









**Table 1.** Baseline characteristics of the included articles.

| Reference                      | Year | Setting       | Region | Sample size | Age          |             | Targeted populations                           | Authors' conclusions   |
|--------------------------------|------|---------------|--------|-------------|--------------|-------------|--|--|
|                                |      |               |        |             | Mean (SD)    | Male/female |  |  |
| <b>Al-Sarheed et al. (21)</b>  | 2006 | Public places | Riyadh | 225         | 37.92 (7.89) | Mothers     | Parents of children with Down syndrome         | Around two-thirds of the mothers breastfed their children and started wearing after 6-9 months of age  |
| <b>Al-Husseyen et al. (22)</b> | 2006 | Public places | Riyadh | 225         | 7.24 (4.11)  | Children    | Children                                       | Satisfactory levels of dietary habits among the included families and occupation status were associated with it.   |
| <b>Mohamed et al. (23)</b>     | 2013 | Public places | Riyadh | 221         | -            | Children    | Children with DSS compared with their siblings | 36% of the Down syndrome children were bottle-fed while only 5.5% of their siblings were. Fruit, vegetables, meat, fast foods, and whole milk consumption were all significantly lower in the Down syndrome group than with their siblings |
| <b>Samarkandy et al. (24)</b>  | 2012 | Public places | Riyadh | 221         | -            | Children    | Children with DSS compared with their siblings | Fat, protein, riboflavin, retinol, calcium, and sodium, and potassium intake were significantly lower in the Down syndrome group than in the other group   |

### *Risk of bias*

The results of the risk of bias assessment are presented in **Table 2**. In brief, two articles were assessed as having good quality, while the other two had satisfactory results, indicating a low degree of bias among the included investigations.

### **Discussion**

In the present systematic review, we have collected all the studies that were previously conducted in Saudi Arabia that discuss the feeding habits for children with Down syndrome, and the results of these studies are discussed in this section, together with comparative findings from other similar worldwide investigations for proper validation of our formulated evidence.

**Table 2.** Quality assessment and domains of the modified Newcastle-Ottawa scale (mNOS) for cross-sectional studies.

| Author                  | Year | Selection                        |             |                 |                               | Comparability   | Outcome               |                      | Total score | Quality      |
|-------------------------|------|----------------------------------|-------------|-----------------|-------------------------------|---|-----------------------|----------------------|-------------|--------------|
|                         |      | Representativeness of the Sample | Sample size | Non Respondents | Ascertainment of the Exposure | The Subjects in Different Outcome Groups are Comparable | Assessment of outcome | Statistical analysis |             |              |
| Al-Sarheed et al. (21)  | 2006 | +                                | +           | +               | +                             | +   | +                     | +                    | 7           | Good         |
| Al-Husseyen et al. (22) | 2006 | +                                | +           | +               | +                             |   |                       | +                    | 5           | Satisfactory |
| Samarkandy et al. (24)  | 2012 | +                                | +           | +               | +                             | ++  | +                     | +                    | 8           | Good         |
| Mohamed et al.(23)      | 2013 | +                                | +           |                 | +                             | +   | +                     | +                    | 6           | Satisfactory |

In Saudi Arabia, we found four relevant investigations. Among these, Al-Sarheed et al. (21) reported that exclusive breastfeeding was introduced by around two-thirds of the included mothers, while the rest introduced formula-based regimens to their children with Down syndrome. More than 60% of the included mothers breastfed their children for more than 6 months, which gradually declined as children grew older.

In addition, the authors reported that most of the included children (45.8%) were weaned at 6-9 months of age. No socio-economic characteristics were significantly associated with any of the feeding habits or the age when solid foods were introduced.

There was a significant correlation between maintaining breastfeeding for 3-6 months and non-working and being literate. Mohamed et al. (23) also reported that around 36% of the children with Down syndrome were bottle-fed while only 5.5% of their siblings were bottle-fed during their infancy period.

Moreover, they showed that around 50% of the children with Down syndrome were breastfed for at least six months during their infancy while only 36.5% of their siblings were. Hospital encouragement of breastfeeding was lower for children with Down syndrome than their siblings. Finally, solid food introduction was markedly more frequently delayed in the Down syndrome group. Fruit, vegetables, meat, fast foods, and whole milk consumption were all significantly lower in the Down syndrome group than with their siblings, while consuming skimmed or low-fat milk was significantly higher in children with Down syndrome.

These findings were supported by another investigation by Samarkandy et al. (24) that assessed the nutritional status of children with Down syndrome and their siblings and found that no significant differences were found between the two groups in terms of caloric intake.

However, fat, protein, riboflavin, retinol, calcium, and sodium, and potassium intake were significantly lower in the Down syndrome group than in the other group, while other minerals did not show any statistical significance between the two groups. Another investigation by Al-Hussyeen et al. (22) that aimed to investigate the dietary habits and oral hygiene practices among children with Down syndrome reported that 56% of the included mothers indicated that their children were frequently given sweets.

Moreover, they reported that 56.2% of these mothers reported that they occasionally gave sweets to their children as a reward. The frequency of sweets consumption was significantly associated with the working status of the corresponding mothers, but neither the educational level, university education, or being illiterate were.

Many worldwide investigations were conducted to assess the frequency of breastfeeding and dietary practices among children with Down syndrome, and the estimated rates for feeding habits were variable across the different studies in the literature. In Italy (25), the rate regarding exclusive breastfeeding for children with Down syndrome was 43%, compared to 55% in Israel (6), to 48% in the Netherlands (8), and 63% in Mexico (26). This indicates that reported rates for the Saudi cohorts are among the highest globally, although not many studies were published across the Kingdom. It was also previously demonstrated the duration of breastfeeding lasted for a significantly longer period in the control group when compared to the Down syndrome group (25). Additionally, maternal depression, insufficient perceived milk, prematurity, suckling difficulties, and congenital malformations were all significantly reported factors that were associated with reduced breastfeeding practices (6, 21, 25, 27). The early termination of breastfeeding is also significantly associated with maternal depression and stress that usually results from the diagnosis of the syndrome in their children (21, 25). Therefore, professional healthcare advice and support should be offered to all mothers with children with Down syndrome to decide whether or not to stop breastfeeding and decide what is best for their children to enhance their outcomes.

Issues regarding swallowing and feeding are also common among children with Down syndrome, and although they were not reported in any of the included Saudi investigations, they were commonly reported among other global studies in the literature. It has been estimated that up to 60% of children with Down syndrome have feeding difficulties (28, 29), up to 40% might require the installation of a nasogastric tube (6, 27, 30), and up to 5% might require gastrotomy (6, 27).

Parenteral feeding habits are also important when studying the feeding habits and nutritional assessment in children with Down syndrome. For instance, a previous investigation showed that nutritional monitoring and feeding restrictions were more common among parents of overweight Down syndrome children than other parents of normal range weight Down syndrome children (31). A further report showed that 47% of parents of children with Down syndrome reported that their children continued to eat as long as the food was present before them (32). However, it should be noted that the evidence regarding this point is still poor, even within global settings, and therefore, further investigations are encouraged to enhance this point.

Our study is limited by the very small number of the included studies that were conducted in Saudi Arabia and the very low number of the included populations among them. Additionally, the heterogeneity among the included studies is also significant regarding the reported outcomes which made it hard to compare these outcomes among the included investigations. However, we performed a rapid review of the current literature as discussed above to elucidate our findings and compare them to the worldwide investigations.

## Conclusion

Our results indicate that the rate of exclusive breastfeeding is relatively high among our population and it also lasts for an acceptable duration during infancy as compared to worldwide investigations. However, the evidence is still poor and it is hard to formulate a solid conclusion as a result of the small number of studies conducted across the Kingdom. Accordingly, further investigations are encouraged to strengthen the current evidence.

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The authors declare no conflict of interest.

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None applicable.

**Data Availability:**

All data is available withing the article.

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