UNRAVELLING THE BREAKFAST PUZZLE: EXPLORING THE EFFECT OF SKIPPING BREAKFAST ON HEMATOLOGICAL PARAMETERS IN UNIVERSITY STUDENTS.

Shazia Parveen Solangi[1*], Naseem Aslam Channa[2], Zahoor Ahmed[3], Amna Yasin Awan[4], Fiza Memon[5], Hira Siyal[6], Parwan Ali Ujjan[7]

[1*]Assistant Professor, Department of Biochemistry, Shah Abdul Latif University, Khairpur, Sindh, Pakistan, Institute of Biochemistry, University of Sindh, Jamshoro, Sindh, Pakistan
[2]Professor & Director, Institute of Biochemistry, University of Sindh, Jamshoro, Sindh, Pakistan
[3]Assistant Professor, Institute of Public Health, Faculty of community medicine and Health Sciences, Peoples University of Medical and Health sciences for women, Nawabshah, Sindh, Pakistan
[4]Institute of Biochemistry, University of Sindh, Jamshoro, Sindh, Pakistan
[5]Institute of Public Health, Faculty of Community Medicine and Health Sciences, Peoples University of Medical and Health Sciences for Women, Nawabshah, Sindh, Pakistan
[6]Institute of Public Health, Faculty of Community Medicine and Health Sciences, Peoples University of Medical and Health Sciences for Women, Nawabshah, Sindh, Pakistan
[7]Department of Biochemistry, Shah Abdul Latif University, Khairpur, Sindh, Pakistan

*Corresponding Author: Shazia Parveen Solangi
*Assistant Professor, Department of Biochemistry, Shah Abdul Latif University, Khairpur, Sindh, Pakistan & Institute of Biochemistry, University of Sindh, Jamshoro, Sindh, Pakistan,
Email: spsolangi82@gmail.com

Abstract
This study investigated the association between breakfast skipping and hematological parameters among university students. Four hundred fifty students were randomly selected from Shah Abdul Latif University Khairpur, with 259 males and 191 females aged between 18 and 25 years. Among the participants, 158 were breakfast-skippers and 292 were non-skippers. Anthropometric measurements and lifestyle questionnaires were collected, along with blood samples for complete blood count (CBC) analysis and lipid profile assessment. The results revealed that male participants had a higher prevalence of breakfast skipping (68%), while female participants were more likely to consume breakfast regularly (59%). Comparing breakfast skippers to non-skippers, significant differences were observed in several hematological parameters, including white blood cell count, red blood cell count, mean corpuscular hemoglobin, hematocrit, mean platelet volume, and mean corpuscular hemoglobin concentration. Additionally, gender differences were observed, with females exhibiting lower red blood cell counts and mean corpuscular hemoglobin concentration compared to males. These findings highlight the potential impact of breakfast skipping on hematological health in university students. Further research is needed to elucidate the underlying mechanisms and long-term consequences. Promoting regular breakfast consumption among students may have beneficial effects on hematological parameters and overall well-being.

Keywords: Breakfast skippers, Hematology, Sociodemographic, University Students

Abbreviations: BS - Breakfast Skipping; CBC - Complete Blood Count; MCH - Mean Corpuscular Hemoglobin; HCT – Hematocrit; MPV - Mean Platelet Volume; MCHC - Mean Corpuscular Hemoglobin Concentration; WBC - White Blood Cell; RBC - Red Blood Cell; NS - Non-Skippers**.**

Introduction

Breakfast is frequently regarded as the most significant meal of the day. Refueling the body with energy and necessary nutrients and assisting in the acceleration of metabolism [Edefonti, et al., et al., 2019]. Nonetheless, male and female both frequently skip breakfast. In males, it is predicted that 109 (51.9%) and 59% miss breakfast. Regular breakfast eaters, both students male and female had improved memory, cognitive performance, and attendance at university [Edefonti, et al., 2014]. Numerous investigations have evaluated the correlation between breakfast intake and several health metrics. An analysis of those who skip breakfast and those who don't students who ate breakfast were more likely than those who skipped it to have greater daily nutrient intakes, healthier diets, and better food choices [Rampersaud, G.2009]. Research involving university students has demonstrated a link between breakfast intake and a reduced body mass index (BMI). Globally, obesity is a major issue [Blüher, M. 2019]. While there are a number of variables that contribute to the growth of overweight and obesity, missing breakfast (SB) may be one of them [Wicherski, J., et al 2021]. Blood manufactured in bone marrow and released into peripheral blood once they are mature. Blood is a cell which transport essential nutrients to the various parts of the body and excrete waste material from body through excretory organ. Blood composed approximately 45% blood cells There are three main components of cells i.e Red Blood Cells (RBCs), White Blood Cells (WBCs), and Platelets. It is numerous earlier research projects have demonstrated the well-established benefits of breakfast for hunger control (Musaiger, A. 2007). While a number of factors can impact an individual's nutritional status, the most significant factor that predisposes young university males and females to the development of anemia is their tendency to skip breakfast. This is because skipping breakfast repeatedly prevents the body from obtaining the variety of nutrients required for the synthesis of blood cells. Despite all of these facts, breakfast is often avoided, particularly by younger people. Nearly all male university students either skip breakfast or just sometimes eat it (Adolphus, K, et al. 2017; Spence, C 2017).

There is little information about the association between skipper and non-skipper breakfast consumption with obesity and blood pressure among male and female students in university. So the primary aim of this study was to test the BMI, blood pressure, and complete blood count between breakfast consumption and non-consumptions among university students. The authors hypothesized that breakfast skippers would have higher BMI, pulse rate, and blood pressure values than non-breakfast eaters. A secondary aim was to investigate the association of breakfast consumption with food non-consumption behavior. The authors hypothesize that those who breakfast skipped would have unhealthy food habits, compared with those who had breakfast non-skipped.

Materials and Methods

A total no. of 450 students was randomly selected from Shah Abdul Latif University Khairpur after signing in the written informed consent form, there were 259 males and 191 females with age range of 18 to 25 years. Among the participants, breakfast skippers were 158 and non skippers were 292. All university students were examined for age height and weight measurements, questionnaire regarding to their life style and nutrient intake questionnaires were filled in by one week recall method. Blood samples of 5 ml was also collected from all university students by standard methods to analyze the complete blood count (CBC) through CBC analyzer and lipid profile and proteins by ADVIA 1800 Siemens analyzer. The statistical analysis was done by SPSS version 21 and p-value < 0.05 was kept as level of significance.

Results and Discussion

Out of the 200 subjects that participated in the study, 109 (51.9%) were men, and 68% of them are rare breakfast eaters. Male breakfast eaters were about equally likely to eat breakfast frequently (46%) and regularly (54%). Also, it was found that young men tend to consume breakfast more frequently than other demographics. However the proportion of women who frequently ate breakfast (59%) was greater. Compared to males, the proportion of female unusual (11) and regular (30%) breakfast eaters was lower in table showed 1. The comparison of male breakfast skipper and female breakfast non skipper university students were found most of the breakfast skippers are female were observed as compared to male breakfast skippers with age group 22-23 years in breakfast skippers. The highest percentage of breakfast skipper university students were found with normal weight as compared to other categories of body mass index (BMI). The comparison of blood pressure between breakfast skipper and breakfast non skipper university students is presented. Normal blood pressure and normal pulse rate was noted in majority of breakfast skipper and breakfast non skipper university students. In some studies skipping breakfast may cause low blood pressure due to hypoglycemic condition, but present study does not support it. In table 2, the comparison of haematology complete blood count between breakfast skipper and breakfast non skipper university students. It was revealed that WBCs, RBCs, MCH, MCHC, HCT, MPV and Basophils were significantly decreased in breakfast skipper as compared to breakfast non skipper university students. Although, the haematology was within normal limits. Breakfast has a very important role in haematology. Breakfast has a good effect an anemia.

In Table 3, we found that RBCs and MCHC were significantly decreased in females as compared to male breakfast skipper university students, whereas, Basophils were significantly increased in female as compared to male breakfast skipper university students. Although, the CBCs parameters were within normal limits. Normaly RBCs are more in males as compared to females and present study also reported same.

Table 1: Sociodemographic characteristics of breakfast skipper and breakfast non skipper university students.

Sociodemographic Characteristics	Breakfast skippers N= 158 (%)	Breakfast non skippers N=292 (%)
Gender wise		
Male	78 (49.3)	178 (60.9)
Female	80 (50.6)	114 (39.0)
Age groups (years)		
18-19	18 (11.1)	35 (12.0)
20-21	63 (39.8)	130 (44.5)
22-23	65 (41.1)	99 (33.9)
24-25	12 (7.5)	28 (9.6)
Body Mass Index (kg/m^2)		
Under weight (<18.5)	32 (20.2)	70 (23.9)
Normal weight (18.5-24.9)	90 (56.9)	160 (54.7)
Overweight (25-29.9)	27 (17.0)	54 (18.4)
Obese (>40)	09 (5.6)	08 (2.7)
Blood Pressure		
Normal	133 (84.17)	133 (84.17)
High blood pressure	05 (3.16)	05 (3.16)
Low blood pressure	20 (12.6)	20 (12.6)
Pulse rate		
Normal	118 (74.6)	260 (89.0)
Abnormal	40 (25.3)	32 (10.9)

The table presents the sociodemographic characteristics of breakfast skippers and non-skippers among the study participants. The sample size for breakfast skippers was 158 (49.3%), while for breakfast non-skippers it was 292 (60.9%).

Regarding gender, among the breakfast skippers, 78 (49.3%) were male and 80 (50.6%) were female. In contrast, among the breakfast non-skippers, there were 178 (60.9%) males and 114 (39.0%) females.

The age distribution of the participants varied between the two groups. For breakfast skippers, the majority fell into the 20-21 age group with 63 (39.8%) participants, followed by the 22-23 age group with 65 (41.1%) participants. Comparatively, among the breakfast non-skippers, the highest proportion was in the 20-21 age group with 130 (44.5%) participants, followed by the 22-23 age group with 99 (33.9%) participants.

As for body mass index (BMI), the majority of both breakfast skippers and non-skippers fell within the normal weight range. Among breakfast skippers, 90 (56.9%) had a normal weight, while among breakfast non-skippers, the number was slightly higher at 160 (54.7%). The proportion of underweight individuals among breakfast skippers was 32 (20.2%) compared to 70 (23.9%) among breakfast non-skippers. Additionally, the proportion of overweight individuals was 27 (17.0%) among breakfast skippers and 54 (18.4%) among breakfast non-skippers. A smaller proportion of participants in both groups were classified as obese, with 9 (5.6%) among breakfast skippers and 8 (2.7%) among breakfast non-skippers.

The table also provides information on blood pressure and pulse rate. The majority of participants in both groups had normal blood pressure, with 133 (84.17%) among breakfast skippers and 133 (84.17%) among breakfast non-skippers. A small proportion of participants had high blood pressure, with 5 (3.16%) in each group. Similarly, the majority of participants had a normal pulse rate, with 118 (74.6%) among breakfast skippers and 260 (89.0%) among breakfast non-skippers. A higher proportion of abnormal pulse rates was observed among breakfast skippers, with 40 (25.3%) compared to 32 (10.9%) among breakfast non-skippers.

These findings provide a comprehensive overview of the sociodemographic characteristics of breakfast skippers and non-skippers in the study population. The differences observed in gender, age distribution, BMI, blood pressure, and pulse rate between the two groups highlight potential associations between breakfast skipping and these sociodemographic factors. Further analysis and interpretation of these relationships will be discussed in the subsequent sections of the research paper.

Table 2: Comparison of haematology between breakfast skipper and breakfast non skipper university students.

Complete Blood cells	Breakfast skipper (N=68)	Breakfast non skipper (N=132)	*p*-value (<0.05)	References range
HB	12.51±1.33	13.55±1.75	**0.061**	M=13.5-18 g/dL F=11.5-15 g/dL
WBC	6.57±2.09	7.61±1.89	**0.0012**	4.0-11.0 cell/µL
RBC	4.58±0.43	4.76±0.01	**0.0109**	M=4.5-6.2 F=3.9-5.5
Platelets	225.05±58.3	222.46±30.07	0.7925	150-400cell/ µL
MCV	77.16±7.26	75.78±0.78	0.9612	76.0-96-0fL
MCH	27.65±2.78	28.30±0.34	**0.0447**	26-32pg
MCHC	35.91±1.60	42.64±3.64	**0.0003**	32-36g/dL
HCT	35.88±4.28	37.26±0.33	**0.0354**	M=40-54% F=35.4-42.0%
MPV	9.47±0.84	12.94±2.93	**0.0004**	7.5-11.5fL

Neutrophils	59.38±9.357	61.25±0.53	0.3973	40-75%
Lymphocytes	29.60±8.31	31.36±1.31	0.4540	20-75%
Monocytes	6.08±2.12	5.36±1.31	0.9936	0-10%
Eosinophils	2.2±1.86	2.12±0.40	0.8223	0-6%
Basophils	0.32±0.23	0.45±0.18	**0.0010**	0-1%

Hemoglobin (HB), White blood cells (WBCs), Red blood cells (RBCs), Means corpuscular volume (MCV), Means corpuscular hemoglobin (MCH), Means corpuscular hemoglobin concentration (MCHC), Hematocrit (HCT), Mean platelet volume (MPV)

Table 2 presents a comparison of hematological parameters between breakfast skippers and breakfast non-skippers among university students. The sample size for breakfast skippers was 68, while for breakfast non-skippers it was 132.

The white blood cell count (WBC) was found to be significantly lower in breakfast skippers (6.57±2.09 cells/µL) compared to breakfast non-skippers (7.61±1.89 cells/µL), with a p-value of 0.0012. The reference range for WBC is 4.0-11.0 cells/µL.

Regarding red blood cells (RBC), breakfast skippers had a slightly lower count (4.58±0.43) compared to breakfast non-skippers (4.76±0.01), with a p-value of 0.0109. The reference range for RBC is M=4.5-6.2 and F=3.9-5.5 million cells/µL.

There was no significant difference in platelet count between breakfast skippers (225.05±58.3 cells/µL) and breakfast non-skippers (222.46±30.07 cells/µL), with a p-value of 0.7925. The reference range for platelets is 150-400 cells/µL.

Mean corpuscular volume (MCV) showed no significant difference between breakfast skippers (77.16±7.26 fL) and breakfast non-skippers (75.78±0.78 fL), with a p-value of 0.9612. The reference range for MCV is 76.0-96.0 fL.

Mean corpuscular hemoglobin (MCH) was slightly lower in breakfast skippers (27.65±2.78 pg) compared to breakfast non-skippers (28.30±0.34 pg), with a p-value of 0.0447. The reference range for MCH is 26-32 pg.

Mean corpuscular hemoglobin concentration (MCHC) showed a significant difference between breakfast skippers (35.91±1.60 g/dL) and breakfast non-skippers (42.64±3.64 g/dL), with a p-value of 0.0003. The reference range for MCHC is 32-36 g/dL.

Hematocrit (HCT) was slightly lower in breakfast skippers (35.88±4.28%) compared to breakfast non-skippers (37.26±0.33%), with a p-value of 0.0354. The reference range for HCT is M=40-54% and F=35.4-42.0%.

Mean platelet volume (MPV) showed a significant difference between breakfast skippers (9.47±0.84 fL) and breakfast non-skippers (12.94±2.93 fL), with a p-value of 0.0004. The reference range for MPV is 7.5-11.5 fL.

There were no significant differences observed in the percentages of neutrophils, lymphocytes, monocytes, eosinophils, and basophils between breakfast skippers and breakfast non-skippers.

Table 3: Gender wise comparison of haematology between male and female in breakfast skipper University students.

Complete Blood cells	Female breakfast skippers (N=50) Mean ±SD	Male breakfast skippers (N=18) Mean ±SD	*p*-value (<0.05)	References range
HB	11.51±1.53	12.63±1.81	**0.154**	M=13.5-18 g/dL F=11.5-15 g/dL
WBCs	6.37±2.15	7.12±1.92	0.9997	4.0-11.0 cell/µL
RBCs	4.40±0.33	5.08±0.21	**0.0042**	M=4.5-6.2

				F=3.9-5.5
Platelets	240±55.35	183.55±46.87	1.7600	150-400cell/ µL
MCV	77.24±8.00	76.94±5.05	0.7980	76.0-96-0fL
MCH	27.21±2.96	28.9±1.83	0.4006	26-32pg
MCHC	35.31±1.43	38.57±0.41	**0.0282**	32-36g/dL
HCT	43.58±4.12	39.51±2.16	0.4051	M=40-54% F=35.4-42.0%
MPV	9.49±090	9.42±0.68	0.6280	7.5-11.5fL
Neutrophils	60.39±9.34	56.56±9.32	**0.0531**	40-75%
Lymphocytes	28.66±8.16	32.22±8.65	0.8679	20-75%
Monocytes	6.15±2.25	5.91±1.83	0.5344	0-10%
Eosinophils	1.96±2.00	2.84±1.29	0.9952	0-6%
Basophils	0.34±0.26	0.27±010	**0.0405**	0-1%

Hemoglobin (HB), White blood cells (WBCs), Red blood cells(RBCs), Means corpuscular volume (MCV), Means corpuscular hemoglobin (MCH), Means corpuscular hemoglobin concentration(MCHC), Hematocrit (HCT), Mean platelet volume (MPV)

Table 3 presents a gender-wise comparison of hematological parameters between male and female breakfast skippers among university students. The sample size for female breakfast skippers was 50, while for male breakfast skippers it was 18.

The white blood cell count (WBCs) showed no significant difference between female breakfast skippers (6.37±2.15 cells/µL) and male breakfast skippers (7.12±1.92 cells/µL), with a p-value of 0.9997. The reference range for WBCs is 4.0-11.0 cells/µL.

Regarding red blood cells (RBCs), female breakfast skippers had a significantly lower count (4.40±0.33 million cells/µL) compared to male breakfast skippers (5.08±0.21 million cells/µL), with a p-value of 0.0042. The reference range for RBCs is M=4.5-6.2 and F=3.9-5.5 million cells/µL.

There was no significant difference in platelet count between female breakfast skippers (240±55.35 cells/µL) and male breakfast skippers (183.55±46.87 cells/µL), with a p-value of 1.7600. The reference range for platelets is 150-400 cells/µL.

Mean corpuscular volume (MCV) showed no significant difference between female breakfast skippers (77.24±8.00 fL) and male breakfast skippers (76.94±5.05 fL), with a p-value of 0.7980. The reference range for MCV is 76.0-96.0 fL.

Mean corpuscular hemoglobin (MCH) also showed no significant difference between female breakfast skippers (27.21±2.96 pg) and male breakfast skippers (28.9±1.83 pg), with a p-value of 0.4006. The reference range for MCH is 26-32 pg.

Mean corpuscular hemoglobin concentration (MCHC) showed a significant difference between female breakfast skippers (35.31±1.43 g/dL) and male breakfast skippers (38.57±0.41 g/dL), with a p-value of 0.0282. The reference range for MCHC is 32-36 g/dL.

Hematocrit (HCT) showed no significant difference between female breakfast skippers (43.58±4.12%) and male breakfast skippers (39.51±2.16%), with a p-value of 0.4051. The reference range for HCT is M=40-54% and F=35.4-42.0%.

Mean platelet volume (MPV) showed no significant difference between female breakfast skippers (9.49±0.90 fL) and male breakfast skippers (9.42±0.68 fL), with a p-value of 0.6280. The reference range for MPV is 7.5-11.5 fL.

There were no significant differences observed in the percentages of neutrophils, lymphocytes, monocytes, eosinophils, and basophils between female and male breakfast skippers.

Conclusion

In conclusion, the analysis of hematological parameters among university students who skip breakfast has provided valuable insights into the potential impact of breakfast skipping on blood cell counts and

related factors. The findings suggest that breakfast skipping may have implications for hematological health, potentially affecting immune function, red blood cell production, and platelet characteristics. Moreover, there were gender-related discrepancies observed, with female breakfast skippers exhibiting lower red blood cell counts and mean corpuscular hemoglobin concentration compared to their male counterparts. These differences highlight the potential influence of biological and physiological factors on hematological parameters in the context of breakfast skipping.

The results underscore the importance of considering breakfast habits and gender when assessing hematological parameters in the university student population. Further research is warranted to explore the underlying mechanisms and potential long-term consequences of these findings. Understanding the impact of breakfast skipping on hematological health may have implications for promoting healthy dietary habits among students and optimizing their overall well-being. These findings contribute to our understanding of the relationship between breakfast skipping and hematological parameters, and they provide a foundation for developing targeted interventions to improve the hematological health of breakfast skippers.

Acknowledgements

Conflict of Interest

The authors state that they have no conflict of interest.

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