E-ISSN 2709-569X
Vol 09 No 1 Jan 2024

Dietary Diversity and Nutritional status of teachers in Ogun state, Nigeria

Ilo Jumoke Georgina, Okolosi Joel Eviano, Solana Olorunfunmi Isimioluwa, Chukwuka Olutayo Chibuzor, Uthman-Akinhanmi Yewande Olajumoke, Fakile Oluwapamilerin D.

Department of Home Science and Hospitality Management, Olabisi Onabanjo University, Ayetoro campus, Ogun State, Nigeria

Abstract

Background: Diversity in the diet is essential for preserving people's general health and well-being. The nutritional status and dietary diversity of teachers in Yewa North Local Government, Ogun State, Nigeria, are evaluated in this study.

Materials and Methods: Data from a sample of 390 teachers, ages 25 to 60, was gathered using a cross-sectional study approach. Questionnaires given by interviewers were used to collect data on demographics, socioeconomic status, and dietary diversity based on food groups. Additionally, anthropometric data such as height, weight, and visceral fat were obtained.

Results: The findings demonstrated that a sizable fraction of the participants had low dietary diversity, which suggests that they consumed a restricted range of foods. Gender and nutritional diversity also showed a strong correlation, with females having higher levels of food diversity than males. A considerable portion of the participants were classified as underweight, overweight, or obese. It was shown that there was a substantial correlation between gender and BMI, with more men being underweight and overweight and more women being obese.

Conclusion: Since inadequate dietary diversity and abnormal nutritional status might raise the risk of chronic diseases like obesity and diabetes, these findings have significant implications for the health and well-being of teachers.

Keywords: Anthropometric, dietary assessment, Instructors, school, diet-related disease

Corresponding Author. *ILO Jumoke Ph.D.*
Department of Home Science and Hospitality Management. Nutrition and Dietetics option, Olabisi Onabanjo University, Ayetoro Campus, Ogun State, Nigeria.
**Email: jumoke.ilo@oouagoiwoye.edu.ng*

Introduction

Dietary diversity, defined as consuming a variety of foods from various food groups, is acknowledged as a crucial element of a well-balanced diet [1]. It guarantees the availability of vital vitamins, minerals, and nutrients—all of which are necessary for preserving general health and averting non-communicable illnesses [2,3]. According to Neuhouser [4], eating a varied diet lowers the chance of developing chronic conditions like diabetes, obesity, and cardiovascular diseases. Maintaining an individual's general health and well-being depends heavily on diversity. In addition to providing vital nutrients, a diet rich in a variety of nutrient-rich foods also provides protection against a range of illnesses and ailments [5].

The foundation of the educational system, teachers are essential in determining the direction that our society will follow. They commit to their pupils' intellectual and emotional growth, frequently going above and beyond to create a supportive and stimulating learning environment [6]. However, teachers frequently disregard their own health and well-being, especially their nutritional needs, in the midst of their altruistic dedication to their students. Maintaining optimal health, energy levels, and cognitive function are all dependent on proper nutrition, and these factors are critical for successful teaching [7,8].

Teachers are important members of society who convey knowledge and help to shape the destiny of the next generation. They frequently deal with stressful work schedules and high levels of stress, which can result in bad lifestyle choices and a higher chance of chronic illness [9]. Determining the correlation between dietary variety and nutritional status in educators is essential for creating focused interventions and encouraging better habits in this group. Examining the variety of diets that teachers follow will provide insight into their general nutritional health within this particular demographic. Because teachers play a crucial role in society and frequently experience high levels of stress, it is necessary to identify specific dietary factors that contribute to healthy nutritional status among teachers. This information will then be used to inform the development of targeted interventions and educational programs focused on improving dietary habits. Examining the nutritional status and dietary diversity of teachers in Yewa North Local Government, Ogun State, is essential.

Materials and Methods

Data on the nutritional health and dietary diversity of teachers in Yewa North Local Government, Ogun State, Nigeria, were gathered using a cross-sectional study design. The study included teachers who were between the ages of 25 and 60 and had at least one year of experience in the classroom. Using a random sampling technique, the number of teachers in the Yewa North Local Government Area—390 in both government-owned and private schools—was ascertained. The study included all willing and healthy school teachers who were free of systemic diseases such as sickle cell anemia. The study did not include any instructors who were unwilling to take part.

Data collection

The Demographics and socioeconomic status information was collected at baseline using an interviewer-administered questionnaire. This included participant age, estimated income and education level achieved. Household information included the number of family members and

the number of rooms in the house, structure material water source, and family structure. The Minimum Dietary Diversification by Food and Agriculture Organization of the United Nation [FAO], was used to evaluate respondents' dietary diversity. According to the ten (10) food groups listed in the MDD, respondents were asked if they had eaten at least five (5) of the ten (10) specified food groups the day before or the night before [10]. The MDD-W and food group diversity score were calculated based on the ten food groups: grains, pulses, nuts and seeds, dairy, meat-poultry and fish, eggs, dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables, other fruits. Food group consumption was recorded by entering "1" if the food group was consumed and "0" if it was not. A minimum quantity of 15 g was required for a food group to be recorded. A food group diversity score was calculated out of ten.

Anthropometric measurements, including weight, height, was collected following standardized procedures. Body Mass Index (BMI) was calculated as weight (kg) divided by height (m^2). BMI categories, such as underweight, normal weight, overweight, and obesity, was determined using established cutoff values.

Data Analysis

Descriptive statistics, such as means, standard deviations, frequencies, and percentages, was used to summarize the data on dietary diversity, blood pressure, and other variables. Pearson's correlation coefficient was used to determine the association between dietary diversity and blood pressure. These were calculated using the Statistical Product and Service Solutions (SPSS) version 20.0 software.

Ethical consideration

Ethical approval was obtained from the Ogun State Hospital, Ijaye Abeokuta, Reference Number: SHA/RES/VOL.22/019. Informed consent was obtained from all participants before data collection. Confidentiality and anonymity was ensured throughout the study.

Results

The respondents' average age is 40.6 ± 9.4 years. Of the respondents, between the ages of 40 and 49, made up around half (39.5%). Only a small percentage of the respondents—16.7% and 17.7%, respectively—were under 29 and beyond 50 years old. A quarter (25.6%) of the respondents came from polygamous families, while the majority (74.4%) came from monogamous families. The majority of respondents (58.5%) had a family size of 4-5, while 10.5% and 25.9%, respectively, had a family size of ≤3 and 6-7 members. A small percentage of respondents (14.4%) held a secondary school leaving certificate, while the majority (85.6%) had postsecondary education. A small percentage of respondents (6.4%) only received over 121,000 naira (201 US dollars), while less than half (39.7%) of respondents assessed their monthly income to be between 61,000 and 90,000 naira (101-150 US dollars). Only a small percentage of respondents (13.6%) utilized generators as an alternate source of energy for lightning, compared to the majority (78.7%) who used electricity. Just 1.8% of respondents lived in structures made of mud brick, whereas the majority (62.3%) of respondents live in apartments built of contemporary brick (block). The majority of respondents (80.0%) disposed of their waste in water closets, whereas 18.2% used pits or latrines. The majority of respondents (61.5%) got their

drinking water from a borehole at home, whereas 3.1% and 8.5% of them used sachet water and well water, respectively. In a similar vein, a large percentage of the respondents (65.1%) used a borehole as a source of drinking water at school, compared to 3.8% and 5.9% who used sachet water and well water, respectively. The majority of respondents (77.9%) used gas as their primary source of cooking fuel; the other respondents (8.7%, 9.0%, and 3.8%) used firewood, kerosene, and electricity, respectively.

The minimum dietary diversity of the respondents is presented in Table i. Majority (85.6%) of the respondents consumed grains, white roots / tuber and plantain. A quarter (25.6%) of the respondents ate pulses (beans, peas & lentils) while 47.7% consumed nuts and seeds. A few (3.3%) of the respondents consume dairy products. Above a quarter (33.3%) of the respondents consumed meat, fish & poultry while a few (15.4%) of the respondents consumed eggs. Less than half (39.0%) of the respondents consumed dark-green leafy vegetables while 16.4% consumed other vitamin A rich fruits and vegetables. However, about a half (48.2%) of the respondents consumed other vegetables while 4.4% consumed other fruits.

The Minimum Dietary Diversity score of the respondents by gender is presented in table ii. Majority (74.6%) of the respondents had low dietary diversity while a quarter (25.4%) had high dietary diversity. More males (81.1%) than females (70.1%) had low dietary diversity. However, more females (29.9%) than males (18.9%) had high dietary diversity. There is a statistically significant relationship between the dietary diversity of the male and female respondents $p<0.05$

The Nutritional Status expressed as Body Mass Index (BMI) is presented in Table iii. More than a quarter (30.5%) of the respondents had normal BMI while 24.4% were obese. However, 2.3%, 42.8%, 17.7%, 3.1% and 3.6% were underweight, overweight, obese class I, II and III respectively. More males (3.8%) than females (1.3%) respondents were underweight. However, more males (51.6%) than female (36.8%) respondents were overweight. Similarly, more females (21.6%, 4.8%, 5.6%) than males (11.9%, 0.6%, 0.6%) respondents were obese I, II, III respectively. Majority (69.5%) of the respondents had abnormal (underweight, overweight and obese) nutritional status. There is a statistically significant relationship between the nutritional status (BMI) of the male and female respondents $p<0.05$.

Table i: Minimum Dietary Diversity of the Respondents

Variable	Frequency	Percentage
Grains, white roots & tuber and plantain		
No	56	14.4
Yes	334	85.6
Total	390	100.0
Pulses (beans, peas & lentils)		
No	290	74.4
Yes	100	25.6
Total	390	100.0
Nuts & seeds		
No	204	52.3
Yes	186	47.7
Total	390	100.0
Dairy		
No	377	96.7
Yes	13	3.3
Total	390	100.0
Meat, fish & Poultry		
No	260	66.7
Yes	130	33.3
Total	390	100.0
Eggs		
No	330	84.6
Yes	60	15.4
Total	390	100.0
Dark green leafy vegetables		
No	238	61.0
Yes	152	39.0
Total	390	100.0
Other vitamin A rich fruits and vegetables		
No	326	83.6
Yes	64	16.4
Total	390	100.0
Other vegetables		
No	202	51.8
Yes	188	48.2
Total	390	100.0

Other fruits		
No	373	95.6
Yes	17	4.4
Total	390	100.0

Table ii: Association between Minimum Dietary Diversity Score and Gender of the Respondents

Variable	Gender			X^2	p-Value
Dietary Diversity	Male F (%)	Female F (%)	Total F (%)		
Low (<5.0)	129 (81.1)	162 (70.1)	291 (74.6)	6.019[a]	0.014
High (>5.0)	30 (18.9)	69 (29.9)	99 (25.4)		
Total	159 (100.0)	231 (100.)	390 (100.0)		

Table iii: Body Mass Index of the Respondents

Body Mass Index	Male N (%)	Female N (%)	Total	X^2	p-Value
Underweight (<18.5)	6 (3.8)	3 (1.3)	9 (2.3)	24.165[a]	0.000
Normal weight (18.5-24.9)	50 (31.4)	69 (29.9)	119 (30.5)		
Overweight (25.0-29.9)	82 (51.6)	85 (36.8)	167 (42.8)		
Obesity Class I (30.0-34.9)	19 (11.9)	50 (21.6)	69 (17.7)		
Obesity Class II (35.0-39.9)	1 (0.6)	11 (4.8)	12 (3.1)		
Obesity Class III (≥40.0)	1 (0.6)	13 (5.6)	14 (3.6)		
Total	159 (100.0)	231 (100.0)	390 (100.0)		
Body Mass Index					
Underweight (<18.50)	6 (3.8)	3 (1.3)	9 (2.3)	21.082[a]	0.000
Normal weight (18.50-24.99)	50 (31.4)	69 (29.9)	119 (30.5)		
Overweight (25.00-29.99)	82 (51.6)	85 (36.8)	167 (42.8)		
Obesity (≥30.00)	21 (13.2)	74 (32.0)	95 (24.4)		
Total	159 (100.0)	231 (100.0)	390 (100.0)		

Discussion

The nutritional status and dietary diversity of teachers in Yewa North Local Government, Ogun State, Nigeria, were evaluated in this study. The responders ranged in age from under 29 to over 50. According to the study, a sizable fraction of the participants had low dietary diversity, while the remainder had great dietary diversity. The results of this study are comparable to a study by Fadundin et al. [11] titled "Lifestyle and nutritional status of urban school teachers in Ibadan, Nigeria." This shows that a large number of educators in Ogun State, Nigeria's Yewa North Local Government only eat a small variety of foods. Gender and nutritional diversity have a substantial association, according to the statistical analysis. The study also discovered a statistically significant gender difference in dietary diversity, with more women than men having high levels of dietary diversity. There was low dietary diversity among more men than women, and high dietary diversity among more women than men. This goes against research by Omage et al. [12], which showed that more men than women had far greater dietary variety scores.

The nutritional status and diversity of diets among teachers are the focus of this study. More than 25% of the respondents, according to the data, had a normal BMI, while a sizeable portion were underweight, overweight, or obese. These results are supported by a study by Amope et al. [13], which found that a higher percentage of respondents had minimum dietary diversity score (DDS) and only 6% had high DDS. Additionally, the study found that 37% of respondents were overweight and 11% were obese, with 23% of respondents at high risk of abdominal obesity. Our study's data also indicates a substantial correlation between gender and BMI, with more women classified as obese and more men as underweight or overweight. The majority of study participants exhibited abnormal nutritional status. The results of this study have significant ramifications for teachers' health and wellbeing. Abnormal nutritional status and a low variety of diets can have detrimental effects on general health and raise the risk of chronic illnesses like diabetes and obesity [14, 15]. To preserve their health and wellbeing, teachers must be mindful of their eating habits and nutritional state.

Conclusion

The study's findings further emphasize the necessity of initiatives and treatments targeted at enhancing teachers' nutritional status and variety of diets. To assist educators in making better decisions, tactics including nutrition education, encouraging wholesome eating practices, and granting access to a variety of nutrient-dense food selections can be put into practice. Furthermore, the results imply that there might be variations in BMI, visceral fat, and nutritional diversity between genders among teachers. In view of the unique demands and difficulties faced by male and female teachers with regard to dietary diversity and nutritional status, this emphasizes the need for additional study to uncover the underlying causes of these disparities and to provide focused solutions. All things considered, this study offers insightful information

about the variety of diets and nutritional state of educators. The results emphasize how crucial it is to encourage teachers to eat healthily and to put measures in place to enhance their nutritional status and variety of diets. To investigate the gender disparities found in this study and create solutions specifically for male and female teachers, more research is required.

Funding Sources

There are no funding sources

Conflict of interest

There are no potential conflicts of interest to declare."

Reference

1. Ilo, J., Onabanjo, O., and Hamzat, A. Dietary diversity and micronutrient intake of adult women in Ogun State, Nigeria (Case study). Egyptian Journal of Nutrition. 2023; 38(3): 13-21. Doi: 10.21608/enj.2023.218738.1007
2. Dolui M, Sarkar S, Ghosh P, Hossain M. Dietary diversity and association with non-communicable diseases (NCDs) among adult men (15-54 years): A cross-sectional study using National Family and Health Survey, India. PLOS Glob Public Health; 26:3(4):1775. doi: 10.1371/journal.pgph.0001775.
3. Weerasekara PC, Withanachchi CR, Ginigaddara GAS, Ploeger A. Understanding Dietary Diversity, Dietary Practices and Changes in Food Patterns in Marginalised Societies in Sri Lanka. Foods. 2020; 9(11):1659. doi: 10.3390/foods9111659.
4. Neuhouser ML. The importance of healthy dietary patterns in chronic disease prevention. Nutr Res. 2019;70: 3-6. doi: 10.1016/j.nutres.2018.06.002.
5. Sangam LD, Edith TB, Salvatore C, Stefania G, Hari DU, Rodomiro O. Diversifying Food Systems in the Pursuit of Sustainable Food Production and Healthy Diets. Trends in Plant Science, 2017; 22 (10): 842-856, https://doi.org/10.1016/j.tplants.2017.06.011.
6. UNESCO. Reimagining our futures together: a new social contract for education International Commission on the Futures of Education. 2021; 118. DOI:https://doi.org/10.54675/ASRB4722,
7. Puri S, Shaheen M, Grover B. Nutrition and cognitive health: A life course approach. Front Public Health. 2023; 27:11. doi: 10.3389/fpubh.2023.1023907.
8. Roberts M, Tolar-Peterson T, Reynolds A, Wall C, Reeder N, Rico Mendez G. The Effects of Nutritional Interventions on the Cognitive Development of Preschool-Age Children: A Systematic Review. Nutrients. 2022; 14(3):532. doi: 10.3390/nu14030532.
9. Agyapong B, Obuobi-Donkor G, Burback L, Wei Y. Stress, Burnout, Anxiety and Depression among Teachers: A Scoping Review. Int J Environ Res Public Health. 2022; 19(17):10706. doi: 10.3390/ijerph191710706.
10. FAO. (2021). Minimum Dietary Diversity for Women. https://doi.org/10.4060/cb3434en
11. Fadupin, G, Ariyo, O. Lifestyle and nutritional status of urban school teachers in Ibadan, Nigeria. J of Nutri Sci., 201; 35:86-94.
12. Omage K, Omuemu VO. Assessment of dietary pattern and nutritional status of undergraduate students in a private university in southern Nigeria. Food Sci Nutr. 2018; 22:6(7):1890-1897. doi: 10.1002/fsn3.759.

13. Amope OS, Olajide BR, Sosanya SK. Dietary Diversity and Nutritional Status of Academic Staffs of Federal Polytechnic, Ilaro, Ogun State. JNHS. 2021;10(6):19-25 DOI: 10.9790/1959- 1006021925
14. De Oliveira Otto MC, Anderson CAM, Dearborn JL, Ferranti EP, Mozaffarian D, Rao G, Wylie-Rosett J, Lichtenstein AH; American Heart Association Behavioral Change for Improving Health Factors Committee of the Council on Lifestyle and Cardiometabolic Health and Council on Epidemiology and Prevention; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; and Stroke Council. Dietary Diversity: Implications for Obesity Prevention in Adult Populations: A Science Advisory From the American Heart Association. Circulation. 2018; 138(11):160-168. doi: 10.1161/CIR.0000000000000595.
15. Khamoushi1 SI, Sartang MM, Mazloom Z, Akbarzadeh M. Dietary Diversity and Abdominal Obesity among Female Students of Shiraz University of Medical Sciences. Int J Nutr Sci 2020;5(2):79-83

E-ISSN 2709-569X
Vol 09 No 1 Jan 2024

Diagnostic Enigma: A Case of Silent Pheochromocytoma in a Woman

Shreyas Rai[1], R. B. Nerli[1], Shridhar C. Ghagane[2], Keyur Patel[1], Ashwin Bokare[1], Adarsh Sanikop[3], Nishant Setya[1]

[1]Department of Urology, JN Medical College, KLE Academy of Higher Education and Research (Deemed-to-be-University), JNMC Campus, Nehru Nagar, Belagavi, Karnataka 590010, India.
[2]Dr. Prabhakar Kore Basic Science Research Center, KLE Academy of Higher Education and Research, JNMC Campus, Nehru Nagar, Belagavi, Karnataka 590010, India.
[3]Department of Pathology, JN Medical College, KLE Academy of Higher Education and Research (Deemed-to-be-University), JNMC Campus, Nehru Nagar, Belagavi, Karnataka 590010, India.

Abstract

Pheochromocytomas are rare tumours that arise from neural crest cells of the adrenal medulla. They commonly secrete catecholamines and other biological peptides that account for, hypertension, palpitations, and episodic headaches associated with the condition. However, the symptoms and clinical presentations are highly variable due to variations in catecholamine biosynthesis and secretion because of differences in gene expression. A small proportion of tumours hardly synthesize or release catecholamines and may have no symptoms and are termed non-functional pheochromocytoma. The non-functional pheochromocytomas are usually identified as incidentalomas, and the biochemical workup is usually negative. Non-functioning pheochromocytomas pose a challenge even to an astute clinician. We report a woman who presented with clinically non-functioning pheochromocytoma.

Keywords: Pheochromocytoma, catecholamines, hypertension, non-functioning.

Corresponding Author: Rajendra B. Nerli, Professor
Department of Urology, JN Medical College, KLE Academy of Higher Education and Research (Deemed-to-be-University), JNMC Campus, Nehru Nagar, Belagavi, Karnataka 590010, India.
Email: rbnerli@gmail.com

Introduction

Pheochromocytoma is a tumour that arises from the catecholamine-producing cells of the adrenal medulla. Approximately 1 to 2 per 100,000 individuals are diagnosed annually with pheochromocytoma, although the reports on incidence may vary (1). It is estimated that approximately 0.5% of cases of hypertension are due to pheochromocytoma (2). Approximately 5% of pheochromocytomas are incidentally detected as adrenal masses (3, 4). Incidentally discovered lesions account for 10% to 25% of all pheochromocytomas (2, 5).

Paroxysmal hypertension is the classic presenting sign in patients with pheochromocytoma. Such episodic spikes in blood pressure are documented in only approximately 30% to 50% of patients and can occur against the backdrop of baseline essential hypertension. The remainder of patients demonstrate persistently elevated blood pressure, and a minority are entirely normotensive (6). The triad of headache, episodic sudden perspiration, and tachycardia is a classic hallmark of pheochromocytoma (5). Pheochromocytomas, due to their diverse presentations, are considered “the great mimic ” and this can pose a challenge even to an astute clinician (7, 8). In this paper we report a woman who presented with clinically non-functioning pheochromocytoma.

Case Report

A 45-year-old female was admitted to the Urologic-oncology division of the hospital with complaints of right-sided abdominal pain of two months duration. The patient did not have a known case of diabetes mellitus, hypertension or cholelithiasis. The vital parameters such as blood pressure, pulse rate and respiration were within normal range. Abdominal ultrasonography (Figure 1a, b) done at a primary healthcare centre revealed a heterogeneously echogenic large mass in the region of the right adrenal gland. The patient was referred to our hospital for further management.

A plain CT (computed tomography) abdomen confirmed the presence of a large soft tissue lesion measuring 12×9.5 cms in the right suprarenal location (Figure 1c&d), pushing the right kidney inferiorly. The right adrenal gland was not seen separately. The left adrenal gland appeared normal. MRI (magnetic resonance imaging) abdomen, revealed a well-defined lobulated lesion appearing hypointense on T1 weighted images and appeared hyperintense on T2W images. In the post-contrast study, the lesion showed heterogenous

enhancement. The features were suggestive of a right adrenal pheochromocytoma. Twenty-four hours of urinary VMA (vanillylmandelic acid) excretion were within normal ranges and the serum metanephrine and nor-metanephrine levels. In view of normal catecholamine levels, a diagnosis of non-functioning pheochromocytoma or adrenocortical carcinoma was thought of.

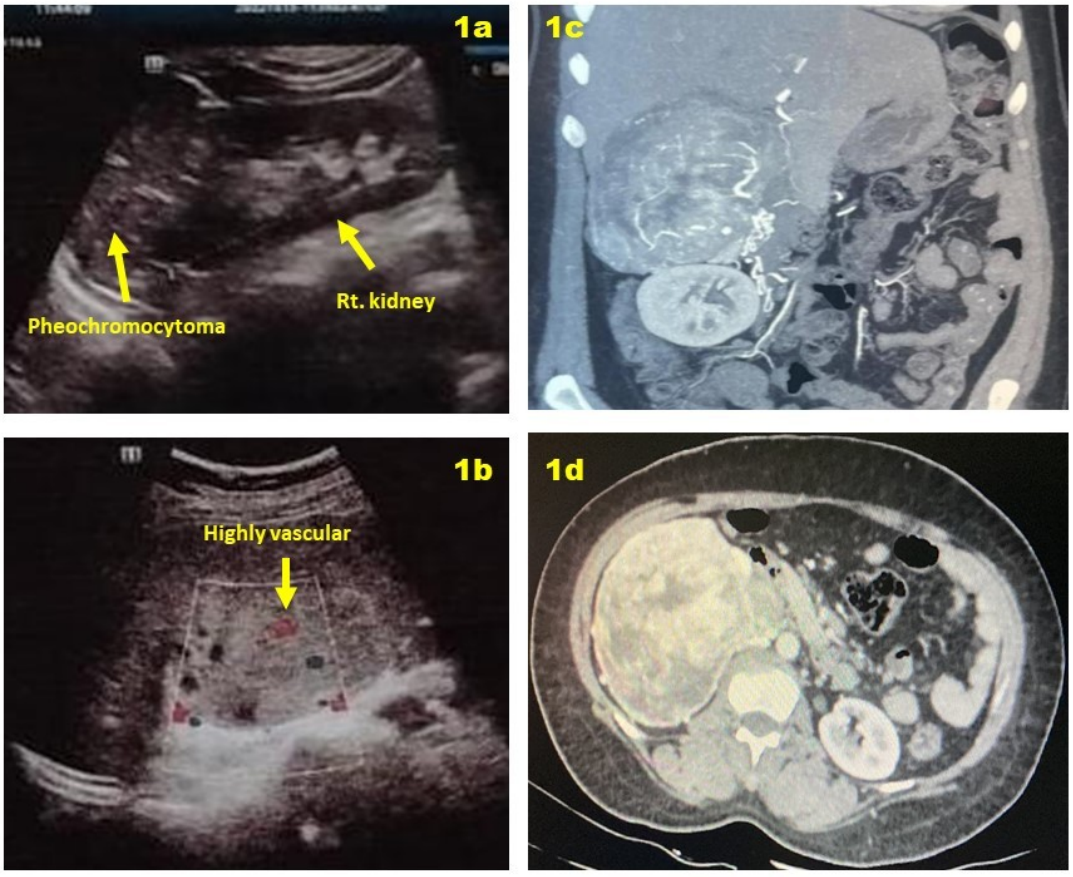

Figure 1. a & b: Ultrasonography shows Rt. Kidney being pushed inferiorly by the adrenal mass. The mass appears to be highly vascular on colour doppler. **c & d**: CT scan of the abdomen shows Rt. Sided adrenal mass is 12x9.5 cm, pushing the Rt. Kidney inferiorly.

On CT angiography of the abdomen (Figure 2a), the lesion appeared well-defined, lobulated and heterogeneously enhancing with haemorrhagic and necrotic areas within it. Early arterial enhancement and washout on delayed phases were noted. The patient was properly prepared for surgery and was put on calcium channel blockers on the advice of an endocrinologist. The patient was explored using a right subcostal incision and retroperitoneal approach. The

lesion was dissected away from the surrounding tissues and excised. Both the intra-operative period and the post-operative period were uneventful. There were no episodes of hypertension noted. The gross specimen (Figure 2 b&c) was of the size 12×9.5 cms and appeared to be soft and lobulated. The histopathology report shows an intermediate and power view of the histopathology specimen Zell-Ballen pattern (nesting) pathognomonic of pheochromocytoma (Figure 3 a & b).

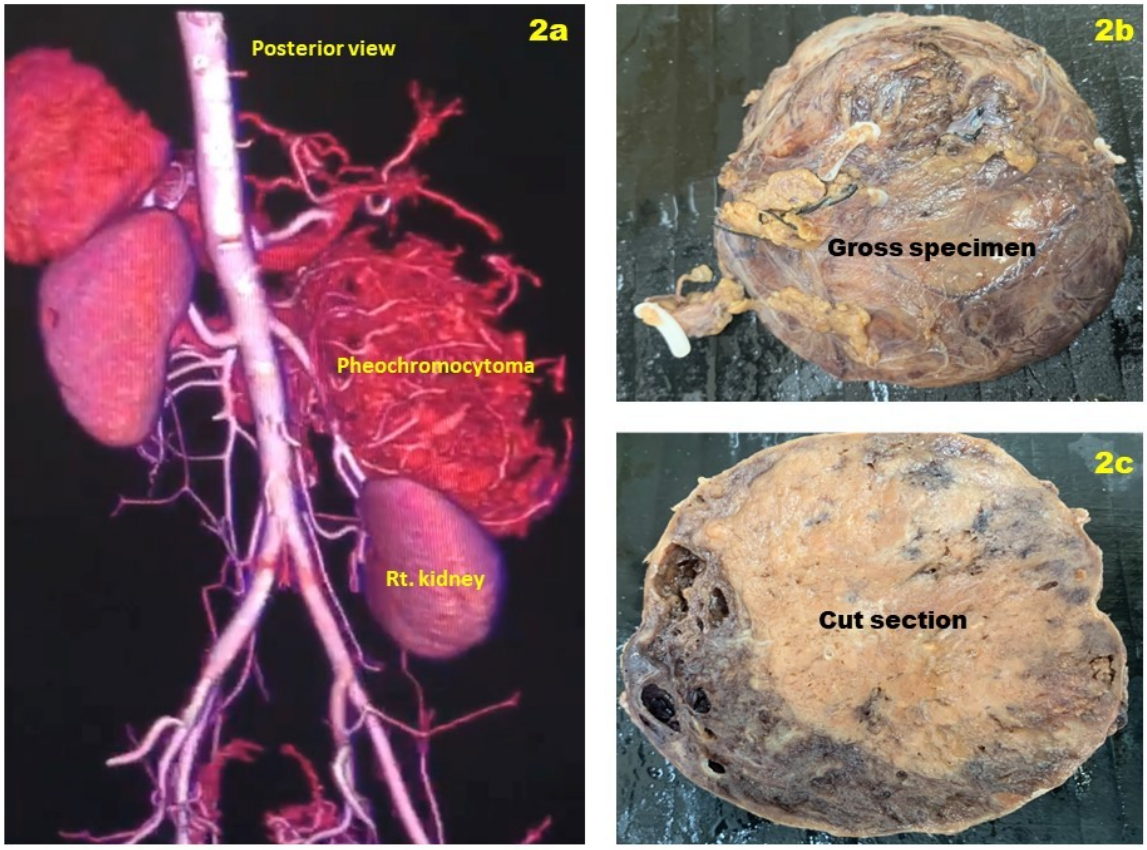

Figure 2. a. CT angiography shows a highly vascular adrenal tumour with the Rt. Renal artery being encased by the tumour. **b.** Gross specimen **c.** Cut a section of the specimen mahogany brown colour tumour.

Discussion

Pheochromocytomas are catecholamine-secreting neuroendocrine tumours that arise from the chromaffin cells of the adrenal medulla. The incidence is about 0.1% of the general population and 0.1–0.2% of patients presenting with hypertension (9). Recent advances in genetic studies have shown that up to 25% of patients have an inherited pattern with germline mutations (10, 11). Inherited Pheochromocytomas are known to be associated with conditions such as multiple endocrine neoplasia type II (MEN-2A or MEN-2B), von Recklinghausen's neurofibromatosis type I (NF-1), von Hippel–Lindau (VHL) syndrome, and familial PG (pyoderma gangrenosum) due to germline mutations of genes encoding succinate dehydrogenase (SDH) subunits B, C, and D (9).

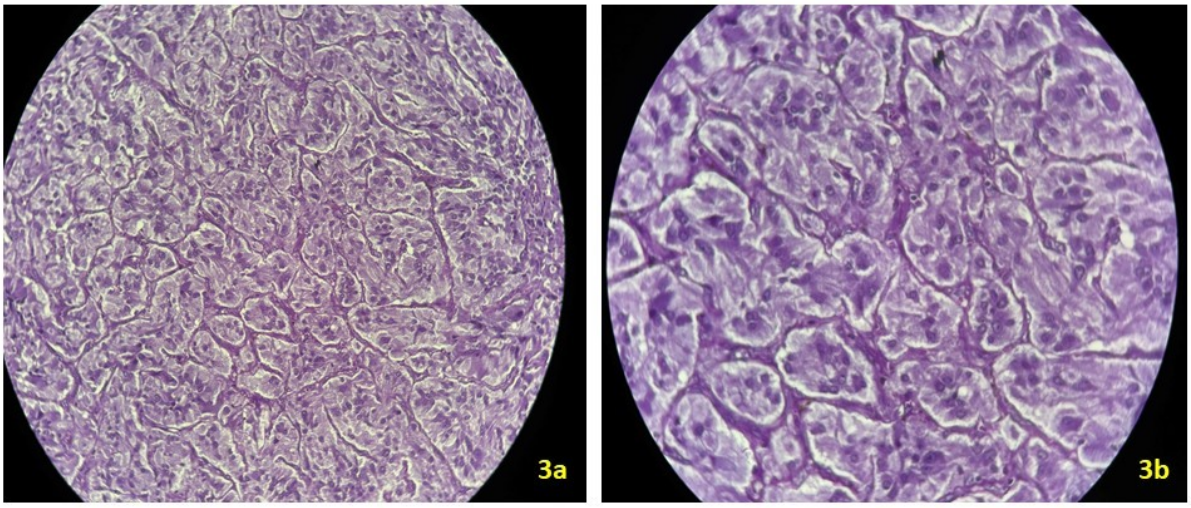

Figure 3. a: Intermediate power view of the Histopathology specimen Zell-Ballen pattern (nesting) pathognomonic of pheochromocytoma. **b:** High power view of the Histopathology specimen Zell-Ballen pattern (nesting) pathognomonic of pheochromocytoma.

Pheochromocytomas are catecholamine-secreting neuroendocrine tumours that arise from the chromaffin cells of the adrenal medulla. The incidence is about 0.1% of the general population and 0.1–0.2% of patients presenting with hypertension (9). Recent advances in genetic studies have shown that up to 25% of patients have an inherited pattern with germline mutations (10, 11). Inherited Pheochromocytomas are known to be associated with conditions such as multiple endocrine neoplasia type II (MEN-2A or MEN-2B), von Recklinghausen's neurofibromatosis type I (NF-1), von Hippel–Lindau (VHL) syndrome, and familial PG (pyoderma gangrenosum) due to germline mutations of genes encoding succinate dehydrogenase (SDH) subunits B, C, and D (9).

Pheochromocytoma, because of its protean manifestations is often referred to as "the great mimic ". Symptoms of pheochromocytomas are due to progressive excess of catecholamines, leading to hypertension. The most consistent sign in pheochromocytomas is hypertension, [5,9] as a result of the activation of α- and β-adrenergic receptors by catecholamine excess. Asymptomatic pheochromocytomas have been referred to as non-functional, silent or subclinical, and non-secreting lesions (9, 12). Absence of hypertension has been reported in 14–55% of incidental pheochromocytomas (13-15), especially those with adrenal incidentalomas and dopamine-secreting tumours.

Recent studies have shown that pheochromocytomas that are normotensive show downregulation of five genes phenylethanolamine-*N*-methyltransferase (PNMT), secretogranin II, vesicular monoamine transporter type I, norepinephrine transporter, and NPY involved in key processes of catecholamine metabolism in comparison to those with hypertensive pheochromocytomas. This process of downregulation of genes leads to smaller amounts of catecholamines being secreted and thereby presenting with minimal clinical symptoms (16, 17). Patients with non-functioning pheochromocytomas are also known to have a lower prevalence of diabetes suggesting a lower level of catecholamine synthesis compared with those with functioning tumours.

The patients need to be properly prepared before surgery, a multidisciplinary is necessary to guarantee the best possible outcome. As of today, improved preoperative medical preparation

and modern anaesthesia along with surgical techniques have resulted in a very low perioperative mortality of less than one percent (18). Medical preparation is necessary to prevent dangerous complications due to massive surges of catecholamine release. A preoperative evaluation of the cardiovascular system that includes an electrocardiogram, an echocardiography is a must. An effective alpha blockade is necessary in all patients. Calcium channel blockers have been added to alpha-blockers recently. Beta-receptor blockade is part of the treatment to reduce tachycardia and tachyarrhythmia (8). Tumour resection is the standard of care especially when done using minimally invasive procedures. Follow-up of these patients for long-term is necessary.

The patient in our study presented with vague abdominal pain and neither had hypertension nor diabetes mellitus. The abdominal ultrasonography revealed the adrenal mass. The laboratory tests were negative for increased catecholamine secretion. It was histopathology which clinched the diagnosis. Non-functioning pheochromocytomas pose a significant challenge to clinicians and commonly present as adrenal incidentalomas in imaging studies. Pheochromocytomas with normal blood pressure have distinct clinical, biological, and molecular characteristics distinct from pheochromocytomas that present with hypertension. There also appears to be a difference in the concentration of urinary catecholamines between the two types of pheochromocytomas. The use of preoperative α blockade or the use of calcium channel blockers in non-functioning pheochromocytomas is debatable but may help manage hemodynamic instability. However, the long-term outcome of non-clinical/functioning pheochromocytomas needs further evaluation.

References

1. Rijken JA, Neimeijer ND, Jonker MA, et al: The penetrance of paraganglioma and pheochromocytoma in SDHB germline mutation carriers, *Clin Genet* 2017;**93**(1):60–66.
2. Davison AS, Jones DM, Ruthven S, Helliwell T, Shore SL. Clinical evaluation and treatment of phaeochromocytoma. *Annals of Clinical Biochemistry*. 2018; 55(1):34-48.
3. Sconfienza E, Tetti M, Forestiero V, Veglio F, Mulatero P, Monticone S. Prevalence of functioning adrenal incidentalomas: a systematic review and meta-analysis. *The Journal of Clinical Endocrinology & Metabolism*. 2023;108(7):1813-23.

4. Voltan, G., Boscaro, M., Armanini, D., Scaroni, C. and Ceccato, F., A multidisciplinary approach to the management of adrenal incidentaloma. *Expert Review of Endocrinology & Metabolism*, 2021. *16*(4), pp.201-212.
5. Kiriakopoulos, A., Giannakis, P. and Menenakos, E., Pheochromocytoma: a changing perspective and current concepts. *Therapeutic Advances in Endocrinology and Metabolism*, 2023;*14*, p.20420188231207544.
6. Mete, O., Tischler, A.S. and Asa, S.L., Paragangliomas and pheochromocytomas. *The Spectrum of Neuroendocrine Neoplasia: A Practical Approach to Diagnosis, Classification and Therapy*, 2021; pp.263-285.
7. Nerli RB, Patil RA, Patne P, Suresh SN, Hiremath MB. Unusual presentation of pheochromocytoma. *Journal of the Scientific Society*. 2014;**41**(2):136.
8. Nerli RB, Musale A, Ghagane SC, Hiremath MB, Dixit NS. Adrenal hemorrhagic pseudocyst-A case report of a rare presentation of pheochromocytoma. *Urology Case Reports*. 2018; **21:5**-7.
9. Lui S-A, Oh HB, Tan KB, *et al.* Clinical Challenges in Non-functional Pheochromocytomas. *World J Endoc Surg* 2019;**11**(3):86–90.
10. Jhawar, S., Arakawa, Y., Kumar, S., Varghese, D., Kim, Y.S., Roper, N., Elloumi, F., Pommier, Y., Pacak, K. and Del Rivero, J., New insights on the genetics of pheochromocytoma and paraganglioma and its clinical implications. *Cancers*, 2022; *14*(3), p.594.
11. Butz, J.J., Yan, Q., McKenzie, T.J., Weingarten, T.N., Cavalcante, A.N., Bancos, I., Young Jr, W.F., Schroeder, D.R., Martin, D.P. and Sprung, J., Perioperative outcomes of syndromic paraganglioma and pheochromocytoma resection in patients with von Hippel-Lindau disease, multiple endocrine neoplasia type 2, or neurofibromatosis type 1. *Surgery*, 2017;*162*(6), pp.1259-1269.
12. Lui SA, Oh HB, Tan KB, Parameswaran R. Clinical challenges in nonfunctional pheochromocytomas. *World*. 2019;11(3):87.
13. Kopetschke R, Slisko M, Kilisli A, et al. Frequent incidental discovery of phaeochromocytoma: data from a German cohort of 201 phaeochromocytoma. *Eur J Endocrinol* 2009;**161**(2):355–361.
14. Mercado-Asis LB, Siao RM, Amba NF. Evolving clinical presentation and assessment of pheochromocytoma: a review. Journal of Medicine, University of Santo Tomas. 2017; 1;1(1):5-23.
15. Mantero F, Terzolo M, Arnaldi G, et al. A survey on adrenal incidentaloma in Italy. Study Group on Adrenal Tumors of the Italian Society of Endocrinology. *J Clin Endocrinol Metab* 2000;**85**(2):637–644.
16. Haissaguerre M, Courel M, Caron P, et al. Normotensive incidentally discovered pheochromocytomas display specific biochemical, cellular, and molecular characteristics. *J Clin Endocrinol Metab* 2013; **98**(11):4346–4354.
17. Zuber SM, Kantorovich V, Pacak K. Hypertension in pheochromocytoma: characteristics and treatment. *Endocrinol Metab Clin North Am* 2011; **40**(2):295–311.

18. Lenders JW, Eisenhofer G. Update on modern management of pheochromocytoma and paraganglioma. *Endocrinology and Metabolism.* 2017; 32(2):152-61.