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Investigating the Link between Alpha-Fetoprotein, Vitamin D, and Obesity: A Multifactorial Analysis

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ABSTRACT
Background: Obesity is a complicated and varied health concern that persists in presenting considerable issues worldwide.Alpha-fetoprotein (AFP) is a glycoprotein mostly synthesised by the foetal liver and yolk sac during gestation.The relationship between AFP and vitamin D concerning obesity is a subject of continuing investigation. Both indicators are associated with adipose tissue function and metabolism.
Aim: The aim of this study is to investigate the multifactorial relationship between alpha-fetoprotein (AFP) levels, vitamin D status, and obesity in order to understand how these factors interrelate and influence each other.
Methods: The study comprised fifty-nine overweight people, defined by a body mass index over 25. Another 35 individuals were selected for the control group. Measurement of serum concentrations of Serum Alpha Fetoprotein using competitive radioimmunoassay utilising the VIDAS system, and serum vitamin D through solid phase competitive sandwich enzyme-linked immunosorbent assay (ELISA).
Results: The serum level of AFP was significantly higher in overweight group compered to healthy group.There is positive statistically significant correlation between age and serum level of AFP in overweight patients. There is a negative statistically significant correlation between BMI and Serum level of Vit D_3 in overweight patients**.**
Conclusions: The study explores the link between AFP, vitamin D, and obesity, revealing the pathogenesis of obesity and potential treatment targets. The study emphasizes the importance of monitoring liver health and cancer risk in overweight individuals, and the need for regulating body weight and obtaining sufficient vitamin D for overall health.

Keywords: Alpha-Fetoprotein (AFP), Vitamin D, Obesity, overweight.

INTRODUCTION

Obesity is a complicated and varied health concern that persists in presenting considerable issues worldwide. Recent data from the U.S. Centres for Disease Control and Prevention (CDC) reveals that although the overall obesity rate in the United States has stabilised at approximately 40%, the incidence of severe obesity has escalated, especially among women (1). This trend is alarming, as severe obesity is strongly associated with increased risks of cardiovascular illnesses, diabetes, and diminished quality of life.
According to the World Health Organisation (WHO), in 2022, nearly 2.5 billion persons worldwide were overweight, with 890 million categorised as obese. The extensive prevalence highlights the pressing necessity for effective interventions and strategies to tackle the obesity epidemic (3).
Comprehending the determinants of obesity, including socioeconomic position, education, and healthcare accessibility, is essential for formulating focused policies to mitigate its effects on public health (4). As research progresses, it is essential to be updated on the most recent discoveries and developments in obesity prevention and treatment.

Alpha-Fetoprotein (AFP) and Obesity

Alpha-fetoprotein (AFP) is a glycoprotein mostly synthesised by the foetal liver and yolk sac during gestation. In adults, increased AFP levels are frequently linked to hepatic disorders and certain malignancies. Emerging research indicates a possible connection between AFP and obesity. Research suggests that AFP may contribute

to adipogenesis, the development of adipocytes, and could be implicated in the regulation of body fat distribution.

Vitamin D and Obesity

Vitamin D, a lipophilic vitamin, is essential for skeletal health, immunological response, and the modulation of inflammation. A multitude of studies has demonstrated a negative correlation between vitamin D levels and obesity. Obese persons frequently demonstrate reduced levels of vitamin D, potentially because to volumetric dilution, sequestration in adipose tissue, and diminished production in the skin (7).

Recent data indicate that although obesity correlates with reduced vitamin D levels, weight reduction exerts negligible influence on enhancing vitamin D status. Moreover, vitamin D supplementation does not substantially influence body weight (8).

Combined Impact on Obesity

The relationship between AFP and vitamin D concerning obesity is a subject of continuing investigation. Both indicators are associated with adipose tissue function and metabolism. Although AFP's participation in obesity is not well comprehended, the involvement of vitamin D is more clearly defined, especially regarding its regulatory effects on adipose tissue and inflammation (9).

MATERIALS AND METHODS

The research is a case-control study conducted at Al-Sadiq Teaching Hospital in Babylon, Iraq. The study comprised fifty-nine overweight people, defined by a body mass index over 25, comprised of 28 males and 31females with an average age of 32 ± 9 years. Another 35 individuals were selected for the control group with a BMI less than 25, comprised of 13 males 22 femaleswith an age range of 29.5 ± 5.9 years.

Venous blood samples from all subjects were analysed for serum alpha-fetoprotein and vitamin D concentrations. The exclusion criteria encompass individuals with diseases and/or pathologies that affect serum alpha-fetoprotein and vitamin D levels (e.g., pregnant women, menopausal women, patients with polycystic ovary syndrome), except obesity. Weight and height were measured on the day of blood collection to compute BMI in kilogrammes per square metre.

The Institutional Review Board authorised the protocol. Following the elucidation of the study's objectives and the acquisition of written informed consent from all participants, baseline demographic and clinical data were gathered through interviews and documented using the study questionnaire.

Measurement of serum concentrations of Serum Alpha Fetoprotein using competitive radioimmunoassay (VIDAS system), and serum vitamin D through solid phase competitive sandwich enzyme-linked immunosorbent assay (Thermo Fisher Scientific).

The difference in Serum Alpha Fetoprotein and vitamin D levels between the overweight group and the control group was evaluated using the Student's t-test via the Statistical Package for the Social Sciences (SPSS), version 22. Pearson's correlation coefficient was employed to evaluate the potential link between various biochemical indicators and both age and BMI of the patients.

RESULTS

The analysis of study subjects' demographic features showed that there were no significant differences between overweight group and healthy group regarding gender distribution and age as shown in table 1.

Table 1: Demographic features of the study groups

Demographic feature	Study Group		P value
	Overweight	Healthy	
Age (years)	32 ± 9	29.5 ± 5.9	0.14
BMI (kg/m^2)	33 ± 4.3	24.1 ± 2.3	0.00
Gender Male : female	28:31	13:22	0.11

Serum Alpha Fetoprotien (AFP)

The table 2 and figure 1 depicted serum levels of AFP in overweight group and healthy group. The serum level of AFP was significantly higher ($P < 0.05$) in overweight group compered to healthy group.

Table 2: the mean ±SD in serum concentration of Alpha Fetoprotien (ng/ml) in overweight group and healthy group.

Group	N	Serum AFP (ng/ml) ± SD	P value
Overweight group	59	1.62 ± 0.8 *	0.044
Healthy group	35	1.3 ± 0.64	

* P value according to t test is < 0.05
SD: standard deviation.

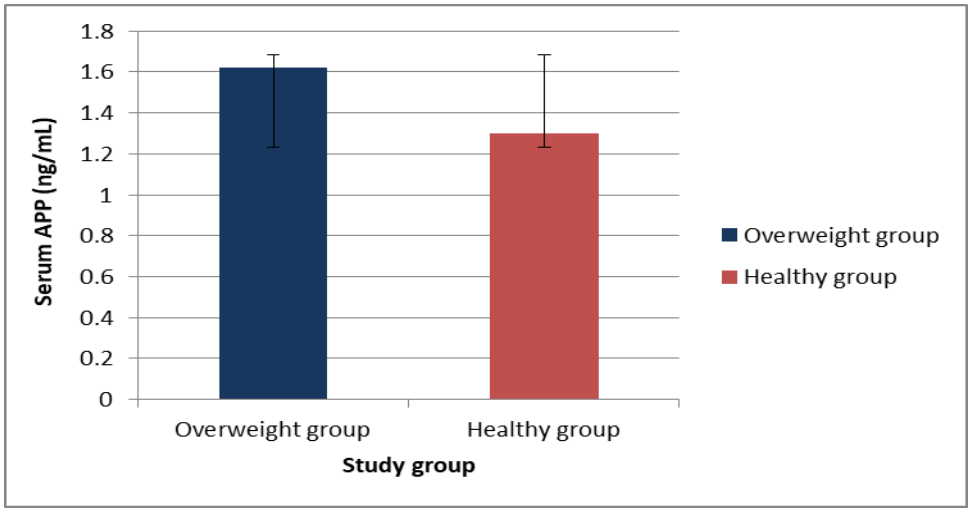

Figure 1: the mean ±SD in serum concentration of Alpha Fetoprotien (ng/ml) in overweight group and healthy group.

Serum Vitamin D_3

There is no significant difference in the level of serum Vitamin D_3 between overweight group and healthy group as shown in table (3) and figure 2.

Table 3: the mean ±SD in serum concentration of Vitamin D_3 (ng/ml) in overweight group and healthy group.

Group	N	Serum Vitamin D3 (ng/ml) ± SD	P value
Overweight group	22	14.05 ± 7.66	0.875
Healthy group	27	14.32 ± 8.55	

* P value according to t test is < 0.05
SD: standard deviation.

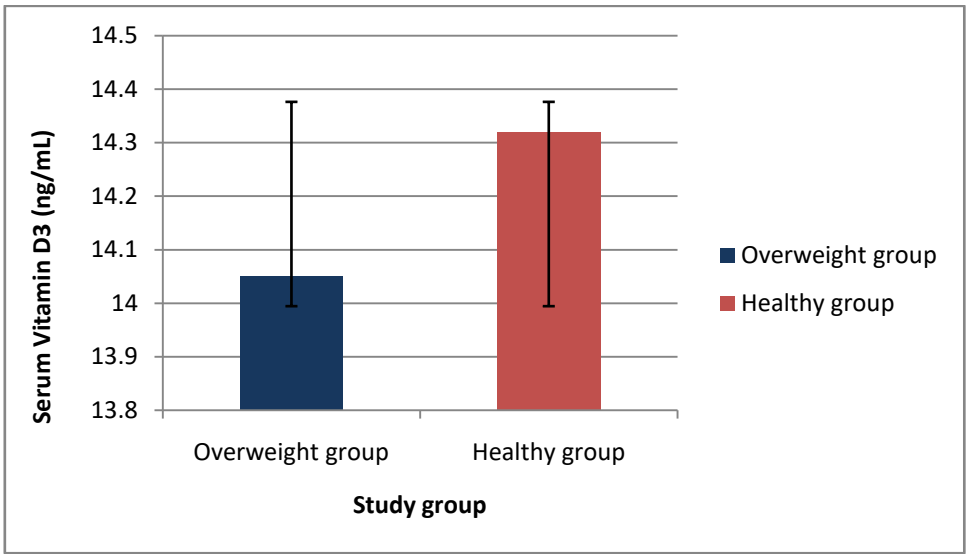

Figure 2: the mean ±SD in serum concentration of Vitamin D_3 (ng/ml) in overweight group and healthy group.

Correlational study

In order to evaluate the possible correlations among biochemical study parameters and both age and BMI, Pearson's correlation was used, as shown in table 4 and figures 3, 4, 5 and 6.There is positive statistically significant correlation between age and serum level of AFP in overweight patients (R= 0.315, P < 0.05). This correlation was not established between age and serum Vit D_3.There is a negative statistically significant correlation between BMI and Serum level of Vit D_3 in overweight patients (R= - 0.252, P < 0.05).

Table 4: Pearson's correlation coefficient between different biochemical parameters in overweight patients

Parameter	Serum AFP (ng/ml)	Serum vitamin D3 (ng/ml)
Age	0.315*	0.214
BMI	-0.086	-0.252*

* Statistical significance regarding Pearson correlation.

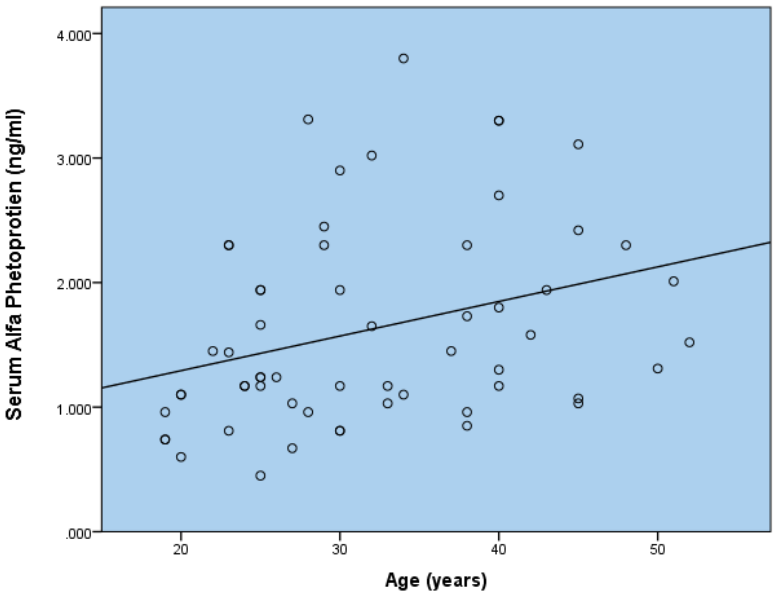

Figure 3: Correlation between serum alpha fetoprotein and age in overweight group

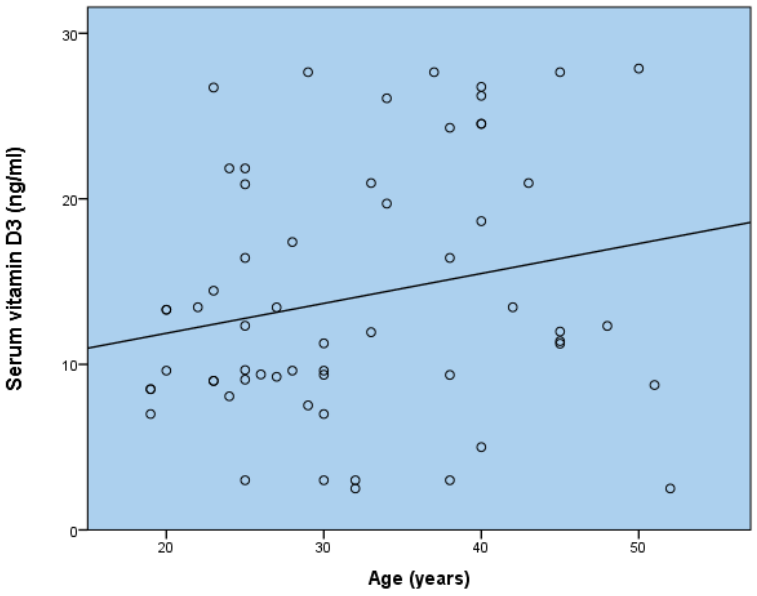

Figure 4: Correlation between serum vitamin D_3 and age in overweight group.

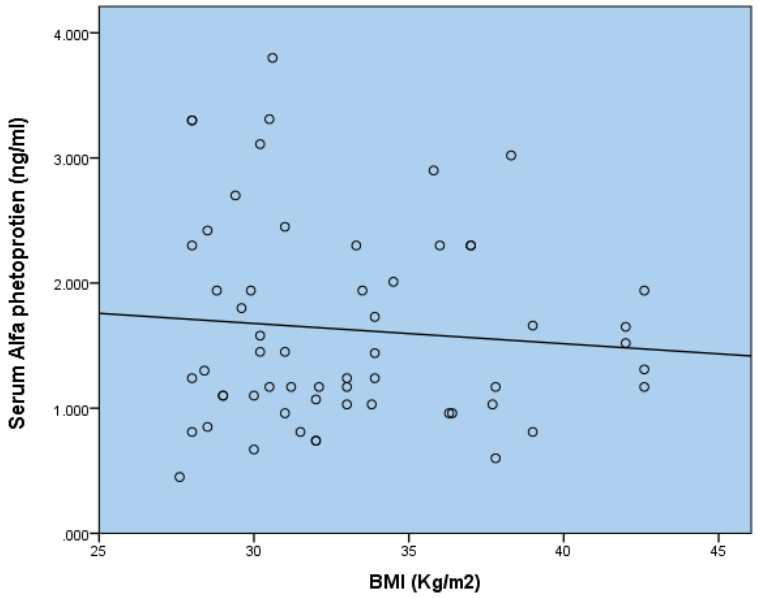

Figure 5: Correlation between serum alpha fetoprotein and body mass index in overweight group

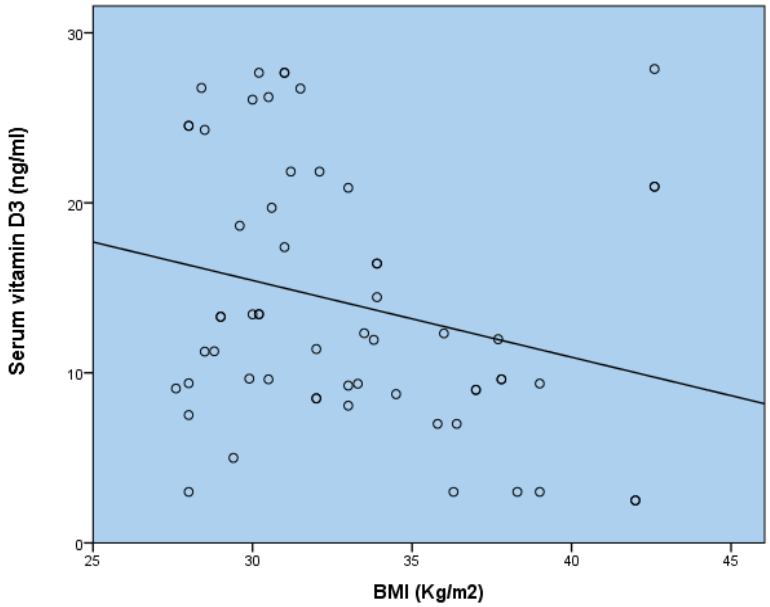

Figure 6: Correlation between serum vitamin D_3 and body mass index in overweight group.

DISCUSSION

In persons with obesity or overweight, increased alpha-fetoprotein (AFP) levels may correlate with several issues, including hepatic disorders, as obesity is a significant risk factor for nonalcoholic fatty liver disease, including ailments like nonalcoholic steatohepatitis. These hepatic conditions may prompt liver cells to release elevated concentrations of AFP into the bloodstream (10).

Elevated AFP levels may be associated with a protective phenotype against hepatic steatosis, myosteatosis, and sarcopenia. Increased AFP levels may indicate the body's response to address these conditions (11).

The concept of a "protective phenotype" concerning raised alpha-fetoprotein (AFP) levels suggests that heightened AFP levels may play a role in mitigating certain adverse effects linked to obesity and metabolic health.

These findings suggest that AFP may contribute to the body's adaptive response to alleviate the detrimental effects of obesity and related metabolic disorders (13).

The mechanisms linking low vitamin D levels to obesity include impaired adipose tissue differentiation and development, as well as the regulation of hormones such as leptin and parathyroid hormone.
The identification of a statistically significant positive correlation between age and serum alpha-fetoprotein (AFP) levels in overweight individuals suggests that serum AFP levels increase with advancing age in this population. The aging process in individuals with obesity may correlate with hepatic diseases, such as fatty liver disease, potentially leading to elevated AFP levels (15).

CONCLUSION

Examining the relationship among AFP, vitamin D, and obesity may yield insights into the pathogenesis of obesity and identify novel treatment targets. Although the association between vitamin D and obesity is well-established, the involvement of AFP necessitates additional research. Ongoing research is crucial to elucidate the intricate relationships between these biomarkers and their influence on obesity.
The results of the present investigation underscore significant health implications for those with excess weight. The strong link between age and AFP levels highlights the necessity of monitoring liver health and cancer risk in ageing overweight persons. The inverse relationship between BMI and vitamin D3 levels indicates that regulating body weight and securing sufficient vitamin D intake are essential for preserving overall health. Comprehending these relationships can facilitate the development of focused therapies and preventive strategies in the healthcare of overweight patients.

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