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THE ROLE OF OBESITY AND BARIATRIC SURGERY IN CANCER RISK AWARENESS LEVELS OF SAUDI ARABIA'S GENERAL POPULATION

Samah Hameed Alrehaili[1], Hassan Adel Hassan Alasiri[2], Abdulaziz Mari Ali AlQahtani[2], Abdullah Mohammed Alrofydi[2], Faisal Suheam B Alamri[2], Majed Mohammed Al Saleh[1], Bandar A Alasmari[1], Abdullah Saeed[3]

[1]Consultant, Family medicine, Aseer Health Cluster, Saudi Arabia.
[2]Resident, Family medicine, Aseer Health Cluster, Saudi Arabia.
[3]Epidemiologist and Biostatistician, Family medicine, Aseer Health Cluster, Saudi Arabia.

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Corresponding author: Samah Hameed Alrehaili
(Dr-sama7.r@hotmail.com)

ABSTRACT

Obesity is a known risk factor for various cancers; however, there is a lack of public knowledge regarding this link especially in the Middle East. Objectives: The aim of this study was to investigate awareness of the associations between obesity and cancer, and knowledge about bariatric surgery among the general population in Saudi Arabia. This was a prospective cross-sectional study in which a survey was made available to the general population of Saudi Arabia through the survey website. Methods: A descriptive, cross-sectional study was conducted among residents of the southern region of Saudi Arabia, utilizing convenience sampling to administer an online questionnaire to 409 participants aged ≥18 years. Descriptive statistics were used to summarize the sample and chi-square tests and logistic regression were conducted to examine associations between sociodemographic variables and levels of awareness. A total of 90.4% of the participants understood that obesity is a disease.However, incidences of certain obesity-related cancers were much worse: colorectal (46.5%), pancreatic (40.5%), breast (34.0%) and kidney (28.2%) cancers. 77 (62.4%) had moderate knowledge of bariatric surgery, 81.9% knew about therapeutic effects and 44.6% about safety. Healthcare workers had 2.40 times greater odds of being aware of colorectal cancer (95% CI: 1.15–4.99, p=0.019) than that among non-healthcare workers. Neither age nor education was found to be a significant independent predictor during multivariable analysis. Conclusions High general obesity awareness was identified; however, specific knowledge of obesity-associated cancer risk and bariatric surgery safety is low. Working in healthcare, but not level of education, predicts awareness of risk for colorectal cancer. Health education campaigns specific to cancers and bariatric surgery safety are needed to address this gap in knowledge.

Keywords: Obesity; Awareness of cancer; Bariatric surgical procedure; Cross sectional study; KSA; Knowledge deficits; Health promotion in the community

1. INTRODUCTION

The prevalence of overweight and obesity, defined as a body mass index (BMI) >25 kg/m2 (or >23 kg/m2 for Asian populations), is increasing globally and constitutes a major public health problem. These diseases are closely related to increased rates of morbidity and mortality due to non-communicable diseases such as cardiovascular disease, type 2 diabetes mellitus, and various cancers. Overweight and obesity are highly prevalent in the Arab region, affecting between 25 and 40% of children and 66–75% of adults. Saudi Arabia's adult population is among the most obese in the world with 68.2% of adults being overweight and 33.7% obese, showing lack of proper preventive action.

1.1. Obesity and Cancer Risk

Obesity is a modifiable risk factor for about 40% of cancer cases globally. The link between obesity and cancer is also particularly strong for endometrial, postmenopausal breast, and colorectal cancers collectively comprising more than 60 percent of obesity-related cancer deaths. Epidemiological studies suggest that the risk of colorectal cancer is increased by 30% among obese individuals, whereas those with morbid obesity (BMI ≥40) have a sevenfold greater risk of endometrial cancer. The 2018 World Cancer Research Fund/American Institute for Cancer Research expert report broadened the range of obesity-related cancers to include esophageal, liver, pancreatic, gall bladder, ovarian, thyroid, and renal cancers and multiple myeloma.

Intentional weight loss is linked to a decreased incidence of cancer in obese people. In the Iowa Women's Health Study, women who lost ≥20 pounds (9.1 kg), intentionally, had a 14% lower risk of obesity-related cancers than those who gained weight. Newer data show that intentional weight loss in obese women is associated with a 54% reduction in the risk of endometrial cancer.

1.2. Bariatric Surgery as an Intervention

Bariatric surgery continues to be the best treatment option for morbid obesity (BMI ≥40 kg/m²) with comorbidities due to associated long-term weight loss and metabolic benefits. A large landmark cohort study including >22,000 patients undergoing bariatric surgery reported a 33% decreased risk of all cancers and a 41% decreased risk of obesity-related cancers after a median follow-up of 3.5 years. Importantly, this risk reduction seemed to be a direct function of weight loss and not of the surgical procedure per use. Despite the advantages, bariatric surgery has risks of early complications (within 30 days, such as nausea, vomiting, intestinal obstruction) and late complications (after 30 days, including various nutritional deficiencies and malabsorption). Proper post-operative follow-up is essential for sustaining long-term benefits and avoiding chronic complications.

1.3. Cancer Burden in Saudi Arabia

Cancer rates in Saudi Arabia have tripled in the past 20 years, mirroring a transition to a disease burden led by non-communicable diseases. Yet, there is low awareness in the general public about modifiable risk factors including the link between obesity and cancer. Although the overall level of awareness of cancer was high among Saudi population, the knowledge of obesity, overweight, diet and other risk factors is very poor. To the best of our knowledge, no study has yet evaluated the knowledge of the association between obesity and cancer and/or regarding bariatric surgery in Saudi Arabia, which would be a crucial information-source in the line of targeted health education interventions.

1.4. Study Rationale and Aims

It is important to know the level of awareness and knowledge of obesity-related cancer risks, attitudes toward bariatric surgery, and information sources of obesity among the public, as well as their opinion on the best strategies to prevent obesity for tailoring effective and culturally sensitive health message in Saudi Arabia. This research will advance knowledge in the field by investigating awareness and knowledge levels, exploring sociodemographic predictors of awareness, and obtaining community views on strategies to prevent obesity.

1.5. Primary research questions:

1. To what extent is the Saudi population aware of the link between obesity and certain cancers?
2. Is healthcare employment related to obesity-cancer awareness?
3. Which sociodemographic characteristics can predict awareness and knowledge of bariatric surgery?

2. METHODS

2.1. Study Design and Setting

This is an observational cross-sectional study with analytical approach in which in it was conducted in the southern region of Saudi Arabia ('Asir Region).The cross-sectional design was chosen to deliver a population-based overview of awareness at a specific moment in time and to assess how knowledge was spread among the population and to identify sociodemographic predictors.

2.2. Study Population and Sample

The considered population was Saudi adults who are at least 18 years old, have internet access, and live in the southern region of Saudi Arabia. Inclusion criteria included the following: 1) Saudi nationality, 2) age ≥ 18 years, and 3) an ability to access the Internet to complete the survey online. No formal exclusion criteria were stated.

The sample size was calculated by using Epi Info 7 taking 50% awareness about obesity as risk for cancer as an assumption for the prevalence with 95% confidence interval and 5% margin of error. This gave a minimum sample size of 385 participants. The final analytic sample consisted of 409 participants after the exclusion of disqualified records.

2.3. Sampling Method

A convenience sampling technique without randomization was used. The questionnaires were sent out via social media and other online channels, enabling us to recruit a great number in a short time with minimal-cost. Although this method is subject to selection bias and cannot be generalized to the whole Saudi population, it was selected for pragmatical feasibility of the study setting.

2.4. Data Collection Tool

A semi-structured self-report questionnaire was designed in Arabic after reviewing the literature as there is no validated instrument to measure this phenomenon in context of Saudi Arabia. After revision, face and content validity of the questionnaire were performed by an expert panel to ensure relevance, comprehensiveness, and cultural adequacy. A pilot test was performed before complete data collection to evaluate question clarity, response understanding, and respondent burden.

2.5. The study instrument included four main sections

Section I Sociodemographic and Clinical data on gender, age, marital status, educational attainment, monthly income, employment industry, personal or family history of cancer, previous bariatric surgery, and prior obesity-related health education were collected.

Section II: Perceptions and Knowledge of Obesity as a Risk Factor for Cancer After completion of the module, participants were identified as perceiving obesity as a disease, differentiating between obesity and morbid obesity, perceiving obesity-related chronic diseases (diabetes, cardiovascular disease, stroke, arthritis, autoimmune diseases), and having knowledge of obesity-associated cancers (breast, colorectal, endometrial, kidney, pancreatic, liver). Items also assessed knowledge of weight loss via diet and physical activity as a means for cancer prevention.

Section III: Awareness, Knowledge, Attitude and Practice Concerning Bariatric Surgery investigated knowledge of surgical options for weight loss, knowledge of how the procedure works, perception of safety and indications, risk of complications, knowledge of potential for reduction of cancer risk, and willingness to suggest surgery to others and to have surgery if recommended medically.

Section IV: Priorities for Addressing Obesity Ranking approaches to tackling obesity, from city planning to encouraging physical activity among the public and in schools, to initiatives aimed at managing weight.

Answers were scored as: "Yes" (correct response) = 1, "No" (incorrect response) = 0, "Do not know" = 0. For ease of analysis, variable with binary responses were constructed for all the awareness and knowledge variables.

2.6. Data Cleaning and Analysis

Statistical analyses were conducted in Python (version 3.x) using the pandas and stats models libraries. Descriptive statistics (frequency distributions, percentages, means and standard deviations) were used to describe the sample of the study and levels of awareness. X2 test of independence was used to examine the relationships between categorical variables (sociodemographic characteristics and awareness/knowledge items) at $\alpha=0.05$ level of significance.

To avoid the problem of inferring causality from correlations, we only progressed to multivariate logistic regression (multiple predictors) for those variables that had significant bivariate associations ($p<0.05$). In addition, age (continuous), healthcare sector employment (yes/no), and postgrad education (yes/no) were predictors in the logistic regression model predicting colorectal cancer awareness, and model diagnostics were checked (convergence, pseudo-R^2 reporting). The odds ratio (OR) and the 95% confidence interval (CI) were presented for the results.

$P<0.05$ was considered significant for all analyses.

2.7. Ethical Considerations

Approval for our study was granted by the ethics committee of the Ministry of Health in Saudi Arabia at the Aseer region. Participation in the study was voluntary, and informed consent was obtained from all participants before they completed the survey. Participants received a written information sheet that explained the purpose of the study, procedures,

potential benefits and the right to withdraw without any penalty. The data of all participants were kept strictly confidential and anonymous, and no identifiable information of the participants was obtained or retained. The study followed the principles of the Declaration of Helsinki in research involving human subjects.

3. RESULTS

3.1. Study Sample Characteristics

A total of 409 eligible respondents participated in the survey. The sample's descriptive features are in Table 1. The average age was 39.8 years (SD 11.2, min. 18, max. 75 years). The participants were mainly female (76.0%), consistent with greater participation of women in online health surveys. The sample with respect to education was varied with 69.9% having a university education, 18.1% having a secondary education, and 10.3% having a postgraduate education.

The distribution across sectors for employment indicated that 11.0% were working in the health sector, and 89.0% in other sectors or not employed. The distribution of body mass index was poorly uniform: 35.5% obese, 31.3% overweight, 30.8% with normal weight and 2.4% underweight.

Table 1: Sociodemographic and Clinical Characteristics of Study Participants (n=409)

Characteristic	n	(%)	Mean (SD) / Range
Age (years)			39.8 (11.2) / 18–75
Gender			
Female	311	76.0	
Male	98	24.0	
Education Level			
Primary	5	1.2	
Intermediate	1	0.2	
Secondary	74	18.1	
University	286	69.9	
Postgraduate	42	10.3	
Literacy/Basic	1	0.2	
Employment Sector			
Healthcare	45	11.0	
Non-Healthcare/Other	364	89.0	
BMI Category			
Underweight (<18.5)	10	2.4	
Normal (18.5–24.9)	126	30.8	
Overweight (25–29.9)	128	31.3	
Obese (≥30)	145	35.5	

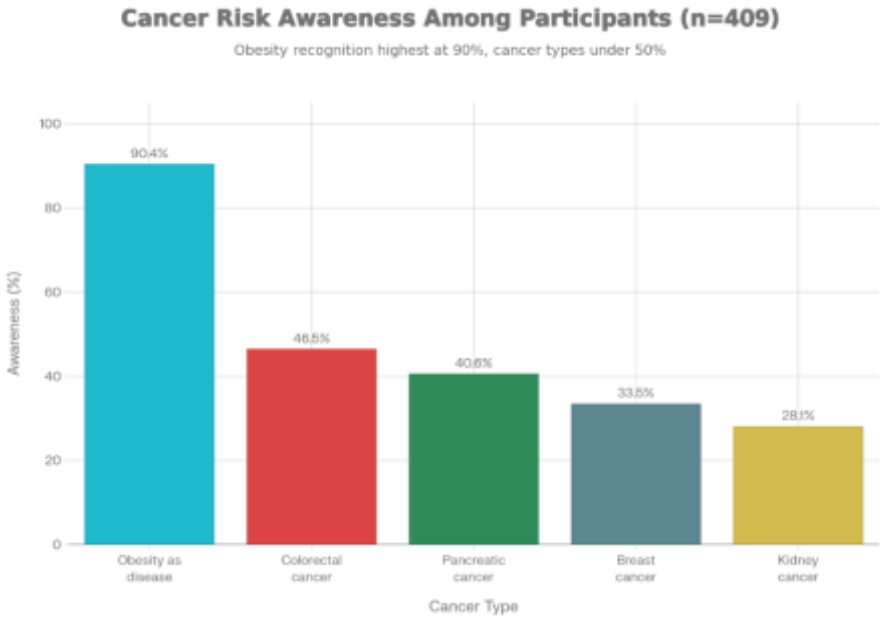

Figure: 1

3.2. Awareness of Obesity as a Disease and Cancer Risk Factor

The knowledge of obesity as a disease was 90.4% (370/409) excellent. However, the awareness of

specific obesity-related cancers was highly variable. Obesity was linked to colorectal cancer by 46.5% of respondents, pancreatic cancer by 40.6%, breast cancer by 33.5%, and kidney cancer by 28.1%. This is a pattern that reveals a significant lack of awareness between general obesity and specific knowledge of cancer linkages, with awareness declining as cancers are less publicly promoted through health campaigns.

3.3. Bariatric Surgery Knowledge and Attitudes

Knowledge of bariatric surgery and weight loss as cancer prevention was described. Most participants (81.9%) were aware that obesity has related comorbidities and that bariatric surgery is beneficial in this regard. That is comparable to the 77.0% who answered that weight loss with diet and exercise prevents cancer. But the indications for the procedure were less well understood (67.7%) and the perceived safety of surgery was alarmingly low (44.6%).This is consistent with findings that although participants understood the general advantages of weight loss and surgery, their understanding of which patients should receive the surgery and how safe it was, was less sophisticated.

3.4. Bivariate Associations Between Sociodemographic Factors and Awareness

1. Two statistically significant relationships were identified by the chi-square analyses (Table 2):
2. Employment in the healthcare sector and awareness of colorectal cancer: Healthcare personnel had greater knowledge of colorectal cancer as obesity-related (p=0.0065). Among healthcare workers 66.7% (30/45) knew about the link versus 44.0% (160/364) in the non-healthcare sectors (χ^2=7.42, p=0.0065).
3. Employment in the healthcare sector and awareness of breast cancer: Being employed in the health care sector was also positively correlated with breast cancer awareness (p=0.0129). Healthcare workers had 51.1% (23/45) awareness as compared to 31.3% (114/364) from other occupations (χ^2=6.18, p=0.0129).
4. Level of education and knowledge among overweight individuals that weight loss potentially prevents cancer: The level of educational attainment was not significantly correlated with knowledge of figure 1 that losing weight prevents cancer (χ^2=8.23, p=0.1442).

Table 2: Chi-Square Test Results for Significant Associations

Association	n	χ^2	p-value	Finding
Job Sector vs. Colorectal Cancer Awareness	409	7.42	0.0065*	Healthcare: 66.7% vs. Non-Healthcare: 44.0%
Healthcare	45			Aware: 30/45 (66.7%)
Non-Healthcare	364			Aware: 160/364 (44.0%)
Job Sector vs. Breast Cancer Awareness	409	6.18	0.0129*	Healthcare: 51.1% vs. Non-Healthcare: 31.3%
Healthcare	45			Aware: 23/45 (51.1%)
Non-Healthcare	364			Aware: 114/364 (31.3%)
Education vs. Weight Loss Cancer Prevention	409	8.23	0.1442	Not significant

*Significant at p<0.05

3.5. Logistic Regression Analysis: Predictors of Colorectal Cancer Awareness

Logistic regression was performed to identify independent predictors of colorectal cancer awareness (Table 3). The model demonstrated statistical significance overall (LLR χ^2=8.78, p=0.0325), with a pseudo-R^2 of 0.0155, indicating that the included variables explained approximately 1.55% of variance in awareness.

Table 3: Logistic Regression Model for Colorectal Cancer Awareness

Variable	Coefficient	SE	z-statistic	p-value	Odds Ratio	95% CI
Intercept	−0.0026	0.394	−0.007	0.995	0.997	0.461–2.159
Age (per year)	−0.0059	0.009	−0.634	0.526	0.994	0.976–1.012
Healthcare Worker	0.8750	0.374	2.340	0.019*	2.398	1.153–4.993
Postgraduate Education	0.0077	0.364	0.021	0.983	1.008	0.494–2.057

Model Statistics: n=409, Iterations=4, LLR χ^2=8.78, p-value=0.0325, Pseudo R^2=0.0155
*Significant at p<0.05

Employment in the healthcare industry was the only statistically significant independent predictor; healthcare workers had 2.40 times the odds of being aware of colorectal cancer as non-healthcare workers (95% CI: 1.15–4.99, p=0.019). Age and postgraduate education level were not independently correlated with awareness of colorectal cancer after adjusting for other covariates. The low pseudo-R^2 of the model indicates that awareness of the specific cancers is likely influenced by factors not captured by the analysis, including possibly having a personal experience with cancer, exposure to the media, or receiving formal health education.

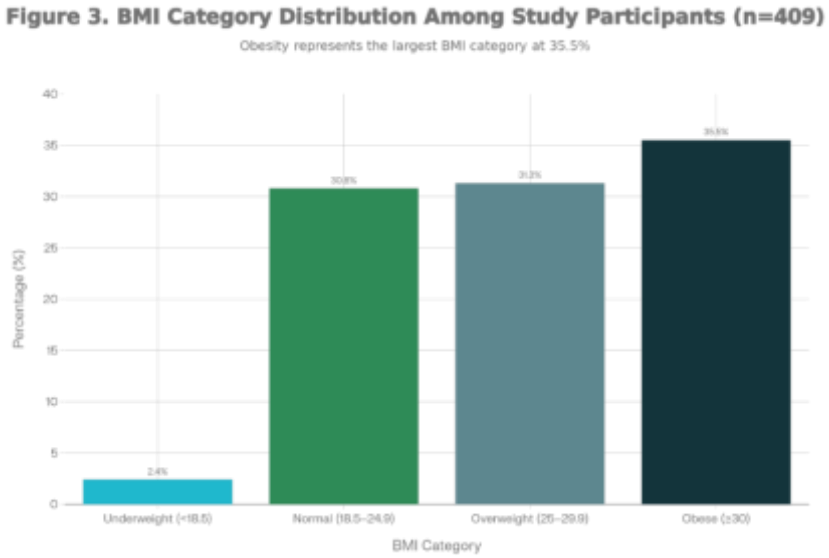

Figure 2:

4. DISCUSSION

4.1. Key Findings

Among 409 Saudi adults, this cross-sectional study demonstrated a notable paradox, general perception of obesity as a disease was almost universal (90.4%), however, awareness of specific cancers related to obesity was much lower and varied between types of cancer. This gap indicates that the public's perception of the health risks of obesity is still somewhat shallow, and the public may not have the specific disease-related knowledge to make fully informed decisions about prevention or screening.

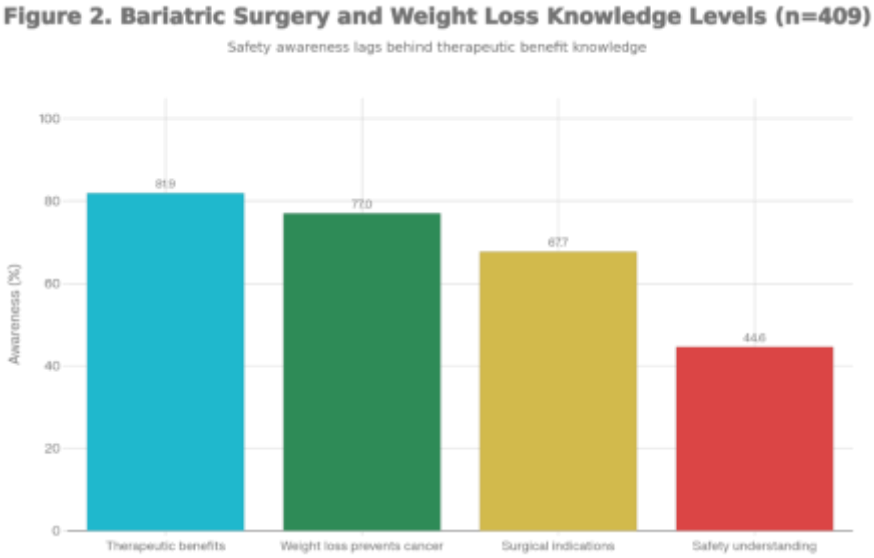

Figure 3:

4.2. High Awareness of Obesity as a Disease

The 90.4% who were aware that obesity is a disease is a significant finding. This is in contrast to historical views that considered obesity a matter of lifestyle rather than a disease, and might be indicative of increased public health messaging and medical professional advocacy in recent years. This high baseline allows for more focused, tailored cancer risk education.

4.3. Low Cancer-Specific Awareness

The much lower awareness of specific obesity-associated cancers is worrisome from a public health standpoint. Awareness of colorectal cancer, 46.5%, was highest among those mentioned cancers possibly indicating greater public awareness due to the higher visibility of colonoscopy screenings programs some Middle Eastern countries. Awareness of breast cancer (34.0%), despite its prominence in health marketing campaigns, was lower than anticipated and might be

explained by the possibility that the general public does not universally view breast cancer as having a specific link to obesity (with other risk factors were more prominent, e.g., genetic predisposition, hormone replacement therapy). Poor knowledge of kidney (28.1%) and pancreatic (40.6%) cancer is unsurprising, given the paucity of public debate surrounding these less common but also obesity-associated cancers.

The pattern of awareness emerging across types of cancer suggests that an understanding of obesity-related cancer risk in the general public is shaped primarily by broad-based health messaging rather than by a clear understanding of specific pathophysiologic mechanisms. This represents a critical knowledge gap that is potentially addressable through focused educational efforts.

4.4. Bariatric Surgery Knowledge Profile

The far higher proportion of respondents that knew about the therapeutic effects of bariatric surgery (81.9%) compared with the risk was rather low (44.6%). This lack of knowledge is potentially dangerous in clinical practice if this ignorance of risk results in unrealistic expectations, inadequate consent or poor compliance with postoperative surveillance programs designed to detect early and late complications.

The 77.0% awareness of weight loss in cancer prevention is a positive finding and indicates that the concept of weight loss for cancer prevention is familiar to the participants. However, the comparatively modest level of knowledge with regard to indications for surgery (67.7%) indicates that patients may not be aware of proper eligibility criteria, which may translate into demands for surgery from individuals with contraindications or with mild obesity.

4.5. Healthcare Sector as a Predictor

The positive employment in the healthcare respondent and colorectal cancer awareness (OR=2.40, 95% CI: 1.15 4.99) was the strongest result of this analysis and its interpretation has relevance. The increased odds of awareness seen in healthcare workers (OR=2.40) likely reflects easier occupational access to medical education, greater clinical exposure to obesity-related illnesses, and continued reinforcement of evidence-based knowledge of risk factors in professional practice. This indicates that physicians would be an instrumental group in a public education campaign, although such a campaign would need to be specifically designed and operationalized.

The higher awareness of the association of colorectal and breast cancer with obesity among healthcare workers (66.7% vs. 44.0% and 51.1% vs. 31.3%, respectively) reflects a similar advantage across cancer types, which concurs with the learning by doing assumption.

4.6. Age and Education

Neither bivariate nor logistic analyses showed a significant effect of age on colorectal cancer awareness. This was an unexpected finding, since older people with more lifetime exposure to health and personal were assumed to be more aware. The age non-association could be indicative of generational shifts in health literacy, as younger people who are generally more digitally connected and reliant on use of the internet for information may be the receiving end of more health-related information through digital media.

Bivariate association was observed between the level of education and weight loss cancer prevention knowledge; however, among the educational tiers, Postgraduate education was not found as a significant predictor in the logistic regression model (p=0.983). This may indicate that the bivariate relationship is obscured by unmeasured confounders such as occupation, exposure to media, or health consciousness. The fact that a two way association was not observed for high education may suggest that high education itself does not greatly enhance cancer risk awareness without further more focused activities.

5. STUDY LIMITATIONS

5.1. There are a few key limitations to this study

This study was a cross-sectional online survey which employed the method of convenience sampling and relied on self-reports. The sample of internet users from a single region in Saudi Arabia was not representative and the cross-sectional nature of the study limits the ability to draw causal conclusions and may lead to underestimation or overestimation of the true levels of awareness.

5.2. Comparison with Previous Literature

The results of this study are consistent with previous literature demonstrating large gaps in knowledge about obesity as a risk factor for cancer in different racial/ethnic populations. A 2023 study by Alaniz et al. in Saudi Arabia also revealed that 94% of responders agreed that obesity was a disease, although awareness regarding specific cancer risks was much lower. Our results extend this work by offering a population-based assessment of levels of cancer-specific awareness and by revealing occupational predictors. The HCW advantage found

in this study is in line with previous studies reporting that HCWs have far better knowledge on obesity-cancer link than laypeople, highlighting the importance of occupational exposure to medical education in influencing health literacy.

5.3. Public Health Implications

1. The knowledge gaps identified now represent a potential opportunity to intervene in public health: 1. Now that serious diseases are known to be linked with obesity, public health campaigns need to move beyond general awareness of the obesity epidemic and focus on specific cancer risks. Visual tools, infographics and short educational sessions could be developed to communicate the risk premium for common cancers (e. g, "Obesity increases risk of colorectal cancer 1.3-fold").
2. Health Professional Engagement: Because of healthcare workers greater knowledge and occupational credibility, they may be effective messengers to disseminate and promote the obesity-cancer message through 3H (physicians, nurses, and allied health professionals).
3. Communication of Bariatric Surgery Risk: The public education about bariatric surgery prior to demand stimulation should equally address risk of safety and complications as well as therapeutic benefit for realistic expectation and informed decision- making. Integration with Screening Programmed: Cancer screening programs, in particular for colorectal cancer, provide a platform on which to build opportunistic education that obesity is a modifiable risk factor.

6. CONCLUSIONS

This is the first report of the results of a national survey on the awareness and knowledge of obesity as a risk factor for several types of cancer among adults in Saudi Arabia. Employment in the healthcare sector was identified as a significant independent predictive factor for colorectal cancer awareness showing more than twice the chance for HCWs than for non-HCWs. Age and education were not significant independent predictors in multivariable analysis.

The results highlight the need for focused, cancer-specific public health education that goes beyond general obesity awareness and includes quantified risk and specific prevention information. Health professionals, who have the occupational knowledge advantage and are trusted by the public, are a key resource for raising awareness that obesity is not just a vague disease but rather a modifiable risk factor for distinct, preventable cancers.

Studies should also use representative sampling techniques, validate instruments, evaluate longitudinal changes in awareness as a result of educational interventions, and investigate other as yet unexplored predictors of awareness of cancer risk. Implementation research to assess the impact of focused educational campaigns on increasing awareness of and changing behaviors related to these risk factors would add to the evidence base for developing public health policies.

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Conflicts of Interest: The authors declare no conflicts of interest.

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