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Fruit and Vegetable Intake, Physical Activity, and Body Weight Status in Saudi Arabia: Analysis of Multiple National Data Sources and Implications for Public Health

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ABSTRACT: Background: Healthy dietary behaviors and physical activity support health throughout life. Poor diet, excess body weight and low physical activity contribute to noncommunicable diseases and premature death. This study compared estimates of fruit and vegetable intake, weight status, physical activity and sedentary time by year, age, sex and region in Saudi Arabia.

Methods: This secondary analysis used estimates from four national datasets produced by the General Authority for Statistics. The datasets covered diet and body weight in 2023 and 2024, and physical activity in 2024 and 2025. Percentages and sedentary time were examined according to the population and indicator definitions in each source.

Results: In 2024, 90.65% of Saudi nationals aged 15 years and older reported fewer than five daily fruit and vegetable servings. Overweight affected 42.26% and obesity 23.86%. Together, overweight and obesity affected 66.12%. Obesity peaked at ages 65-69 years (39.11%). Regional prevalence ranged from 14.08% to 27.88%. Among all residents aged 18 years and older, 41.50% fell below the activity threshold in 2024 and 40.95% in 2025. At ages 5-17 years, the corresponding proportions were 81.30% and 81.05%. In 2025, 56.94% of women and 33.55% of men fell below the threshold. The adult sex gap widened from 17.70 to 23.39 percentage points. Adult activity estimates declined in nine of the 13 regions. Women reported more sitting time than men in both years. The means were 6.20 versus 5.70 hours in 2024 and 5.32 versus 5.07 hours in 2025.

Conclusions: Low fruit and vegetable intake, excess weight, and low physical activity were prevalent among Saudi nationals. Among all residents, most children and adolescents fell below the activity threshold. The adult sex gap widened, and women reported more sitting time than men. Prevention should address healthy diet, weight control, physical activity and sedentary time together, with programs tailored to age and sex.

INTRODUCTION

Social and material conditions influence health behaviors and the choices available to individuals. The Dahlgren-Whitehead model places individual lifestyle factors within layers of social networks and living and working conditions. It also includes wider socioeconomic, cultural and environmental influences [1]. Dietary and metabolic risks contribute substantially to the global burden of disease [2]. In two US cohorts, healthier lifestyles were associated with longer life expectancy free of cardiovascular disease, cancer and type 2 diabetes [3]. Prevention efforts should address health behaviors and the social conditions that shape them.

Fruit and vegetable consumption is associated with long-term health outcomes. One study examined intake and mortality in two US cohorts and combined these findings with 24 other cohorts in a meta-analysis [4]. About five combined servings of fruit and vegetables per day were associated with lower mortality than two servings. No additional reduction was observed at higher intakes [4]. A separate systematic analysis linked higher vegetable consumption to lower risks of ischemic heart disease and stroke. The strength of evidence varied across outcomes [5]. These findings support monitoring fruit and vegetable intake as part of population health surveillance.

Body weight provides information about nutritional status and population health. A pooled analysis documented widespread increases in obesity among children, adolescents and adults between 1990 and 2022. Assessing underweight and thinness provides a broader assessment of weight status. Estimates by age, sex and region can guide nutrition and health promotion programs.

Physical activity supports health throughout life. World Health Organization guidelines recommend regular activity and limiting sedentary time, with recommendations tailored to age, ability and health status [7]. A pooled analysis of 507 surveys estimated that 31.3% of adults aged 18 years or older were insufficiently active in 2022. This age-standardized global estimate had a 95% uncertainty interval of 28.6%-34.0% [8]. Prevalence varied by sex, age and location [8]. These differences can guide priorities for physical activity promotion.

A scoping study identified gaps in publicly available nutrition evidence in Saudi Arabia [9]. Food availability, reported intake and biomarkers measure different aspects of nutrition [9]. This study used national survey estimates to describe fruit and vegetable consumption, body mass index (BMI) categories, obesity, physical activity and sedentary time in Saudi Arabia. It examined differences by age, sex and administrative region to guide prevention.

METHODS

Study design and sources

This secondary analysis used four national datasets published by the General Authority for Statistics (GASTAT). Health Determinants Statistics provided fruit and vegetable intake, BMI categories and obesity estimates for 2023 and 2024 [10,11]. Physical Activity Statistics provided activity and sedentary time estimates for 2024 and 2025 [12,13]. Values were checked against the original data tables.

Source survey procedures

The data came from the National Health Survey and the Woman and Child's Health Survey, which covered Saudi and non-Saudi households in all 13 administrative regions [14,15]. GASTAT collected responses through computer-assisted personal interviews. The 2024 methodology report describes survey weights adjusted for nonresponse and calibrated to population totals [14]. The 2025 surveys used stratified cluster sampling and systematic household selection from the 2022 Census frame [15]. Activity estimates for ages 5-14 came from the Woman and Child's Health Survey, and those for ages 15-17 came from the National Health Survey [12,13].

Measures

The 2023 age tables covered all residents and reported fruit and vegetable intake separately as one, two or more than two servings on a typical day. The 2024 estimates used here covered Saudi nationals. Combined intake was classified as none, 1-4 or at least five servings daily. These categories were reported separately for each year. Intake below five servings in 2024 was calculated as 100 minus the percentage consuming at least five servings [10,11].

BMI categories and obesity estimates were extracted using the source classifications. Child estimates covered ages below 15 years in 2023 and 2-14 years in 2024; adult estimates covered ages 15 years and older. Child BMI distributions were reported separately for each year because age coverage differed and the classification criteria could not be harmonized [10,11,14]. Physical activity was defined by the GASTAT thresholds of at least 60 minutes daily at ages 5-17 and at least 150 minutes weekly at ages 18 years and older. Sedentary time categories followed each source. Adult sitting time in 2025 was converted from minutes to hours by dividing by 60 [12,13]. The 2023 obesity estimates by age were also reported separately from the Saudi BMI and regional estimates because the source repeats the age values across nationality groups [10].

Proportions were converted to percentages and reported to two decimal places. National totals were taken directly from the source tables. Changes in physical activity were calculated as the 2025 percentage minus the 2024 percentage and expressed in percentage points, using the original precision.

Ethical considerations

This study used publicly available aggregate statistics and involved no individual records or participant recruitment.

RESULTS

Diet

In 2023, one serving per day was the most common category for both fruit and vegetables among people aged 15-54 years. Across these age groups, the percentages ranged from 67.55% to 74.88% for fruit and from 53.50% to 67.96% for vegetables (Table 1). Among Saudi nationals aged 15-54 years in 2024, the most common category was 1-4 combined servings per day. Within this age range, intake of at least five servings was highest at ages 50-54 years (12.54%) and lowest at ages 15-19 years (8.12%). At ages 50-54 years, 13.73% of women and 11.25% of men reported this intake. Across all age groups, the lowest proportion was 6.28% among people over 80 years.

Table 1. Fruit and vegetable intake estimates by age and sex, 2023 and 2024

Variables		2023 %						2024 %			
		Fruit servings/day			Vegetable servings/day			Fruit and vegetables, servings/day			
Age, years	**Sex**	**1**	**2**	**>2**	**1**	**2**	**>2**	**0**	**1-4**	**≥5**	**<5**
15-19	Male	68.77	18.65	3.25	66.65	26.52	2.40	7.90	84.69	7.41	92.59
	Female	68.27	20.74	4.11	69.34	20.76	3.40	6.73	84.44	8.84	91.16
	Total	68.52	19.67	3.67	67.96	23.71	2.89	7.32	84.56	8.12	91.88
20-24	Male	72.97	11.27	6.84	66.85	23.44	5.69	9.33	81.13	9.55	90.45
	Female	64.16	19.46	2.72	55.81	35.47	2.16	4.78	85.21	10.00	90.00
	Total	69.66	14.35	5.29	62.70	27.96	4.36	7.07	83.16	9.77	90.23
25-29	Male	70.38	20.88	2.49	66.95	27.64	1.14	6.95	82.57	10.48	89.52
	Female	65.22	25.06	3.19	57.91	35.45	3.94	3.59	87.28	9.13	90.87
	Total	68.74	22.21	2.71	64.07	30.13	2.03	5.28	84.91	9.81	90.19
30-34	Male	71.41	17.97	3.49	62.75	30.70	4.43	5.39	85.52	9.09	90.91
	Female	71.25	19.02	3.27	60.92	32.42	4.71	4.80	86.05	9.15	90.85
	Total	71.36	18.30	3.42	62.17	31.25	4.52	5.10	85.79	9.12	90.88
35-39	Male	68.49	20.52	5.50	56.17	36.01	4.18	4.40	85.71	9.89	90.11
	Female	69.24	19.93	5.58	55.44	35.09	7.48	4.68	88.29	7.04	92.96
	Total	68.73	20.33	5.52	55.94	35.72	5.22	4.54	87.00	8.47	91.53
40-44	Male	69.66	23.75	3.97	54.54	37.50	6.88	5.47	84.19	10.34	89.66
	Female	62.89	25.46	5.80	55.52	35.79	5.60	3.37	87.53	9.10	90.90
	Total	67.55	24.28	4.54	54.85	36.97	6.48	4.41	85.87	9.72	90.28

Variables		2023 %						2024 %			
		Fruit servings/day			Vegetable servings/day			Fruit and vegetables, servings/day			
Age, years	**Sex**	**1**	**2**	**>2**	**1**	**2**	**>2**	**0**	**1-4**	**≥5**	**<5**
45-49	Male	75.73	16.54	4.12	53.17	37.25	6.61	4.97	84.68	10.36	89.64
	Female	64.26	29.57	2.17	54.22	35.65	7.23	3.21	89.33	7.46	92.54
	Total	72.15	20.61	3.51	53.50	36.75	6.81	4.07	87.04	8.88	91.12
50-54	Male	76.21	19.81	1.70	54.25	33.10	11.99	5.15	83.60	11.25	88.75
	Female	72.17	23.11	0.52	60.78	34.26	3.19	3.56	82.71	13.73	86.27
	Total	74.88	20.90	1.31	56.40	33.48	9.10	4.32	83.14	12.54	87.46
55-59	Male	64.19	25.55	8.92	61.23	32.75	5.55	4.47	85.61	9.92	90.08
	Female	70.03	23.22	1.81	58.71	29.12	7.50	3.65	86.31	10.03	89.97
	Total	66.18	24.75	6.49	60.37	31.51	6.22	4.04	85.98	9.98	90.02
60-64	Male	60.51	29.17	6.05	61.76	26.48	9.03	4.60	85.62	9.78	90.22
	Female	61.85	28.87	3.45	35.45	54.12	9.10	4.64	85.42	9.94	90.06
	Total	60.98	29.07	5.14	52.59	36.10	9.06	4.62	85.51	9.86	90.14
65-69	Male	75.40	16.31	3.59	44.88	48.67	0.16	4.09	86.42	9.49	90.51
	Female	54.19	26.73	5.58	52.18	29.83	9.65	3.56	87.97	8.47	91.53
	Total	66.42	20.73	4.43	47.98	40.69	4.18	3.82	87.21	8.97	91.03
70-74	Male	50.61	32.97	13.54	53.64	32.03	13.40	4.30	82.52	13.19	86.81
	Female	65.93	28.02	0.00	66.92	29.39	0.00	5.34	87.72	6.95	93.05
	Total	57.85	30.63	7.14	59.91	30.78	7.07	4.84	85.25	9.91	90.09
75-80	Male	86.36	4.46	9.18	89.61	10.39	0.00	3.04	82.49	14.48	85.52
	Female	50.29	39.36	10.35	53.47	33.49	10.35	13.86	79.60	6.54	93.46
	Total	69.61	20.66	9.73	72.83	21.12	4.81	8.42	81.05	10.53	89.47
>80	Male	66.76	9.60	8.82	57.59	17.87	0.00	6.69	89.23	4.08	95.92
	Female	78.08	4.61	0.00	60.93	11.02	17.06	9.03	82.72	8.25	91.75
	Total	72.43	7.11	4.40	59.26	14.44	8.54	7.92	85.80	6.28	93.72
Total	Male	70.59	19.46	4.37	60.50	31.64	4.89	6.25	84.14	9.61	90.39
	Female	66.81	22.62	3.62	58.29	32.96	5.09	4.66	86.24	9.10	90.90
	Total	69.29	20.55	4.11	59.73	32.10	4.96	5.45	85.19	9.35	90.65

In 2024, 85.19% of Saudi nationals aged 15 years and older reported consuming 1-4 servings of fruit and vegetables per day (Table 2). At least five servings were reported by 9.35%, while 5.45% reported none. Overall, 90.65% consumed fewer than five servings per day. This proportion was 90.39% among men and 90.90% among women. Intake of at least five servings

ranged from 1.92% in Najran to 15.69% in Hail. The proportions below this threshold were 98.08% and 84.31%, respectively. Najran had the highest proportion reporting no intake (14.30%), and Al-Jouf had the lowest (0.94%). In the Northern Borders, 15.54% of women and 7.68% of men reported at least five servings.

Table 2. Regional dietary source components in 2023 and intake prevalence in 2024, by sex

Variables		2023 %						2024 %			
		Fruit servings/day			Vegetable servings/day			Fruit and vegetables, servings/day			
Region	**Sex**	**1**	**2**	**>2**	**1**	**2**	**>2**	**0**	**1-4**	**≥5**	**<5**
Riyadh	Male	23.03	5.40	0.76	19.75	9.33	1.10	7.13	81.68	11.19	88.81
	Female	44.31	11.98	1.63	38.87	18.61	3.63	4.05	86.51	9.44	90.56
	Total	30.05	7.58	1.05	26.07	12.39	1.93	5.60	84.08	10.32	89.68
Makkah	Male	24.36	4.24	1.65	21.00	9.32	1.19	7.61	83.94	8.45	91.55
	Female	42.17	12.73	2.14	38.87	17.94	3.09	4.54	87.24	8.22	91.78
	Total	30.63	7.23	1.83	27.30	12.36	1.86	6.06	85.61	8.33	91.67
Madinah	Male	26.59	7.93	1.68	24.65	10.74	1.33	4.60	92.65	2.76	97.24
	Female	51.87	17.00	1.52	47.21	20.56	4.12	5.36	91.63	3.01	96.99
	Total	35.69	11.20	1.62	32.78	14.27	2.34	4.99	92.13	2.89	97.11
Qassim	Male	38.88	3.18	1.16	31.93	11.61	1.58	11.79	86.97	1.24	98.76
	Female	52.93	17.27	2.06	47.24	27.75	2.95	8.26	88.96	2.79	97.21
	Total	44.02	8.34	1.49	37.53	17.52	2.08	9.99	87.98	2.03	97.97
Eastern Region	Male	24.28	7.24	0.86	21.42	9.67	2.25	3.49	82.19	14.33	85.67
	Female	49.08	16.31	2.42	38.61	28.28	3.85	2.89	84.48	12.63	87.37
	Total	32.03	10.07	1.35	26.79	15.48	2.75	3.20	83.31	13.50	86.50
Aseer	Male	31.61	12.88	1.85	28.64	14.37	3.45	7.12	81.08	11.80	88.20
	Female	62.79	17.98	2.04	52.05	30.68	2.79	8.82	78.83	12.35	87.65
	Total	43.17	14.77	1.92	37.32	20.41	3.21	7.99	79.93	12.08	87.92
Tabuk	Male	34.69	8.87	1.91	30.31	14.23	1.38	3.20	89.51	7.29	92.71
	Female	57.41	18.38	2.89	50.96	26.33	4.87	2.29	87.73	9.99	90.01
	Total	42.74	12.24	2.26	37.62	18.52	2.62	2.74	88.62	8.64	91.36
Hail	Male	33.22	11.27	0.60	28.79	14.05	2.95	2.95	80.69	16.35	83.65
	Female	56.09	12.23	1.61	48.69	20.78	3.14	1.20	83.76	15.04	84.96
	Total	41.59	11.62	0.97	36.07	16.51	3.02	2.07	82.23	15.69	84.31
Northern Borders	Male	30.09	12.51	3.35	33.17	15.85	1.67	1.94	90.38	7.68	92.32
	Female	50.05	17.96	7.17	46.34	27.17	9.79	1.97	82.49	15.54	84.46

Variables		2023 %						2024 %			
		Fruit servings/day			Vegetable servings/day			Fruit and vegetables, servings/day			
Region	**Sex**	**1**	**2**	**>2**	**1**	**2**	**>2**	**0**	**1-4**	**≥5**	**<5**
	Total	37.64	14.57	4.80	38.15	20.13	4.74	1.95	86.41	11.64	88.36
Jazan	Male	40.44	10.21	0.30	35.77	15.45	1.19	4.72	87.71	7.56	92.44
	Female	62.65	16.14	0.60	45.30	30.88	1.99	5.00	88.63	6.37	93.63
	Total	49.40	12.60	0.42	39.62	21.67	1.51	4.87	88.18	6.95	93.05
Najran	Male	30.73	7.41	2.11	24.90	15.03	1.58	15.27	83.59	1.14	98.86
	Female	63.14	10.45	4.18	43.27	32.03	2.95	13.36	83.96	2.68	97.32
	Total	42.18	8.49	2.84	31.39	21.03	2.07	14.30	83.78	1.92	98.08
Al-Baha	Male	41.58	9.06	2.03	37.52	14.40	1.47	4.45	87.37	8.19	91.81
	Female	63.44	17.80	2.91	52.43	26.03	1.79	3.22	88.71	8.08	91.92
	Total	49.95	12.41	2.37	43.23	18.86	1.59	3.80	88.07	8.13	91.87
Al-Jouf	Male	32.74	8.15	2.54	26.39	17.00	1.95	0.47	87.79	11.75	88.25
	Female	71.09	7.93	2.63	51.17	26.32	2.43	1.41	84.84	13.75	86.25
	Total	46.61	8.07	2.58	35.35	20.37	2.12	0.94	86.30	12.76	87.24
Total	Male	26.55	6.47	1.23	23.14	10.61	1.56	6.25	84.14	9.61	90.39
	Female	48.99	14.16	2.03	41.92	22.49	3.43	4.66	86.24	9.10	90.90
	Total	34.29	9.12	1.51	29.62	14.71	2.21	5.45	85.19	9.35	90.65

BMI

Among children, the 2023 estimates were 43.18% for normal weight, 42.26% for underweight, 9.08% for overweight and 5.48% for obesity (Table 3). In 2024, overweight was more common among boys (36.15%) than girls (30.10%). Obesity was also more common among boys (15.51%) than girls (13.79%). The combined proportions for overweight and obesity were 14.56% in 2023 and 47.83% in 2024. Among adults, overweight prevalence was 34.68% in 2023 and 42.26% in 2024. Obesity prevalence was 24.29% and 23.86%, respectively, with similar estimates for men and women in each year. Overweight and obesity together accounted for 58.97% of adults in 2023 and 66.12% in 2024.

Table 3. BMI categories among children and adults by sex, 2023 and 2024

BMI category	**2023 %**			**2024 %**		
	Male	**Female**	**Total**	**Male**	**Female**	**Total**
BMI: children						
Underweight	42.90	41.68	42.26	2.60	2.65	2.62
Normal weight	43.12	43.23	43.18	45.73	53.47	49.54
Overweight	8.57	9.54	9.08	36.15	30.10	33.17

BMI category	2023 %			2024 %		
	Male	Female	Total	Male	Female	Total
Obesity	5.41	5.55	5.48	15.51	13.79	14.66
Overweight or obesity	13.98	15.09	14.56	51.66	43.89	47.83
BMI: adults ≥15 years						
Underweight	4.27	2.44	3.35	1.04	0.77	0.91
Normal weight	34.49	40.85	37.68	32.53	33.42	32.98
Overweight	37.07	32.31	34.68	42.53	41.99	42.26
Obesity	24.17	24.40	24.29	23.90	23.82	23.86
Overweight or obesity	61.24	56.71	58.97	66.43	65.81	66.12

Obesity

In 2023, obesity prevalence was 2.73% among children aged 5-9 years and 2.59% among those aged 10-14 years (Table 4). The 2024 estimates were 18.78% and 5.28%, respectively. Boys had higher prevalence than girls in both age groups in 2024. The youngest child groups were aged 0-4 years in 2023 and 2-4 years in 2024. At ages 50-54 years, prevalence was 42.64% among women and 27.14% among men. In 2023, adult prevalence was highest at ages 55-59 years (44.02%). In 2024, adult obesity prevalence rose across age groups from 11.94% at ages 15-19 years to 37.96% at ages 50-54 years. At ages 50-54 years, prevalence was 41.68% among women and 33.94% among men. The overall peak was 39.11% at ages 65-69 years. Prevalence among women was highest at ages 65-69 years (49.25%). Among men, it was highest at ages 70-74 years (35.25%).

Table 4. Obesity estimates among children and adults by age and sex, 2023 and 2024

Age, years	2023 %			2024 %		
	Male	Female	Total	Male	Female	Total
Obesity by age: children						
0-4 (2023 only)	13.50	12.46	12.95	-	-	-
2-4 (2024 only)	-	-	-	22.24	23.03	22.62
5-9	2.46	2.98	2.73	19.72	17.81	18.78
10-14	2.22	2.92	2.59	6.72	3.81	5.28
Obesity by age: adults ≥15 years						
15-19	18.15	7.10	12.76	14.68	9.14	11.94
20-24	11.38	12.14	11.67	16.12	12.01	14.08
25-29	18.19	16.50	17.65	20.68	13.34	17.03
30-34	24.76	20.14	23.29	23.82	20.61	22.22
35-39	27.33	23.30	26.06	25.91	26.71	26.31
40-44	27.87	32.37	29.27	32.43	32.80	32.62

Age, years	2023 %			2024 %		
	Male	Female	Total	Male	Female	Total
45-49	29.87	32.15	30.58	32.72	35.45	34.11
50-54	27.14	42.64	32.23	33.94	41.68	37.96
55-59	40.95	49.95	44.02	32.01	41.84	37.11
60-64	26.44	46.74	33.51	30.78	43.65	37.50
65-69	30.20	34.66	32.09	28.47	49.25	39.11
70-74	10.47	39.81	24.33	35.25	40.02	37.76
75-80	18.42	45.48	30.98	19.17	39.53	29.30
>80	16.50	32.13	24.33	25.14	28.51	26.91
Adult age-table total	23.87	23.51	23.75	23.90	23.82	23.86

Childhood obesity prevalence ranged from 3.98% in Madinah to 9.51% in Al-Jouf in 2023 (Table 5). In 2024, it ranged from 11.88% in Jazan to 17.52% in the Northern Borders. In the Northern Borders, prevalence was 20.10% among boys and 14.89% among girls. National estimates were 5.48% in 2023 and 14.66% in 2024. Adult obesity prevalence ranged from 18.41% in Najran to 28.11% in the Eastern Region in 2023. In 2024, it ranged from 14.08% in Najran to 27.88% in Aseer. In Hail, prevalence was 31.59% among women and 17.24% among men in 2024. National estimates were 24.29% in 2023 and 23.86% in 2024.

Table 5. Obesity among children and adults by administrative region and sex, 2023 and 2024

Administrative region	2023			2024		
	Male	Female	Total	Male	Female	Total
Children						
Riyadh	6.46	4.67	5.53	16.86	14.00	15.45
Makkah	3.77	6.24	5.08	18.58	15.36	17.00
Madinah	3.92	4.02	3.98	12.81	11.41	12.11
Qassim	6.33	5.62	5.96	12.19	15.40	13.80
Eastern Region	6.61	4.99	5.76	14.60	12.60	13.62
Aseer	6.24	8.53	7.42	14.20	13.72	13.97
Tabuk	7.43	10.24	8.89	13.35	13.50	13.43
Hail	6.20	9.51	7.94	13.43	12.32	12.89
Northern Borders	7.42	9.16	8.36	20.10	14.89	17.52
Jazan	6.84	4.53	5.61	11.62	12.15	11.88
Najran	6.10	6.89	6.52	12.22	14.74	13.48
Al-Baha	6.00	3.68	4.79	14.80	11.33	13.09
Al-Jouf	5.50	12.93	9.51	16.90	15.37	16.12
Total children	**5.41**	**5.55**	**5.48**	**15.51**	**13.79**	**14.66**

Administrative region	2023			2024		
	Male	Female	Total	Male	Female	Total
Adults ≥15 years						
Riyadh	24.28	23.87	24.08	28.23	23.79	26.02
Makkah	26.70	26.94	26.82	21.07	20.79	20.93
Madinah	22.88	18.99	20.91	19.98	21.16	20.58
Qassim	19.83	25.36	22.64	27.22	28.11	27.68
Eastern Region	28.87	27.32	28.11	25.94	27.33	26.62
Aseer	22.90	22.37	22.63	28.49	27.30	27.88
Tabuk	16.04	25.71	20.85	16.78	27.50	22.12
Hail	19.18	24.63	21.91	17.24	31.59	24.43
Northern Borders	22.38	24.78	23.58	17.11	27.71	22.45
Jazan	20.94	18.28	19.58	20.24	18.58	19.39
Najran	13.87	22.95	18.41	16.76	11.41	14.08
Al-Baha	20.23	22.76	21.50	21.17	21.97	21.58
Al-Jouf	18.39	20.44	19.42	18.49	25.52	22.04
Total adults ≥15 years	**24.17**	**24.40**	**24.29**	**23.90**	**23.82**	**23.86**

Physical activity

Among all residents aged 5-17 years, 18.70% met the physical activity threshold in 2024 and 18.95% in 2025 (Table 6). Boys had higher proportions than girls in both years: 23.20% compared with 14.00% in 2024, and 23.26% compared with 14.37% in 2025. Among adults aged 18 years and older, the proportions were 58.50% in 2024 and 59.05% in 2025. The proportion among men rose from 64.00% to 66.45%, while the proportion among women fell from 46.30% to 43.06%. The largest increase by age was at ages 18-29 years, from 62.47% to 71.17%, a difference of 8.70 percentage points. At ages 60-69 years, the proportion fell from 38.40% to 26.98%. This was the largest decrease, at 11.42 percentage points. The proportion also fell from 25.89% to 17.97% at ages 70-79 and from 12.18% to 3.49% at ages 80 years and older. Among Saudi nationals in 2024, 54.10% of adults and 18.50% of children met the activity thresholds.

Table 6. Physical activity among children and adults by sex and age, 2024 and 2025

Sex or age, years	2024 met, %	2025 met, %	Difference, pp	2024 below, %	2025 below, %
Children 5-17 years: sex					
Male	23.20	23.26	+0.06	76.80	76.74
Female	14.00	14.37	+0.37	86.00	85.63
Total	18.70	18.95	+0.25	81.30	81.05
Children 5-17 years: age					
5-10	19.49	19.70	+0.21	80.51	80.30
11-17	17.67	18.02	+0.35	82.33	81.98
Total	18.67	18.95	+0.28	81.33	81.05

Sex or age, years	2024 met, %	2025 met, %	Difference, pp	2024 below, %	2025 below, %
Adults ≥18 years: sex					
Male	64.00	66.45	+2.45	36.00	33.55
Female	46.30	43.06	-3.24	53.70	56.94
Total	58.50	59.05	+0.55	41.50	40.95
Adults ≥18 years: age					
18-29	62.47	71.17	+8.70	37.53	28.83
30-39	62.60	62.56	-0.04	37.40	37.44
40-49	58.70	56.07	-2.63	41.30	43.93
50-59	53.87	53.85	-0.02	46.13	46.15
60-69	38.40	26.98	-11.42	61.60	73.02
70-79	25.89	17.97	-7.92	74.11	82.03
≥80	12.18	3.49	-8.69	87.82	96.51
Total	58.52	59.05	+0.53	41.48	40.95
Saudi nationals in 2024 only					
Adults ≥18: male	61.90	Not reported	-	38.10	Not reported
Adults ≥18: female	44.60	Not reported	-	55.40	Not reported
Adults ≥18: total	54.10	Not reported	-	45.90	Not reported
Children 5-17: male	23.10	Not reported	-	76.90	Not reported
Children 5-17: female	13.70	Not reported	-	86.30	Not reported
Children 5-17: total	18.50	Not reported	-	81.50	Not reported

Adult physical activity estimates varied by region (Table 7). In 2024, the proportion meeting the threshold ranged from 44.49% in Najran to 70.53% in Tabuk. In 2025, it ranged from 45.94% in Al-Baha to 67.61% in Makkah. The national estimate was 58.52% in 2024 and 59.05% in 2025. Estimates were higher in four regions and lower in nine in 2025. Najran had the largest increase (14.43 percentage points), followed by Makkah (7.61 percentage points). Qassim had the largest decrease (12.05 percentage points), followed by the Eastern Region (11.29 percentage points). Among children in 2024, regional estimates ranged from 14.70% in Riyadh to 30.37% in Al-Baha.

Table 7. Physical activity by administrative region among adults in 2024-2025 and children in 2024

Region	2024 %	2025 %	Adult difference, pp	Children 2024 %
All residents: adults ≥18 and children 5-17 years				
Riyadh	53.95	59.01	+5.06	14.70
Makkah	60.00	67.61	+7.61	20.45
Madinah	57.08	48.85	-8.23	21.90

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Region	2024 %	2025 %	Adult difference, pp	Children 2024 %
Qassim	66.85	54.80	-12.05	16.32
Eastern Region	60.97	49.68	-11.29	14.71
Aseer	56.95	48.41	-8.54	19.57
Tabuk	70.53	64.12	-6.41	26.30
Hail	56.94	60.51	+3.57	16.99
Northern Borders	64.63	62.27	-2.36	21.98
Jazan	66.16	57.81	-8.35	23.96
Najran	44.49	58.92	+14.43	29.52
Al-Baha	55.09	45.94	-9.15	30.37
Al-Jouf	61.68	52.91	-8.77	18.73
Total	58.52	59.05	+0.53	18.67

Figure 1 shows regional physical activity estimates and national estimates by sex. The difference between men and women was 17.70 percentage points in 2024 and 23.39 in 2025. This gap widened by 5.69 percentage points. Among children, the difference between boys and girls narrowed from 9.20 to 8.89 percentage points. Both panels cover all residents. The thresholds were at least 60 minutes per day for children and at least 150 minutes per week for adults.

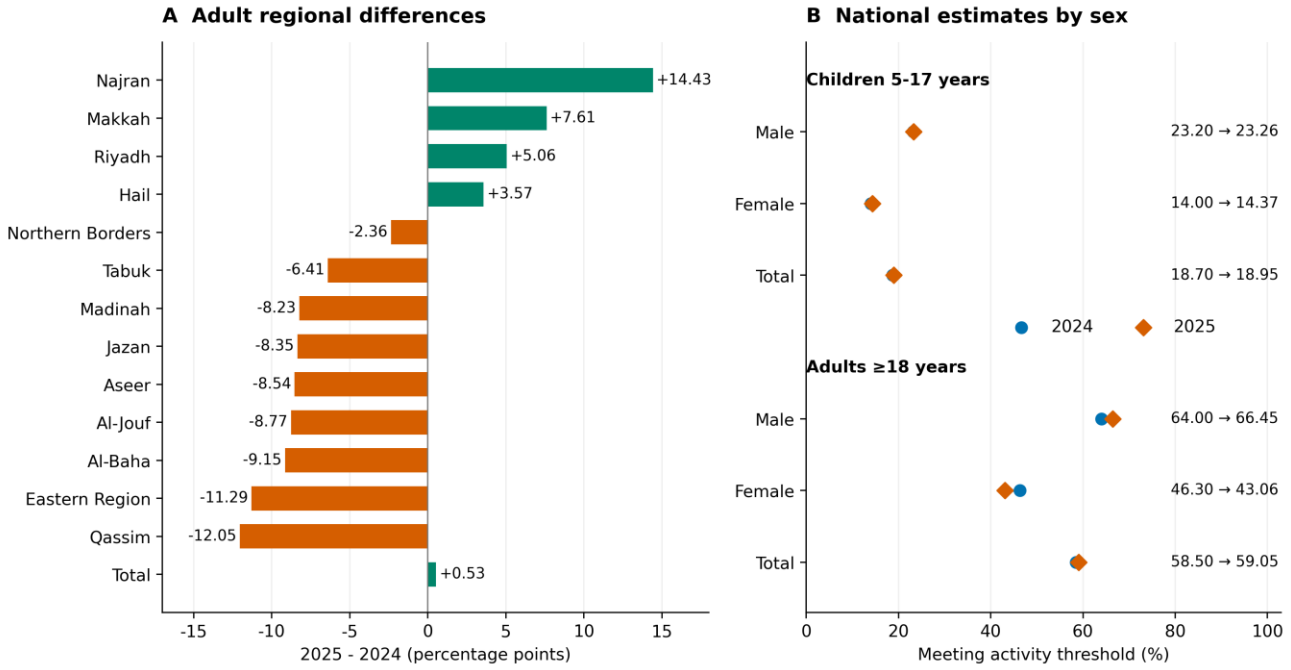


Figure 1. Physical activity estimates by administrative region and sex among children and adults, 2024 and 2025.

Among Saudi nationals in 2024, intake of at least five daily fruit and vegetable servings was similar among men (9.61%) and women (9.10%) (Figure 2). Among children, overweight prevalence was 6.05 percentage points higher in boys than girls. Obesity prevalence was 1.72 percentage points higher in boys. Adult obesity estimates were similar for men and women. Among Saudi

adults, 61.90% of men and 44.60% of women met the physical activity threshold, a difference of 17.30 percentage points. Among Saudi children, the proportions were 23.10% for boys and 13.70% for girls, a difference of 9.40 percentage points.

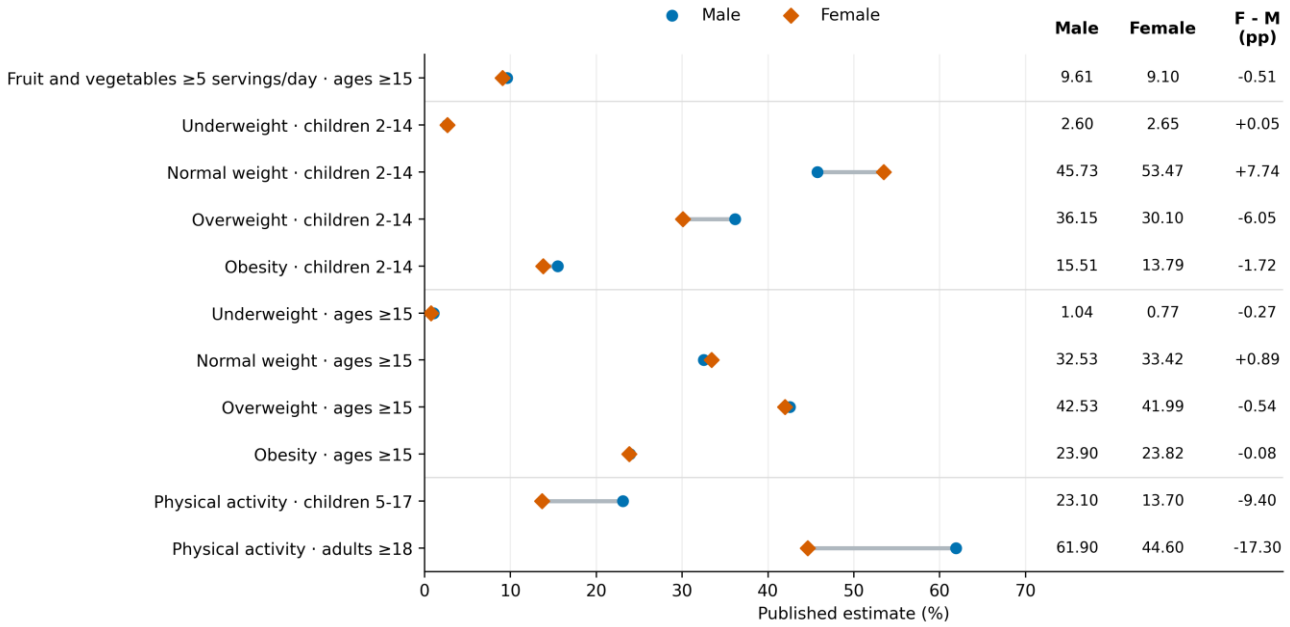


Figure 2. Sex differences in fruit and vegetable intake, weight status and physical activity among Saudi nationals, 2024.

In 2024, Hail had the highest proportion of Saudi nationals reporting at least five daily fruit and vegetable servings (15.69%) (Figure 3). Childhood obesity prevalence was highest in the Northern Borders (17.52%). Adult obesity prevalence was highest in Aseer (27.88%).

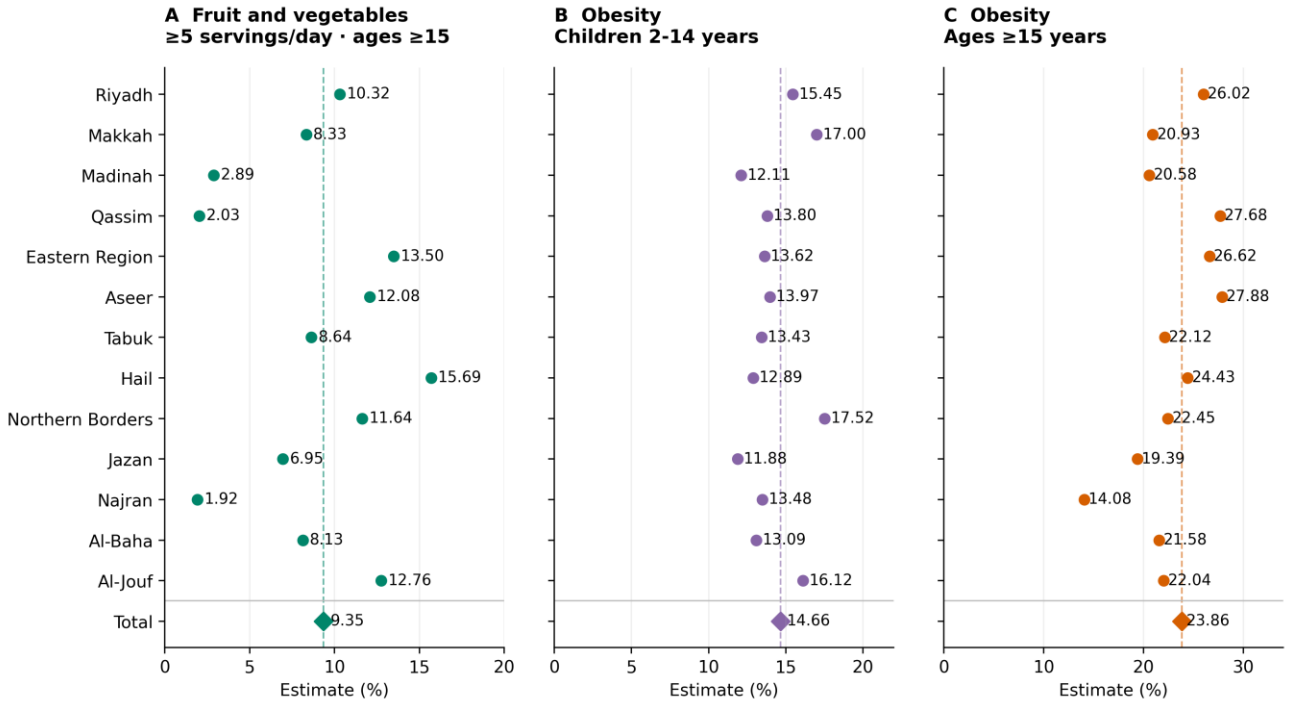


Figure 3. Regional patterns in fruit and vegetable intake and obesity among Saudi nationals, 2024.

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Sedentary time

Average daily sitting time among all residents aged 18 years and older was 5.90 hours in 2024 and 5.15 hours in 2025 (Table 8). The averages for men were 5.70 and 5.07 hours, respectively. For women, they were 6.20 and 5.32 hours [12,13]. Among children aged 5-17 years, 35.30% were reported to sit for more than three hours per day in 2024. In 2025, 13.24% were in the category of three to less than four hours and 5.68% in the category of four hours or more. Together, these categories accounted for 18.92% reporting at least three hours per day in 2025.

Table 8. Sedentary time among all residents in 2024 and 2025

Measure or category	2024	2025	Unit
Adults ≥18 years (hours/day)			
Male	5.70	5.07	Hours/day
Female	6.20	5.32	Hours/day
Total adults	5.90	5.15	Hours/day
Children 5-17 years (%)			
Less than one hour	14.90	20.14	%
One to two hours	23.60	34.55	%
Two to three hours	22.90	23.71	%
More than three hours (2024 category)	35.30	Not reported	%
Three to less than four hours (2025 category)	Not reported	13.24	%
Four hours or more (2025 category)	Not reported	5.68	%
Unknown	3.30	2.67	%
Total	100	100	%

DISCUSSION

This study identified differences in diet, weight status and activity by age, sex and region in Saudi Arabia. In 2024, more than nine in ten Saudi nationals aged 15 years and older reported fewer than five daily fruit and vegetable servings, and nearly two in three had overweight or obesity. Low activity was particularly common among children, women and girls. Nutrition and activity programs should be planned together and adapted to the needs of these groups.

Only 9.35% of Saudi nationals aged 15 years and older reported at least five daily fruit and vegetable servings in 2024 (Tables 1 and 2). National estimates were similar for men and women. Regional estimates ranged from 1.92% in Najran to 15.69% in Hail. Among people aged 15-54 years, intake at this level was lowest at ages 15-19 and highest at ages 50-54. Across all age groups, it was lowest among those over 80 years. Earlier findings from the 2013 Saudi Health Interview Survey also showed low intake. Only 5.2% met the fruit recommendation and 7.5% met the vegetable recommendation [16]. A later analysis of the same survey identified low fruit and vegetable consumption as a common risk factor [17]. Alsubaie reported limited daily fruit and vegetable intake among primary school boys in Saudi Arabia [18]. The same survey found that about one-third of boys did not consume milk or dairy products daily. None of the surveyed schools provided or sold fruit or vegetables [18]. A separate study found that sweet food consumption was associated with intake of carbonated beverages, energy drinks and high-fat foods [19]. These findings support school nutrition programs that address food and drink choices together. Practical lessons can help children choose healthier snacks and drinks, while school food standards can make these choices easier.

Low fruit and vegetable intake and excess weight support the need for a broader dietary assessment. This assessment should cover food variety, portion sizes, sugary drinks and foods high in fat or sugar. Recent Saudi research also supports combining intake measures with other indicators of nutritional risk [9]. A study in female high schools in Riyadh identified barriers related

to staff training, time, facilities and student motivation [20]. Students and staff also described difficulties with healthy food choices and opportunities for activity. These findings support reviewing canteen options, food prices, equipment and suitable spaces for exercise. Health education should be supported by healthier food options and opportunities for activity at school.

Food prices can also influence dietary choices. A 2024 systematic review found that reducing prices by 20% increased fruit and vegetable purchases by about 17% [21]. A 2025 Community Guide review found improved intake and food security following fruit and vegetable incentives for lower-income US households [22]. Similar programs could be tested in Saudi Arabia, with purchases and intake monitored separately. Policymakers should consider targeted subsidies for healthy foods, beginning with fruit and vegetables. Options include vouchers for households with limited resources, discounts at participating retailers and subsidized healthy school meals. WHO guidance supports subsidies that lower the retail prices of foods contributing to a healthy diet [23]. Healthy food subsidies can complement measures to reduce sugary drink purchases. A Saudi evaluation linked the carbonated drink excise tax to higher prices and lower sales relative to comparison countries [24]. A wider systematic review found similar associations for sugar-sweetened beverage taxes [25]. Schools can support these policies by providing drinking water and applying nutrition standards to food and drink sales. Restrictions on marketing unhealthy foods to children could support these measures, as recommended by WHO [26].

In 2024, 42.26% of Saudi adults were classified as overweight and 23.86% as having obesity, compared with 32.98% at normal weight (Table 3). The 2023 estimates were 34.68% for overweight and 24.29% for obesity. These estimates support weight management and nutrition services. Among children in 2024, overweight was more common than obesity, and both estimates were higher among boys than girls. International evidence supports monitoring underweight as well as excess weight throughout life [6]. A Saudi study found different childhood obesity estimates when WHO, International Obesity Task Force and Saudi growth references were applied to the same children [27]. Consistent growth references are therefore important for monitoring child weight status and planning services. In 2024, adult prevalence rose across age groups from 11.94% at ages 15-19 years to 37.96% at ages 50-54 years. National estimates were similar for men (23.90%) and women (23.82%). Prevalence was higher among women at ages 50-54 years and in several regions. The peak occurred at ages 65-69 years among women and 70-74 years among men. These findings support including older adults in nutrition and weight management services. Across regions, adult prevalence ranged from 14.08% in Najran to 27.88% in Aseer (Tables 4 and 5). Earlier Saudi studies also reported a substantial obesity burden. The 2013 Saudi Health Interview Survey found obesity in 28.7% of adults, including 33.5% of women and 24.1% of men [28]. Sharik surveillance reported estimates of 21.4-22.2% during 2020-2023 [29]. Childhood obesity in 2024 was higher among boys and was highest in the Northern Borders (Tables 3-5). Prevalence was also higher at ages 5-9 than at ages 10-14 years. A large study of children attending National Guard health facilities found higher prevalence among boys and the highest estimate among young children [30]. These findings support early prevention and programs adapted to local needs. National physical activity estimates differed little between 2024 and 2025, while differences by sex and region were larger (Table 6 and Figure 1). Among all residents, 58.50% of adults met the activity threshold in 2024 and 59.05% in 2025. The estimate rose among men and fell among women. The difference between them widened from 17.70 to 23.39 percentage points. The largest increase by age occurred at ages 18-29 years. Fewer than one in five children and adolescents met the activity threshold in either year, with lower proportions among girls. A global pooled analysis of school-going adolescents aged 11-17 years also found lower activity among girls [31]. In Saudi Arabia, Alsubaie and Omer reported low physical activity among male secondary-school students [32]. Students described limited community sports facilities, few suitable public clubs and a lack of peer support as barriers. Limited time, dislike of exercise and concerns about body image were also reported [32]. These findings support combining activity education with accessible facilities and peer participation. For adults, the global age-standardized estimate of insufficient activity was 31.3% in 2022 [8]. A Gulf Cooperation Council (GCC) review found that women reported lack of social support and skills more often than men [33]. Local programs should assess these barriers and offer activities suited to participants' abilities and preferences. Alsubaie found that activity was associated with better self-rated health and life satisfaction among male adolescents in Riyadh [34]. Among Saudi adults, Albujulaya and Stevinson found more reported barriers among younger adults, with few differences between men and women [35]. These findings support involving participants in designing activities. Enjoyment, confidence and social support should be considered alongside physical health goals.

Schools can support healthy eating, physical activity and the prevention of excess weight among children and adolescents. WHO and UNESCO standards link school policy, learning, the school environment, health services and family participation [36]. In Saudi schools, this approach could include affordable healthy meals, food preparation skills and regular physical

education. Protected activity time, trained staff and shaded or indoor spaces could address barriers identified in Riyadh schools [20]. School health teams can coordinate these measures with teachers, families and local health services. Alsubaie identified gaps in nutrition education in primary schools in Saudi Arabia [37]. The surveyed schools had no structured nutrition education program or designated nutrition coordinator. Most children wanted nutrition education, yet only about half reported being taught about healthy eating. Reported teaching was not significantly associated with dietary behavior or BMI. These findings support structured nutrition education with practical food skills [37]. A Cochrane review found little or no average increase in daily moderate-to-vigorous activity from school programs, although fitness may improve [38]. A Saudi trial of a smartphone app found no significant improvement in adolescent fruit and vegetable intake [39]. Sitting time deserves attention even among people who meet an activity threshold. WHO guidance addresses both regular physical activity and limiting sedentary time [7]. Schools and workplaces can include movement breaks in daily routines. Community programs can encourage activities that reduce prolonged sitting. Community programs should offer affordable activities that women, girls and older adults can access and enjoy. A GCC review found evidence that walking and step-counting programs can improve activity in the short term [40]. Prospective evidence also links small increases in activity among inactive adults with lower disease and mortality risks [41]. A review of randomized trials found modest gains in self-reported activity after interventions delivered or prompted by health professionals [42]. Results based on device measurements showed no clear effect. A systematic review found that balance and functional exercise reduced falls [43]. Health, education and municipal authorities should plan these actions together. School health services can monitor access to healthy meals and regular activity. Evaluation should track continued participation, food affordability and changes in diet and activity. Reporting results by age, sex, income and region can show whether services reach the groups with the greatest need. The dietary indicator measures fruit and vegetable intake but does not capture overall dietary quality. It excludes other dietary behaviors, such as consuming sugary drinks, highly processed foods, or foods high in salt or saturated fat. Participants may have had difficulty recalling their usual habits or may have reported healthier behaviors than they practiced.

CONCLUSION:

Low fruit and vegetable intake, excess weight and low physical activity were common in the national estimates examined. The age, sex and regional patterns can guide health promotion, with particular attention to children, women, girls and older adults. Health, education and municipal services should coordinate nutrition and activity programs. Priorities may include testing targeted fruit and vegetable subsidies, improving school meals and protecting time for physical education. Affordable community activities and accessible indoor or shaded spaces may support participation. Evaluation should track food affordability, participation and changes in diet and physical activity across population groups.

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CONFLICTS OF INTEREST

The author reports no conflicts of interest in this work.

Declaration of AI use

AI assisted with language editing, polishing, checking numbers and figure preparation. The author remains responsible for the accuracy and integrity of the work.

REFERENCES

[1] Dahlgren G, Whitehead M. The Dahlgren-Whitehead model of health determinants: 30 years on and still chasing rainbows. Public Health. 2021;199:20-24. doi: 10.1016/j.puhe.2021.08.009.

[2] GBD 2021 Risk Factors Collaborators. Global burden and strength of evidence for 88 risk factors in 204 countries and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2024;403(10440):2162-2203. doi: 10.1016/S0140-6736(24)00933-4.

[3] Li Y, Schoufour J, Wang DD, Dhana K, Pan A, Liu X, et al. Healthy lifestyle and life expectancy free of cancer, cardiovascular disease, and type 2 diabetes: prospective cohort study. BMJ. 2020;368:l6669. doi: 10.1136/bmj.l6669.

[4] Wang DD, Li Y, Bhupathiraju SN, Rosner BA, Sun Q, Giovannucci EL, et al. Fruit and vegetable intake and mortality: results from 2 prospective cohort studies of US men and women and a meta-analysis of 26 cohort studies. Circulation. 2021;143(17):1642-1654. doi: 10.1161/CIRCULATIONAHA.120.048996.

[5] Stanaway JD, Afshin A, Ashbaugh C, Bisignano C, Brauer M, Ferrara G, et al. Health effects associated with vegetable consumption: a Burden of Proof study. Nat Med. 2022;28(10):2066-2074. doi: 10.1038/s41591-022-01970-5.

[6] NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. Lancet. 2024;403(10431):1027-1050. doi: 10.1016/S0140-6736(23)02750-2.

[7] Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54(24):1451-1462. doi: 10.1136/bjsports-2020-102955.

[8] Strain T, Flaxman S, Guthold R, Semenova E, Cowan M, Riley LM, et al.; Country Data Author Group. National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5·7 million participants. Lancet Glob Health. 2024;12(8):e1232-e1243. doi: 10.1016/S2214-109X(24)00150-5.

[9] Alagal RI. Assessment of nutritional risk representations in publicly available data in Saudi Arabia: a triangulated scoping study. Nutrients. 2026;18(17):2888. doi: 10.3390/nu18172888.

[10] General Authority for Statistics. Health determinants statistics publication 2023 [Internet]. Riyadh: General Authority for Statistics; 2023 [cited 2026 Oct 16]. Available from: https://www.stats.gov.sa/documents/20117/2435259/Health-Determinants-Statistics-Publication-2023-EN_0.xlsx_fixed_2466307/05eb2cde-b1a9-408b-c875-3b64c43da3bf

[11] General Authority for Statistics. Health determinants statistics publication 2024 [Internet]. Riyadh: General Authority for Statistics; 2024 [cited 2026 Oct 16]. Available from: https://www.stats.gov.sa/documents/20117/2435259/Health_Determinants_Statistics_Publication_2024_EN.xlsx_fixed_2466331/7079508b-a71c-fcca-3b01-7c428ef11d20

[12] General Authority for Statistics. Physical activity statistics publication 2024 [Internet]. Riyadh: General Authority for Statistics; 2024 [cited 2026 Oct 16]. Available from: https://www.stats.gov.sa/documents/20117/2435259/Physical_Activity_Statistics_Publication_2024_EN.xlsx_fixed_2466403/e39fa22c-0b90-da3a-2aa0-e086e5a7ef9e

[13] General Authority for Statistics. Physical activity statistics 2025 [Internet]. Riyadh: General Authority for Statistics; 2025 [cited 2026 Oct 16]. Available from: https://www.stats.gov.sa/documents/20117/2435273/Physical_Activity_Statistics_2025_EN.xlsx_fixed_5189696/45f1bba8-f37e-2679-fae7-82e9f7b34b48

[14] General Authority for Statistics. Methodology and quality report of health determinants statistics publication [Internet]. Riyadh: General Authority for Statistics; 2024 [updated 2024 Nov 25; cited 2026 Oct 16]. Available from: https://www.stats.gov.sa/en/w/methodology-and-quality-report-of-health-determinants-statistics-publication

[15] General Authority for Statistics. Methodology and quality report of physical activity statistics [Internet]. Riyadh: General Authority for Statistics; 2025 [updated 2025 Oct 22; cited 2026 Oct 16]. Available from: https://www.stats.gov.sa/en/w/methodology-and-quality-report-of-physical-activity-statistics

[16] Moradi-Lakeh M, El Bcheraoui C, Afshin A, Daoud F, AlMazroa MA, Al Saeedi M, et al. Diet in Saudi Arabia: findings from a nationally representative survey. Public Health Nutr. 2017;20(6):1075-1081. doi: 10.1017/S1368980016003141.

[17] Al-Hanawi MK, Keetile M. Socio-economic and demographic correlates of non-communicable disease risk factors among adults in Saudi Arabia. Front Med (Lausanne). 2021;8:605912. doi: 10.3389/fmed.2021.605912.

[18] Alsubaie ASR. Intake of fruit, vegetables and milk products and correlates among school boys in Saudi Arabia. Int J Adolesc Med Health. 2021;33(1):20180051. Published online 9 May 2018. doi: 10.1515/ijamh-2018-0051.

[19] Alsubaie ASR. Consumption and correlates of sweet foods, carbonated beverages, and energy drinks among primary school children in Saudi Arabia. Saudi Med J. 2017;38(10):1045-1050. doi: 10.15537/smj.2017.10.19849.

[20] Aldukair S, Woodside JV, Almutairi K, McGowan L. Barriers and enablers to obesity prevention in female-only high schools in Riyadh: a qualitative study exploring healthy eating, physical activity and school-based interventions using the COM-B model. BMC Public Health. 2026;26:1020. doi: 10.1186/s12889-026-26568-1.

[21] Huangfu P, Pearson F, Abu-Hijleh FM, Wahlich C, Willis K, Awad SF, et al. Impact of price reductions, subsidies, or financial incentives on healthy food purchases and consumption: a systematic review and meta-analysis. Lancet Planet Health. 2024;8(3):e197-e212. doi: 10.1016/S2542-5196(24)00004-4.

[22] Stein R, Finnie RKC, Harmon S, Peng Y, Pritchard C, Vecsey H, et al. Impact of fruit and vegetable incentive programs on food insecurity, fruit and vegetable consumption, and health outcomes: a Community Guide systematic review. Am J Prev Med. 2025;68(3):627-637. doi: 10.1016/j.amepre.2024.11.016.

[23] World Health Organization. Fiscal policies to promote healthy diets: WHO guideline. Geneva: World Health Organization; 2024. Available from: https://www.who.int/publications/i/item/9789240091016 (accessed 16 October 2026).

[24] Alsukait R, Wilde P, Bleich SN, Singh G, Folta SC. Evaluating Saudi Arabia's 50% carbonated drink excise tax: changes in prices and volume sales. Econ Hum Biol. 2020;38:100868. doi: 10.1016/j.ehb.2020.100868.

[25] Andreyeva T, Marple K, Marinello S, Moore TE, Powell LM. Outcomes following taxation of sugar-sweetened beverages: a systematic review and meta-analysis. JAMA Netw Open. 2022;5(6):e2215276. doi: 10.1001/jamanetworkopen.2022.15276.

[26] World Health Organization. Policies to protect children from the harmful impact of food marketing: WHO guideline. Geneva: World Health Organization; 2023. Available from: https://www.who.int/publications/i/item/9789240075412 (accessed 16 October 2026).

[27] Al-Hazzaa HM, Alrasheedi AA, Alsulaimani RA, Jabri L, Alhowikan AM, Alhussain MH, et al. Prevalence of overweight and obesity among Saudi children: a comparison of two widely used international standards and the national growth references. Front Endocrinol (Lausanne). 2022;13:954755. doi: 10.3389/fendo.2022.954755.

[28] Memish ZA, El Bcheraoui C, Tuffaha M, Robinson M, Daoud F, Jaber S, et al. Obesity and associated factors-Kingdom of Saudi Arabia, 2013. Prev Chronic Dis. 2014;11:E174. doi: 10.5888/pcd11.140236.

[29] Althumiri NA, Bindhim NF, Al-Rayes SA, Alumran A. Mapping obesity trends in Saudi Arabia: a four-year description study. Healthcare (Basel). 2024;12(20):2092. doi: 10.3390/healthcare12202092.

[30] AlEnazi S, AlAjlan R, AlKhalaf H, Abolfotouh M, Alharbi O, Alfawaz R, et al. Prevalence of obesity among children and adolescents in Saudi Arabia: a multicenter population-based study. Saudi J Med Med Sci. 2023;11(1):19-25. doi: 10.4103/sjmms.sjmms_417_22.

[31] Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. Lancet Child Adolesc Health. 2020;4(1):23-35. doi: 10.1016/S2352-4642(19)30323-2.

[32] Alsubaie ASR, Omer EOM. Physical activity behavior predictors, reasons and barriers among male adolescents in Riyadh, Saudi Arabia: evidence for obesogenic environment. Int J Health Sci (Qassim). 2015;9(4):400-408. doi: 10.12816/0031229.

[33] Osabi LA, van de Klundert J, Alhurishi SA, Cramm JM. A theory-informed systematic review to understand physical activity among women in Gulf Cooperation Council countries. BMC Public Health. 2023;23:1009. doi: 10.1186/s12889-023-15725-5.

[34] Alsubaie AS. Associations between self-rated health, life satisfaction and physical activity among adolescents in Saudi Arabia. J Med Life. 2021;14(5):651-657. doi: 10.25122/jml-2021-0046.

[35] Albujulaya N, Stevinson C. Exercise promotion in Saudi Arabia: understanding personal, environmental, and social determinants of physical activity participation and well-being. Int J Environ Res Public Health. 2023;20(4):3554. doi: 10.3390/ijerph20043554.

[36] World Health Organization; United Nations Educational, Scientific and Cultural Organization. Making every school a health-promoting school: global standards and indicators. Geneva: World Health Organization and UNESCO; 2021. Available from: https://www.who.int/publications/i/item/9789240025059 (accessed 16 October 2026).

[37] Alsubaie ASR. An assessment of nutrition education in primary schools and its effect on students dietary behaviors and body mass index in Saudi Arabia. Majmaah J Health Sci. 2017;5(2):45-56. doi: 10.5455/mjhs.2017.02.006.

[38] Neil-Sztramko SE, Caldwell H, Dobbins M. School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. Cochrane Database Syst Rev. 2021;9:CD007651. doi: 10.1002/14651858.CD007651.pub3.

[39] Shatwan IM, Alhefani RS, Bukhari MF, Hanbazazah DA, Srour JK, Surendran S, et al. Effects of a smartphone app on fruit and vegetable consumption among Saudi adolescents: randomized controlled trial. JMIR Pediatr Parent. 2023;6:e43160. doi: 10.2196/43160.

[40] Nash EA, Critchley JA, Pearson F, Awad SF, Abu-Raddad LJ, Abu-Hijleh FM, et al. A systematic review of interventions to promote physical activity in six Gulf countries. PLoS One. 2021;16(10):e0259058. doi: 10.1371/journal.pone.0259058.

[41] Garcia L, Pearce M, Abbas A, Mok A, Strain T, Ali S, et al. Non-occupational physical activity and risk of cardiovascular disease, cancer and mortality outcomes: a dose-response meta-analysis of large prospective studies. Br J Sports Med. 2023;57(15):979-989. doi: 10.1136/bjsports-2022-105669.

[42] Kettle VE, Madigan CD, Coombe A, Graham H, Thomas JJC, Chalkley AE, et al. Effectiveness of physical activity interventions delivered or prompted by health professionals in primary care settings: systematic review and meta-analysis of randomised controlled trials. BMJ. 2022;376:e068465. doi: 10.1136/bmj-2021-068465.

[43] Sherrington C, Fairhall N, Kwok W, Wallbank G, Tiedemann A, Michaleff ZA, et al. Evidence on physical activity and falls prevention for people aged 65+ years: systematic review to inform the WHO guidelines on physical activity and sedentary behaviour. Int J Behav Nutr Phys Act. 2020;17:144. doi: 10.1186/s12966-020-01041-3.