

# Impact of Water Quality and Maternal Diet on Pregnancy Outcomes in Al-Hawija

Impact of Water Quality and Maternal Diet on Pregnancy

Ali Kareem Durib

## ABSTRACT

**Objective:** To determine the effect of the geological nature of drinking water, dietary habits and effect on changing the sex ratio of fetuses through its effect on the pH of the cervix.

**Study Design:** comparative study

**Place and Duration of Study:** This study was conducted at the Middle Technical University, Baghdad Iraq from 1<sup>st</sup> August 2023 to 31<sup>st</sup> August 2024.

**Methods:** This comparative study was conducted at Middle Technical University, Baghdad Iraq. Two hundred and fifty women were enrolled among them 150 from Hawija area and 100 from Kirkuk city.

**Results:** There were 110 (73.3%) males and 40 (26.7%) females in Hawija area and 70 (70%) males and 30 (30%) females in Kirkuk city. The significant increases in the levels of calcium, magnesium and potassium were in the raw water of Al-Hawija area as compared to Kirkuk city. There was no significant difference in the level of sodium in the raw water of Al-Hawija area as compared to Kirkuk city.

**Conclusion:** There is a difference in the sex ratio of births and acidity of the cervix between women in Kirkuk city and Hawija city. The presence of a significant difference in the percentage of calcium, magnesium, sodium and potassium in the water supplied.

**Key Words:** Water pollution, Dietary habits, Sex difference, Cervical pH

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## INTRODUCTION

The sex of the fetus is determined by the male cells (sperm) produced by the man, as the testicles produce two types of sex cells, one of which contains the X chromosome (female sperm) and the other contains the Y chromosome (male sperm). A woman produces one type of sex cell (the egg) that carries the X chromosome. When the egg carrying the X chromosome meets the sperm carrying the X chromosome, the sex of the fetus will be female (XX). However, if the egg meets the sperm carrying the Y chromosome, the sex of the fetus will be male (XY). Therefore, the sex of the newborn is determined from the first moment of fertilization.<sup>1,2</sup>

Scientific research has shown that female sperm (carrying the X chromosome) have a better ability to tolerate the acidic vaginal pH than male sperm

(carrying the Y chromosome)<sup>3,4</sup>, which means that female sperm have a greater chance of survival than male sperm in the vaginal environment and the cervix with an acidic pH.<sup>5</sup> The cells lining the vagina secrete lactic acid and hydrogen peroxide, which act as a protective barrier against bacterial and fungal infections, as it works to lower the vaginal pH level to 3.5-4.5, which is unsuitable for bacterial and fungal growth<sup>6,7</sup>, while the pH that incubates sperm ranges from 6.9 in the testes to 7.14 in semen.<sup>8,9</sup> The cervix also acts as a reservoir for sperm for a short period of approximately two days. It is noted that sperm are active and effective 24 hours after sexual intercourse and in the inner region of the cervix in large quantities. These sperm can move into the uterus and fertilize the egg, as the appropriate degree for the cervical acidity scale is between 3.6-2.7. If the cervical acidity is less than 3.6, this causes paralysis or death of sperm inside the cervix.<sup>10,11</sup>

Sex determination has been the subject of many scientific studies for a long time, as advances in genetics have revealed the existence of some sex-linked genetic diseases (X-linked diseases) that affect only one sex, in addition to common diseases that are not sex-linked but are more common in males, such as autism.<sup>12</sup> Therefore, research and studies continued to arrive at the possibility of determining the sex of fetuses. Among these studies, a method of following diets emerged that leads to increasing the level of calcium and magnesium (CaMg) to the ratio of sodium and potassium (NaK) in

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food and drinking water leading to an increase in the chances of giving birth to females, while increasing the level of sodium and potassium (NaK) to the ratio of calcium and magnesium (CaMg) leads to an increase in the chances of giving birth to males<sup>13</sup>, as Ca+ and Mg ions work to increase the acidity of the vagina and cervix, while Na+ and K+ ions work to increase the alkalinity of the vagina and cervix.<sup>14,15</sup> Considering the geological nature of Al-Hawija district, which is mostly composed of limestone rocks rich in calcium, which has the ability to dissolve in the water passing through it and is prepared for drinking water for all areas of the district<sup>16,17</sup>, in addition to the fact that all agricultural drains in the region carry water from agricultural lands to which chemical fertilizers are constantly added and poured into drinking water sources, which led to the erosion of these ions from agricultural lands of a calcareous nature and their collection in drinking water sources, which led to a change in the proportion of these ions when they reached the population compared to the drinking water supplied to the city of Kirkuk, which passes through lined waterways and is far from the sources of pollution with agricultural fertilizers in the lands, in addition to the different dietary habits of each of the two study groups, as the first group (Al-Hawija women) relied heavily in its nutrition on dairy products rich in calcium and magnesium as a basic food, while the second group (Kirkuk women) relied on diversity in food, which provided the entry of larger quantities of sodium and potassium into the body compared to calcium sources and magnesium.

## METHODS

This comparative study was conducted at Middle Technical University, Baghdad Iraq from 1<sup>st</sup> August 2023 to 31<sup>st</sup> August 2024 vide letter No. 130/QM/Approval/9393JFDNF Dated 15.07.2023. Two hundred and fifty women were enrolled among them 150 from Hawija area and 100 from Kirkuk city. Their ages ranged from 18-38 years, who gave birth to a higher percentage of females than males for women in Hawija, while the samples were taken from women in Kirkuk who gave birth to a higher percentage of males than females. The cervical pH of the women in the study group was measured. Drinking water samples affecting the cervical pH were also taken from the water sources supplied to Al-Hawija district, namely the water of Al-Hawija irrigation project, in addition to drinking water samples from Kirkuk city, where two water samples were collected (a raw water sample, a prepared water sample) from each of the mentioned sources in the seasons (winter, spring, summer). Then, chemical analyses were conducted for these samples and the levels of Ca+, Mg+, Na+, K+ were measured. Data was also collected on the dietary habits of each of the women in the study group. The results of the first group were compared with the results of the second

group. The cervical pH level was measured using special strips. A sterile swab was inserted into the cervix, taking care not to touch the vaginal wall. The swab was then wiped on the measuring strip, and the results were compared with a special measuring ruler. The data was entered and analyzed through SPSS-25.

## RESULTS

There were 110 (73.3%) males and 40 (26.7%) females in Hawija area and 70 (70%) males and 30 (30%) females in Kirkuk city (Table 1).

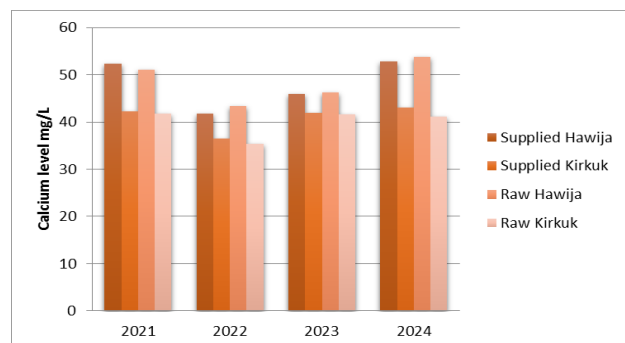
Figure 1 showed a significant increase in the level of calcium in the raw water of Al-Hawija area for the years 2021-2024 at a rate of (51.100±9.163), (43.40±6.90), (46.23±5.35), (53.80±8.69) mg/L respectively compared to the level of calcium in the raw water of Kirkuk city at a rate of (41.700±5.889), (35.40±3.95), (41.57±4.31), (41.20±1.75) mg/L respectively. It also showed a significant increase in the level of calcium in the water supplied to the Al-Hawija area for the same years at a rate of (52.40±6.85), (41.80±7.70), (45.96±5.24), (52.81±7.94) mg/L respectively compared to the water supplied to the city of Kirkuk at a rate of (42.30±4.06), (36.51±3.62), (41.94±5.53), (43.00±1.95) ml/L at a significant level ( $p \leq 0.05$ ).

The significant increase in the level of magnesium in the raw water of the Hawija area for the years was 2021-2024 at a rate of (17.850±6.189), (17.431±5.162), (17.272±2.058), (20.971±3.771) mg/L respectively compared to the raw water of the city of Kirkuk at a rate of (13.681±3.871), (14.201±1.688), (14.937±1.228), (17.740±2.381) mg/L respectively. It also shows a significant increase in the magnesium level of the water supplied in the Hawija area at a rate of (16.941±2.986), (17.993±3.898), (17.546±2.019), (21.130±3.534) mg/L compared to the water supplied to the city of Kirkuk at a rate of (13.942±4.167), (14.480±1.078), (14.719±1.093), (17.890 ±2.457) mg/L respectively for the same years (Fig. 2).

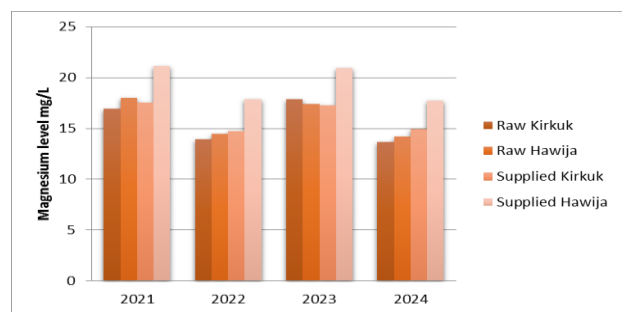
There was no significant difference in the level of sodium in the raw water of Al-Hawija area for the years 2021-2024, with a rate of (6.605±2.016), (9.334±3.001), (7.742±1.176), (9.051±0.708) mg/L, respectively, compared to the level of sodium in the raw water of Kirkuk city, with a rate of (7.010±0.817), (10.355±2.133), (7.628±1.451), (9.021±0.453) mg/L, respectively, for the same years. The figure also shows that there is no significant difference in the sodium level between the water supplied to the Hawija area and the water supplied to the city of Kirkuk for the same years at a rate of (6.251±2.121), (9.334±2.237), (6.726±1.407), (8.841±0.518) compared to the water supplied to the city of Kirkuk at a rate of (7.510±0.547), (10.757±1.546), (6.951±1.612), (9.011±0.491) mg/L respectively for the same years (Fig. 3).

**Table No. 1: Frequency of genders in cities (n=250)**

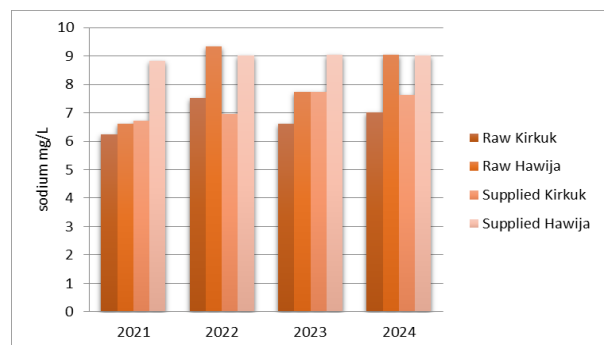
Gender	Hawija city (n=150)		Kirkuk city (n=100)	
	No.	%	No.	%
Male	110	73.3	70	70.0
Female	40	26.7	30	30.0



**Figure No. 1: Comparison of the level of calcium mg/L in prepared and raw water**



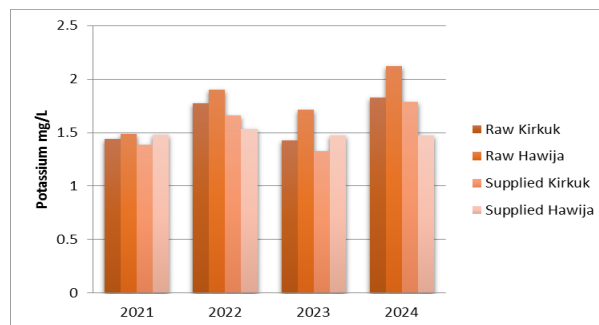
**Figure No. 2: Comparison of the magnesium level mg/L in prepared and raw water**



**Figure No. 3: Comparison of the level of sodium mg/L in prepared and raw water**

Figure 4 showed a significant increase in the level of potassium in the raw water of Kirkuk city for the years 2021-2024 at a rate of (1.826±0.159), (2.123±0.548), (1.788±0.191), (1.473±0.083) mg/L respectively compared to the level of potassium in the raw water of Al-Hawija area at a rate of (1.427±0.088), (1.714±0.244), (1.324±0.214), (1.471±0.081) mg/L respectively for the same years. It also shows a significant increase in the potassium level in the water supplied to Kirkuk city at a rate of (1.776±0.117), (1.902±0.549), (1.657±0.195), (1.531±0.049) mg/L

respectively compared to the water supplied to Al-Hawija area at a rate of (1.439±0.091), (1.488±0.146), (1.386±0.216), (1.482±0.078) mg/L respectively for the same years at a significant level (p≤0.05).



**Figure No. 4: Comparison of the level of potassium mg/L in prepared and raw water.**

## DISCUSSION

The results of our study showed a significant difference in the ratio of males to females between Kirkuk city and Hawija district. In light of what we have reached through this study, the reason for this difference could be one of the reasons for it is the difference in the acidity of the cervix and the sexual canal in women, which our results showed a decrease in the acidity of the cervix in Hawija women compared to Kirkuk women. The cervix has an alkaline environment that is ideal for the movement and activity of sperm with the Y chromosome, unlike the acidic environment, which is harsh and unsuitable for their movement and activity, while sperm with the X chromosome resist the acidic environment.<sup>19</sup> In light of the results of our study, there is a significant difference in the percentage of calcium and magnesium between the water supplied to the city of Kirkuk, which was lower than the percentage in the water of the Hawija district. Diet is one of the most important trends in scientific research to solve all health problems, and it is what researchers have resorted to solve the problem of determining the sex of the fetus. Many studies have focused on the role of high levels of calcium and magnesium compared to sodium and potassium in the diet, and their role in increasing the chance of conceiving females, and this percentage reflects the increased chance of conceiving males.<sup>20,21</sup>

The difference in the proportions of these mineral salts between the water supplied to Kirkuk compared to the water supplied to Al-Hawija district may be attributed to the geological nature of the land and the nature of the canals supplied for the water, in addition to the quantities of organic and chemical agricultural fertilizers, which are considered the largest pollutant of drinking water in Al-Hawija district.<sup>20,21</sup> The lack of health awareness and ignorance of the dangers of using this polluted water is considered an additional reason

for the significant difference in the variation in the proportion of fetal sex.

## CONCLUSION

There is a difference in the sex ratio of births between Kirkuk city and Hawija district and indicated that there is a difference in the acidity of the cervix between women of Kirkuk city and Hawija district in addition to the presence of a significant difference in the percentage of calcium, magnesium, sodium and potassium in the water supplied to Kirkuk city and Hawija district.

### Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Ali Kareem Durib
Drafting or Revising Critically:	Ali Kareem Durib
Final Approval of version:	The above author
Agreement to accountable for all aspects of work:	The above author

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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