۸۶

287 Although at the end of two years, the ratio of underweight for the whole sample under study
288 remained almost constant, but this stability was not associated with maintaining the pattern of
289 gender distribution at birth, insofar as the percentage of underweight in male sucklings is
290 increased, but declined in female infants. If we are supposed to interpret these changes in line
291 with the previous discussion, this seems to be due to the improvement in the height growth of
292 male infants as compared to the weight gaining of these children in comparison to girls.

293 **According to wasting index (underweight for height)**, in the early days of birth, minor wasting
294 in male newborns was about four times higher than girls. Moreover, in view of moderate and
295 severe weight loss (wasting), the prevalence of these degrees of underweight in boys was about
296 one and a half times higher than female infants. This finding is consistent with the results of
297 several other studies [19, 27], while the results of several other studies are contrary to this
298 finding, e.g. in a study in the Gamb province of Nigeria, prevalence of weight loss was higher in
299 girls as compared to boys (2.6 and 2), and severe wasting in both sexes was zero [21, 28].

300 **The proportion of minor short stature** at birth in male newborns was about one-and-a-half
301 percent higher than girls. This index for severe stunting at birth was nearly equal in both genders.
302 In other words, generally speaking, short stature in boys has been more prevalent than girls. This
303 finding is consistent with some other studies, including the study that has been conducted by
304 Zhank in Bangladesh. The prevalence of short stature at birth in boys (18%) was higher than
305 girls (14%) [29, 30].

306 **The trend of changes in minor and severe stunting** in all the infants under study during the
307 two-years period has shown an increasing trend. The point that is noteworthy in this observation
308 is that the gradient of increase in boys has been more as compared to girls. To put it otherwise,
309 severe stunting was more prevalent in boys with higher age, and striking height changes in

310 infants continued to show greater resistance to this point. The prevalence of short stature in this
311 study is consistent with the results of the Nigerian study (the prevalence of moderate short
312 stature in males and females were respectively 47% and 33%, and severe short stature were 14%
313 and 12% respectively) [28].

314 The prevalence of short stature in this study is consistent with the results of the Nigerian study
315 (the prevalence of moderate stunting in male and female infants). However, since the index of
316 stunting is more indicative of chronic malnutrition mainly due to micronutrient deficiencies,
317 serious attention is needed to be paid to eliminating the effective factors such as socioeconomic,
318 nutritional and environmental problems. In several studies, the main cause of short stature has
319 been traced back to poverty, and in the next stages, to inattention, parasitic infections and genetic
320 factors [31, 32]. In a study the positive and direct impact of consumption of the iron supplement
321 has been shown to increase height lengths after 6 months [21].

322 **The percentage of smaller head circumference** at birth in both genders has been less than 1
323 percent, and this trend remained relatively constant during the course of the growth. To state the
324 matter differently, the index showed a desirable status in the population under study. In a study,
325 the direct effect of breastfeeding on the proper growth of the head has been shown [21].
326 Although, no significant difference was seen at birth in the sextuple indexes (weight, height,
327 head circumference, underweight, wasting and stunting) between boys and girls, and though the
328 average weight, height, and head circumference indices were better in boys as compared to girls,
329 but over a two-years period, the prevalence of underweight, wasting and short stature was higher
330 in boys than in girls, and this is a remarkable point that is not consistent with presuppositions of
331 of better male infants' growth indices as compared to those of the female infants. To the state the
332 matter in different words, against the existing expectations, the status of growth indices in boys

۳۳۳ is worse than those of girls, and this issue deserves to be taken into account in view of the justice
۳۳۴ in sexual health. The family structure in Iran, Iranian boys' responsibilities in the family system,
۳۳۵ and finally the increased prevalence of these indicators in male group, double the necessity of
۳۳۶ adopting preventive approaches to children's nutritional care. It seems that the change in Iranian
۳۳۷ families general attitude as regards preferring to have girls instead of boys is one of the most
۳۳۸ important justifications for this difference in the growth trend. Another point that might be useful
۳۳۹ in justifying this finding is that, despite the attention that is paid by families to boys within the
۳۴۰ families of male newborns, the family's cultural, social and economic conditions are more
۳۴۱ effective than the parents' desire in infants growth. This is merely a theory that the present study
۳۴۲ does not provide strong evidence of its confirmation or rejection, and it requires a special study
۳۴۳ to be designed so as to clarify the position of the parents' desire to change versus the family's
۳۴۴ scientific ability to change their child's development. Moreover, the results of the current
۳۴۵ research serve as a warning to the effect that the emphasis on mental beliefs (a health justice gap
۳۴۶ with male gender superiority to the girl) need to be replaced with the approach of "analysis of
۳۴۷ justice in health based on evidences", so that as a result of mere attention based on theoretical
۳۴۸ foundations of policy makers, the opposite group (boys) do not suffer damages following the
۳۴۹ theoretization. We should not forget that two important goals (goals 3 and 4) of the 8th
۳۵۰ MDG2015 are child health and gender equality [33]. Then, though the families need to increase
۳۵۱ their awareness and knowledge in order to change their attitudes, beliefs and practices, there is
۳۵۲ still a more urgent thing here, i.e. having clear evidences of the existence of a gap or the
۳۵۳ superiority of a particular sexual group. by probable outliers, equality of variances, and the
۳۵۴ assumption of normal distribution of data, such as multivariate regression analysis, and so on and
۳۵۵ so forth.

۳۵۶ **Conclusion:** While the primary and subjective theories induce the worse growth indices of girls,
۳۵۷ the findings of the present study suggest a different truth (the prevalence of worsen growth
۳۵۸ indices in male infants). The family structure in Iran and the studied province, the male
۳۵۹ responsibilities in the family system, along with the higher percentage of undesirable growth
۳۶۰ indicators in the male gender group, increase the need for attention and review of preventive
۳۶۱ programs, especially in children's nutritional care. The skewness of the distribution of raw
۳۶۲ numbers of weight, height, and head circumference based on age, as well as the presence of
۳۶۳ probable outliers in the two ends of studied distributions are among the analytic weaknesses
۳۶۴ based on the procedural comparison of the developmental indices. Therefore, it is recommended
۳۶۵ that in future studies other researchers use statistical methods that are not affected

۳۶۶ **Abbreviations:**

۳۶۷ LBW: Low Birth Weight, MDG: Millenium Development Goal ,WHO: World Health
۳۶۸ Organization

۳۶۹ **Declarations:**

۳۷۰ Ethics approval and consent to participate: Study protocol was approved by the Ethic Committee
۳۷۱ of the School of Public Health, Yasuj University of medical sciences (Ir.yums.REC.1394.78).
۳۷۲ informed consent form was obtained from all mothers

۳۷۳ Consent for publication: informed consent was obtained from all mothers. This Informed
۳۷۴ Consent Form had two parts:

- ۳۷۵ • Information Sheet (to share information about the study)
- ۳۷۶ • Certificate of Consent (for signatures if participants choose to participate)

۳۷۷ Availability of data and material: not available

۳۷۸ Competing interests: none declared

۳۷۹ **Funding :** This work was funded by deputy of research of yasuj university of medical
۳۸۰ sciences.sciences

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۳۸۲ **Acknowledgements:** This research was supported by deputy of research of yasuj university of
۳۸۳ medical sciences. We thank our colleagues from department of nutrition and food sciences who
۳۸۴ provided insight and expertise that greatly assisted the research

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۳۸۶ **Conflict of interests:** The authors declare that they have no conflict of interests.

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