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## Dietary Intake of Calcium and Vitamin D among Children and Adolescents in South Sinai.

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**ABSTRACT**

This study was to assess calcium and vitamins D intake among children and adolescents living in five areas in South Sinai. Twenty four hour dietary recall and Food Frequency Questionnaire (FFQ) was obtained from 862 children and adolescents with the mean age 4-18 years old. Milk and dairy products consumption in studied areas ranged between 40% serving three times / week and 60% consuming 5-6 times /week. The mean milk and dairy products, fishes and eggs consumption is far less than the WHO and USDA food guide recommendations. Calcium intake ranged from 133- 349 mg/day in all 5 areas. All obtained intake values were below the recommended needs for calcium intake. Vitamin D intake ranged from 0.27-1.18 µg/d in all 5 areas. These intakes equal 5.86-36.22% of the recommend dietary allowances. The vitamin D intake of the adolescents in age group (15-18 years) of Saint Kathrene area was higher than that of other sites on the same age group. There is a clear need for improving nutrition message through various media and to monitor these messages closely to ensure that these are clearly and fully understood. In addition, supplementation of vitamin D and calcium may need separate strategies.

**Keywords:** children, adolescents, vitamin D, calcium (Ca), food frequency questionnaire (FFQ), South Sinai

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## INTRODUCTION

Bone diseases such as osteoporosis and osteomalacia are major causes of excess mortality, morbidity and health and social services expenditure in older individuals because of their association with low trauma fractures and skeletal deformity. The importance of Ca and vitamin D in the maintenance of bone health has stimulated interest in the potential role of other nutritional factors [1]. Low levels of calcium intake are becoming increasingly prevalent among children and adolescents [2]. This has been suggested to impede the attainment of peak bone mass during adolescence [3]. Thus, there is an imminent need for a valid and efficient calcium assessment tool in this population. Food consumption data are collected using a wide variety of methods and procedures. The 24-hour recall method is the most commonly used assessment tool in large cross-sectional surveys and skeletal development studies in both children and adults. This method has numerous advantages including responsiveness to change in food supply and habit [4 and 5]. The advantage of 24-hour recalls is that employs probes and checks to ensure that responses are correct and accurate [6 & 7]. Single 24-hour dietary recalls are advantageous in clinical use for this population because they provide checks and time references (all foods listed and accounted for) for the child in a capacity that they can comprehend [6]. FFQs on the other hand, can be time efficient and are readily available. The aim of this study was for assessing daily calcium and vitamin D intake in children and adolescent in South Sinai children.

## SUBJECTS AND METHODS

Eight hundred and sixty-two children and adolescents aged 4- 18 years old were recruited from five different cities (Tour, Ras Sidre, Abo-Zenema, Saint Kathrene and Nwebaa) in South Sinai governorate. A descriptive cross sectional study was conducted on sample of children attending governmental schools and nurseries in 5 cities and surrounding Bedouin settlements of south Sinai governorate. A multistage random sampling technique was used to select a sample of children. Selection of children was mediated to represent social, environmental and ethnic variations of South Sinai inhabitants. The questionnaire sheet included: Repeated 24 hour recall and Food frequency method.

### Dietary Assessment

According to authors [8-10] the 24-HDRs are unannounced and conducted by trained interviewers. During the 24-HDR, each subject recalled and described in detail, all types and amounts of foods and beverages consumed in the previous 24 hours on two separate occasions, a weekday and a weekend day. The 24-hour period specified for the dietary recall was defined as the 24 consecutive hours between midnight on day one and midnight on the following day. To assist in estimating portion sizes of consumed foods, respondents were encouraged to view a measuring cup and measuring spoons as they completed their 24-HDR by interview. At the end of this study, there were a total of four completed 24-HDRs for each participant. The participants were asked to estimate, in as much detail as possible, all foods and beverages consumed over 3 days.

### Daily Calcium and Vitamin D Intake

They were assessed from FFQs and calculated by: 1) Average amount of each food item intake to be calculated per day, 2) Analyzed amount of calcium and vitamin D in each food item intake by using nutria-survey software and 3) Sum of calcium and vitamin D amount from each food item.

### Statistical analyses

The obtained data were statistically analyzed using the statistical package for social sciences [11]. Data were analyzed with Nutrisurvey for SMART software [12]. The value of (p) less than 0.05 was considered statistically significant.

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## RESULTS AND DISCUSSION

### Frequency of Consumption of Milk, Dairy Products, Fishes and Eggs

Good dietary sources of vitamin D include the flesh of fatty fish such as herring, salmon, sardines, milk and eggs (13). Consumption of milk and dairy products vary with site. In Tour and Ras Sidre sites, about 38% and 41% of children consumed milk and dairy products three times per week. While, in Saint Kathrene consumers are 72% (three times per week) and in Nwebaa 65% consume milk and dairy products 5-6 times per week (table 1). We found that the mean milk and dairy products consumption is far less than the WHO [14] and USDA [15] food guide recommendations. However, NHANES data show that U.S. adolescents (12-19 years) on an average consume only about 1 cup of dairy daily. Because calcium is important for growing bones, children from 2 to 8 years old should be consume 2 cups per day of fat-free or low-fat milk or equivalent dairy products. Children at 9 years old and older should consume 3 cups per day of fat-free or low-fat milk or equivalent dairy products. To supply normal bone growth and calcium deposition, adolescence is a critical time [16]. Since milk and dairy products provide more than 70 percent of the calcium consumed by Americans, guidance on other choices of dietary calcium is needed for those who do not consume the recommended amount of milk products. Dairy products consumption has been associated with overall diet quality and adequacy intake of many nutrients, including calcium, potassium, magnesium and vitamin D. Some people may avoid milk products because of allergies, cultural recites, taste, or any other reasons. Those who avoid all dairy products need to choose rich sources of the nutrients that provided by milk, including potassium, vitamin A, and magnesium in addition to calcium and vitamin D [17]. We found that the mean fish and egg consumption is far less than the WHO [14] and USDA [16] food guide recommendations.

**Table 1: Frequency of consuming milk, dairy products, eggs and fishes**

| City | Foods | Number of servings consumed per week | | | | |
|---|---|---|---|---|---|---|
| | | None | 1-2 | 3-4 | 5-6 | total |
| Tour | Milk& dairy products | 18% | 8% | 56% | 18% | 100% |
| | Eggs | 10% | 30% | 30% | 30% | 100% |
| | Fishes | 30% | 20% | 30% | 20% | 100% |
| Abo-Zenema | Milk& dairy products | 8% | 34% | 41% | 17% | 100% |
| | Eggs | 19% | 62% | 19% | 0% | 100% |
| | Fishes | 44% | 19% | 19% | 18% | 100% |
| Ras Sidre | Milk& dairy products | 20% | 39% | 41% | 0% | 100% |
| | Eggs | 82% | 9% | 9% | 0% | 100% |
| | Fishes | 19% | 27% | 0% | 54% | 100% |
| Saint Katrene | Milk& dairy products | 9 | 19% | 72% | 0% | 100% |
| | Eggs | 27% | 55% | 18% | 0% | 100% |
| | Fishes | 20% | 41% | 8% | 31% | 100% |
| Nwebaa | Milk& dairy products | 0% | 9% | 26% | 65% | 100% |
| | Eggs | 70% | 0% | 15% | 15% | 100% |

### Calcium Intake

The average of calcium intake in the present work was 133-349 mg/day in all 5 areas. These intakes equal 11-38.7% of the recommend dietary allowances [18] as shown in table 2. The calcium intake of the children and adolescents at age groups (4-6 y and 15-18y) in Nwebaa and at age groups (7-9 y, 10-12y and 13-14y) of Tour area was higher than that of other sites of the corresponding age groups (Table 2). Inadequate deposition of calcium into bones during adolescence increases the risk of osteoporosis in later life [16]. The American National Academy of Science recommended at least 1300 mg of calcium for 14-18 year old adolescents to provide adequate calcium for bone health [19]. However, there is no study showing that adolescents do not consume adequate amounts of calcium and phosphorus [19-21]. The reason behind the low calcium intakes of our subjects may be the decline in milk consumption, which is related to an increase in soft drink consumption. This study showed that a substantial percentage of South Sinai area adolescents have not met the RDA for the essential micronutrient calcium. The results shown above agreed with those findings

of [22] who assessed and evaluated the nutritional status and the dietary intake of the secondary school adolescents in Egypt. The Bogalusa Heart Study analysis revealed that American adolescents were likely to be deficient in calcium [23]. Appropriate nutrition in adolescence is crucial not only to satisfy growth but also to prevent chronic diseases in adulthood [24]. However, like our subjects, adolescents generally have irregular eating patterns and do not conform to nutritional recommendations. About 99% of calcium in the body is found in bones and teeth [25]. Adequate intake of calcium throughout childhood and adolescence is important for proper mineralization of growing bones, attainment of peak bone mass, and reduction of risk of bone fracture and osteoporosis in adulthood. Dietary intake recommendations for calcium in adolescents were established using a factorial method that summed average calcium accretion and calcium losses in urine, feces, and sweat and also adjusted for calcium absorption [25].Dairy products, which provide about 72% of the calcium in the American diet [25], represent rich and absorbable sources of calcium. Milk contains 300 mg of calcium per cup; therefore, adolescents could meet the RDA for calcium by drinking 4.3 cups of low-fat milk daily. Certain vegetables and grains also provide calcium, but their bioavailability is lower compared with dairy. The Nutrition Facts label of packaged foods lists calcium content in one serving as a percent of the Daily Value (DV), with the DV being 1,000 mg. Since the RDA for adolescents is 1,300 mg/day, the percentage of the DV listed on the food label would be an overestimation of the percentage of the RDA. Joanna [26] indicated that more than 40% of female students had intakes below the estimated average requirements for calcium.

**Table 2: Distribution of children and adolescents according to daily intake of calcium and % of RDA for calcium**

| Nwebaa | | Saint Katrene | | RasSidre | | Abo-Zenema | | Tour | | |
|---|---|---|---|---|---|---|---|---|---|---|
| % of RDA | mg/d | % of RDA | mg/d | % of RDA | mg/d | % of RDA | mg/d | % of RDA | mg/d | Age (year) |
| 29.4 | 205.9 [a] | 20.7 | 144.8 [a] | 17.4 | 122.14 [a] | 23 | 161.4 [a] | 21.33 | 147.73 [a] | 4 - 6 |
| ± 5.3 | ± 36.96 | ± 4.91 | ± 33.02 | ±2.7 | ± 19.4 | ±2.68 | ±18.9 | ±4.04 | ±15.9 | |
| 27.6 | 241.9[a] | 16.3 | 146.9[a] | 15.9 | 141.46[b] | 19.4 | 173.9[a] | 38.65 | 347.7[a] | 7 - 9 |
| ± 3.1 | ± 29.7 | ± 2.9 | ± 27.1 | ±1.9 | ± 17.5 | ±2.85 | ±25.96 | ±4.4 | ±39.58 | |
| 25.3 | 275.95 [a] | 15.4 | 170.2[b] | 19.1 | 209.5 [a] | 22.5 | 246.6 [a] | 35.4 | 388.7 [a] | 10 - 12 |
| ± 2.2 | ± 23.8 | ± 2.21 | ± 24.48 | ± 3.65 | ± 40.1 | ±2.3 | ±25.9 | ±2.82 | ±31.03 | |
| 18.2 | 217.7 [a] | 11.1 | 131.86[b] | 19.0 | 227.3 [a] | 21.8 | 262.04 [a] | 23.5 | 282.9 [a] | 13 - 14 |
| ± 3.1 | ± 37.4 | ± 1.53 | ± 18.2 | ± 0.7 | ± 7.03 | ±4.5 | ±53.6 | ±2.35 | ±28.07 | |
| 24.95 | 301.4 [a] | 16 | 189.9[b] | | | 20.3 | 248.6 [a] | 22.96 | 261.1 [a] | 15 - 18 |
| ± 2.3 | ± 27.8 | ± 2.02 | ± 25.15 | | | ±3.4 | ±39.97 | ±2.4 | ±23.5 | |

Values in the same column with the same superscripts are not significant at $p < 0.05$.

**Vitamin D Intake**

Vitamin D intake in the present work ranged from 0.27-1.18 µg/d in all 5 areas. These intakes equal 5.86-36.22% of the recommend dietary allowances [18] as presented in table 3. The vitamin D intake of the adolescents in age group (15-18y) of Saint Kathren area was higher than that of other sites of the same age group (Table 3). Vitamin D is a fat-soluble vitamin whose primary function in the body is to aid in the intestinal absorption of calcium and phosphorus, thereby helping to maintain normal serum levels of these minerals and contributing to the maintenance of bone health. Vitamin D also plays a role as an antiproliferation and prodifferentiation hormone. There is insufficient data to establish an estimated average requirement and calculate an RDA for vitamin D, so an adequate intake (AI) was developed instead. The AI assumes that no vitamin D is available from sun-mediated synthesis in the skin, and is defined as the intake needed to maintain serum 25-hydroxyvitamin D concentrations high enough to avoid rickets or osteomalacia resulting from vitamin D deficiency. Vitamin D can be obtained through synthesis in the skin resulting from exposure to ultraviolet B rays in sunlight, or it can be ingested as dietary vitamin D. Older adults, particularly those living in industrialized cities in the northern hemisphere, are more likely to develop vitamin D deficiency [ 23&27). In Canada, all milks and margarines are fortified with vitamin D. Although it is not possible to present estimates of the prevalence of inadequacy for vitamin D, it is noteworthy that the mean usual intakes exceed the AIs for all age and 18 sex groups except adult men and women 51-70 and 71 and over (13).

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**Table 3: Distribution of children and adolescents according to daily intake of vitamin D and % of RDA for vitamin D**

| Nwebaa | | Saint Katrene | | RasSidre | | Abo- Zenema | | Tour | | Age (year) |
|---|---|---|---|---|---|---|---|---|---|---|
| % of RDA | µg/d | % of RDA | µg/d | % of RDA | µg/d | % of RDA | µg/d | % of RDA | µg/d | |
| 15.6 | 0.78 [a] | 12.77 | 0.64 [a] | 8.02 | 0.4 [a] | 3.25 | 0.17 [a] | 8.8 | 0.44 [a] | 7 - 9 |
| ±5.7 | ±0.28 | ±4.45 | ±0.22 | ±1.79 | ±0.09 | ±1.3 | ±0.07 | ±1.79 | ±0.09 | |
| 19.2 | 0.95 [a] | 15.88 | 0.79 [a] | 11.9 | 0.59 [a] | 3.25 | 0.17 [a] | 17.3 | 0.86 [a] | 10 - 12 |
| ±3.5 | ±0.17 | ±4.2 | ±0.21 | ±3.3 | ±0.17 | ±1.3 | ±0.07 | ±4.6 | ±0.23 | |
| 10.52 | 0.52 [a] | 23.5 | 1.18 [a] | | | 16.25 | 0.8 [a] | 22.88 | 1.14 [a] | 13 - 14 |
| ±2.26 | ±0.11 | ±7.08 | ±0.35 | | | ±9.57 | ±0.47 | ±8.1 | ±0.41 | |
| 12.95 | 0.64 [b] | 36.22 | 1.81 [a] | | | 5.86 | 0.27 [b] | 15.65 | 0.78 [b] | 15 - 18 |
| ±3.75 | ±0.19 | ±7.1 | ±0.35 | | | ±2.7 | ±0.13 | ±4.05 | ±0.2 | |

Values in the same column with the same superscripts are not significant at $p < 0.05$.

## CONCLUSIONS

Supplementation of calcium and vitamin D for children and adolescents of South Sinai is indicated. Although the scientific basis for appropriate complementary feeding is well established, putting these data into practical programs has been lacking. It may need separate strategy.

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