OPEN ACCESS Freely available online

Cardiovascular Pharmacology: Open Access

ISSN: 2329-6607

Research Article

# Diet and Subclinical Inflammation amongst Ellisras Young Adults Aged 18 to 30 Years: Ellisras Longitudinal Study

**Tshephang M.J. Mashiane[1], Kotsedi D. Monyeki[1*], Mbelege R. Nkwana[2], Solomon S.R. Choma[3], Andre P. Kengne[2]**

[1]*Department of Physiology and Environmental Health, University of Limpopo, Sovenga, South Africa*

[2]*Non Communicable Diseases Research Unit, South African Medical Research Council, Parow Valley, Cape Town*

[3]*Department of Pathology and Medical Sciences, University of Limpopo, Limpopo, South Africa*

## ABSTRACT

## INTRODUCTION

Subclinical inflammation is triggered by consumption of high dietary fat intake that increases cholesterol levels, blocks and disrupts the regulation of blood flow in the vessels resulting in cardiovascular diseases (CVD) [1]. A gain in body weight or obesity is linked with subclinical inflammation, which develops progressively as the body mass index (BMI) and abdominal fatincreases [1]. Subclinical inflammation is diagnosed by elevations of inflammatory markers such as C-reactive protein (CRP) [3]. Overweight and obesity are associated with increased levels of CRP [2]. This is due to individuals consuming high amounts of sugar, total fat, saturated fatty acids and cholesterol and low consumption of fruits and vegetables, fish, poultry and dietary fibre [4]. There are few studies that have been done on the effects of diet on inflammatory markers such as CRP among young adults. Thus, inflammatory markers such as CRP may be important early predictors of adult chronic disease risk [5]. Preliminary results from the Ellisras cohort study showed a significant association between dietary intake and BMI [6]. However, the relationship between diet and subclinical inflammation among rural young South African adults was not investigated. Accordingly, the present study aims to investigate the relationship between diet and subclinical inflammation among young adults aged 18 to 30 years from the rural Ellisras setting in South Africa.

## MATERIALS AND METHODS

Geographical area :Ellisras is a deep rural area situated within the north-western area of the Limpopo Province, South Africa. The population is about 50, 000 residing in 42 settlements [7]. These villages are approximately 70 km from the Ellisras town (23° 40S 27° 44W), now known as Lephalale, adjacent to Botswana border. The Iscor coal mine, Matimba and Medupi electricity power stations are the major sources of employment for many of the Ellisras residents, whereas the remaining workforce is involved in subsistence farming and cattle rearing, while the minority is in education and civil services [8, 9].

Study design and sampling: This study was part of the ongoing Ellisras Longitudinal Study (ELS), for which the details of the sampling procedure were reported elsewhere [10].The participants for the present study included 710 young adults, 348 males and 362 females, aged 18 to 30 years who were part of the ongoing ELS of which the selection of the subject have been reported elsewhere [10, 11]. All participants underwent a series of anthropometric measurements (weight, height and waist circumference) according to the standards procedures recommended by the international society of the advancement of Kinanthropometry (ISAK) [12]. Weight was measured on an electronic scale to the nearest 0.1 kg, Martin anthropometric was used to measure height to the nearest 0.1 cm and waist circumference measurements were taken to the nearest 0.1cm, using a soft measuring tape. Body mass index (BMI) was defined as weight (kg)/height2 (m). All participants were classified as underweight, normal, overweight and obese according to World Health Organization [13] cut-off points for adults. World Health Organization [14] cut-off points defined waist circumference.

***Corresponding author:** Kotsedi D. Monyeki, Department of Physiology and Environmental Health, University of Limpopo, Sovenga, South Africa; Tel: 0152682953 ; E-mail: kotsedi.monyeki@ul.ac.za

**Received date:** August 11, 2020; **Accepted date:** August 31, 2021; **Published date:** September 13, 2021

**Citation:** Monyeki K D (2021) Diet and subclinical inflammation amongst Ellisras young adults aged 18 to 30 years: Ellisras Longitudinal Study. Cardiovasc Pharm Open Acces. 10:6;p466.

## Blood pressure

Using an electronic Micronta monitoring kit, at least three BP readings of SBP and DBP were taken after the child had been seated for 5 min or longer [15, 16]. The bladder of the device contains an electronic infrasonic transducer that monitors the BP and pulse rate, displaying these concurrently on the screen. This versatile instrument has been designed for research and clinical purposes. In a pilot study, conducted before the survey, a high correlation of 0.93 was found between the readings taken with the automated device and those with a conventional mercury sphygmomanometer. Hypertension was defined as the average of three separate BP readings if they had a systolic blood pressure higher than 140 mmHg and diastolic blood pressure higher than 90 mmHg [17].

## Dietary assessment

Diet was measured using the 24-hour recall method, which is a valid method to determine group dietary intakes [18]. Senior Northern Sotho speaking Physiology students of the University of Limpopo, specifically trained in using socioeconomic questionnaire and the 24-hour recall method, interviewed the participants over the previous 24 hours in December 2015. Estimated portion sizes of foods consumed were recorded in as much detail as possible, using a pre-tested questionnaire and food models simulating average portions of local foods [19]. There nutrients analysed were digestive Carbohydrates (g) Total protein (g), Total fat (g), Saturated fat (g), Total sugar (g),Dietary fibre (g), Iron (mg), Vitamin A& E (mg), Sodium(mg), Potassium(mg), Zinc(mg),Calcium(mg), Niacin(mg), Folate(mcg). Dietary data was analysed using local food tables and software [19, 20] and compared with recommended intake [21]. The Ethics Committee of the University of Limpopo granted ethical approval prior to the survey, the participants were provided informed consent, and the young adults signed the assent form after receiving verbal agreement from the project leader.

## Biochemical analysis

Fasting blood sample: Participants fasted for 8 – 10 hours before blood collection. Fasting venous blood samples was collected in the morning [22]. The blood samples (10ml) were collected into a yellow top vacutainer containing separation gel for CRP determination. Samples were then placed on ice (2 –8°C) after collection and prior to processing. The blood samples were transported on ice for few hours to the Witpoort Hospital Laboratory prior to separation by centrifugation. Fasting blood samples were centrifuged to obtain serum at 25°C for 15 minutes at 2500 rpm. Haemolysed samples for glycated haemoglobin were discarded according to laboratory procedures. Serum was stored at -80°C for later analysis.

## C-reactive protein

The serum CRP levels were measured by hs-CRP assay test as it has great stability, assay precision,accuracy and availability [23]. This test measured low levels of serum CRP using immunoturbidimetry on IMMAGE analyser and the results were obtained in 25 minutes with sensitivity down to 0.04 mg/L. The criteria for serum CRP levels as a marker of inflammation and cardiovascular risk factors was according to The American Heart Association (AHA) and U.S Centres for Disease Control and Prevention (CDC) [23]. The blood was analysed in the laboratories of the Department of Pathology and Medical Science at the University of Limpopo.

## Statistical analyses

Descriptive statistics are presented by gender and overall population. Dietary intake and serum CRP levels were summarised as medians and 25th-75th percentiles. Wilcoxon sign rank test was used to test for significant difference between gender. Tertiles were used to check the trend of serum CRP levels based on diet and chi square tests were used to compare characteristics across subgroups. Blood profiles and dietary intake data were log transformed to normalize their distributions before analysis. Tertiles were used to check the trend of serum CRP levels based on diet. Linear regression models were used to assess the association between dietary intake and serum CRP levels. Binary logistic regression models were used to assess the association of having high serum CRP levels with dietary intake after adjustment for age and gender. All data were analysed using statistical package for social science (SPSS) version 23 and a p-value<0.05 was used to characterise statistically significant result.

# RESULTS

Table 1 illustrates the mean values and ranges of the nutrients and the recommended dietary allowance(RDA) of nutrients and serum CRP levels summarised as medians and 25th-75th percentiles by gender and overall population among Ellisras young adults aged 18 to 30 years. There was a significant (p<0.05) high sugar intake females (6.3g) compared to males (3.5g) and dietary fibre intake (Males 5.3g) females (6.9g). CRP was significantly high in females (0.5 mg/l) compared to males (0.1mg/l) in the Ellisras rural sample aged18 to 30 years.

**Table 1:** The Serum-CRP, means and mean ranges and RDA of dietary intake and levels by gender among ellisras rural young adults aged 18 to 30 years.

| | **Males median (25; 75)** | **Females median (25; 75)** | **Total population median (25 .75)** | **P-value** |
|---|---|---|---|---|
| Energy (kcal) | 3044.0(1673.8-5555.0) RDA 2400-3000 | 3415.0(1750.0-5013.0) RDA 2000 | 3281.0(1683.0-5270.0) | 0.215 |
| Digestible Carbohydrates (g) | 104.8 (53.7-169.7) RDA 130 | 113.4(55.1-172.6) RDA 130 | 108.7(53.9-171.8) | 0.346 |
| Total protein (g) | 29.5(16.2-52.5) RDA 56 | 30.5(15.3-49.1) RDA 46 | 30.2(15.6-50.7) | 0.721 |

| | | | | |
|---|---|---|---|---|
| Total fat (g) | 20.6(10.3-39.9)<br>AMDR 25-35 | 20.1(8.6-39.1)<br>AMDR 25-35 | 20.3(9.8-39.5) | 0.581 |
| Saturated fat (g) | 5.1(2.9-10.9) | 5.9(2.4-11.6) | 5.1(2.7-11.5) | 0.969 |
| Total sugar (g) | 3.5(0.9-13.2) * | 6.3(1.1-17.3) * | 5.2(1.5-16.6) | 0.011 |
| Dietary fibre (g) | 5.3(2.5-10.6) *<br>RDA 33.6 | 6.9(3.3-11.7) *<br>RDA 28 | 6.1(2.9-11.0) | 0.014 |
| Iron (mg) | 3.4(1.5-5.7)<br>RDA 8 | 3.6(1.7-5.9)<br>RDA 18 | 3.5(1.7-5.8) | 0.585 |
| Vitamin A (mg) | 25.0(0.0-118.0) *<br>RDA 900 | 59.0(3.0-194.0) *<br>RDA 700 | 37.0(2.0-150.5) | 0.008 |
| Vitamin E(mg) | 1.6(0.8-4.4)<br>RDA 15 | 2.1(0.7-5.3)<br>RDA 15 | 1.8(0.7-4.1) | 0.096 |
| Sodium(mg) | 401.0(97.5-931.5)<br>RDA 2300 | 516.0(112.0-959.0)<br>RDA 2300 | 458(.0(102.0-944.0) | 0.165 |
| Potassium(mg) | 616.5(286.5-1111.0) *<br>RDA 4700 | 734.0(326.0-1086.0) *<br>RDA 4700 | 675.0(305.0-1096.0) | 0.032 |
| Zinc(mg) | 3.3(1.4-5.8)<br>RDA 11 | 3.2(1.4-5.5)<br>RDA 8 | 3.3(1.4-5.6) | 0.912 |
| Calcium(mg) | 87.0(33.0-200.5) *<br>RDA 1000 | 117.0(48.0-225.0) *<br>RDA 1000 | 101.0(40.0-209.5) | 0.012 |
| Folate(mcg) | 49.0(16.0-98.0) *<br>RDA 400 | 58.5(21.3-117.0) *<br>RDA 400 | 53.0(19.0-105.0) | 0.032 |
| CRP (mg/l) RR<1.0mg/l-3.0mg/l | 0.1(0.0-0.4) * | 0.5(0.2-0.1) * | 0.3(0.1-0.7) | 0.000 |
| Anthropometric measurements | | | | |
| | Mean (SD) | Mean (SD) | Mean (SD) | |
| Weight | 64.93 (11.48) | 69.44 (17.06) | 67.31 (14.81) | 0.003 |
| Height | 173.92 (12.84) | 163.25 (9.84) | 168.31 (10.32) | 0.053 |
| BMI | 22.24 (10.35) | 26.87 (14.93) | 24.62 (13.13) | 0.002 |
| Waist circumference | 75.12(9.73) | 82.02 (14.63) | 75.75 (11.13) | 0.000 |

P< 0.05; Serum-CRP=serum C-reactive protein; RDA=recommended dietary allowance; AMDR=acceptable macronutrient distribution range, SD = standard deviation

Table 2 present the prevalence of dietary intake and serum CRP levels by gender and overall population. Majority of the population showed abnormal or low intake of dietary fibre (98.3%), potassium (99.9%), calcium (98.9%), and folate (98.9%) with low levels of serum CRP (83.3%).

**Table 2:** The prevalence of dietary intake and serum-CRP levels by gender among Ellisras young adults aged 18 to 30 years.

| Dietary intake | Males N (%) | Females N (%) | Total population N (%) | |
|---|---|---|---|---|
| Energy(kcal) | 124(35.6) | 97(26.7) | 221(31.1) | |
| Digestible Carbohydrates(g) | 218(63.4) | 198(54.8) | 416(59.0) | |
| Total protein(g) | 244(78.2) | 235(71.4) | 479(74.7) | |
| Total fat(g) | 225(63.4) | 230(62.2) | 455(62.8) | |
| Dietary fibre(g) | 289(99.3) | 293(97.3) | 582(98.3) | |
| Iron(mg) | 300(89.3) | 353(99.2) | 653(94.4) | |
| Vitamin A(mg) | 349(98.3) | 351(94.9) | 700(96.6) | |
| Vitamin E(mg) | 271(93.1) | 300(93.8) | 571(93.5) | |
| Sodium(mg) | 330(94.8) | 333(91.7) | 663(93.2) | |
| Potassium(mg) | 348(100) | 362(99.7) | 710(99.9) | |
| Zinc(mg) | 328(94.5) | 325(89.8) | 653(92.1) | |
| Calcium(mg) | 333(98.8) | 353(98.9) | 686(98.8) | |
| Niacin(mg) | 244(79.5) | 238(75.1) | 482(77.2) | |
| Folate(mcg) | 319(98.8) | 337(99.1) | 656(98.9) | |
| Crp (mg/l) | 283(92.2) | 254(75.1) | 537(83.3) | |
| | Mean (SD) | Mean (SD) | Mean (SD) | |
| Weight | 64.93 (11.48) | 69.44 (17.06) | 67.31 (14.81) | 0.003 |
| Height | 173.92 (12.84) | 163.25 (9.84) | 168.31 (10.32) | 0.053 |
| BMI | 22.24 (10.35) | 26.87 (14.93) | 24.62 (13.13) | 0.002 |
| Waist circumference | 75.12(9.73) | 82.02 (14.63) | 75.75 (11.13) | 0.000 |

P< 0.05; Serum-CRP=serum C-reactive protein; RDA=recommended dietary allowance; AMDR=acceptable macronutrient distribution range, SD = standard deviation

**Table 3:** Represent the trend of Serum-CRP tertiles based on dietary intake for males and females.

| Dietary intake | Males (95%CI) | | | P-value | Females (95% CI) | | | P-value |
|---|---|---|---|---|---|---|---|---|
| | Tertile 1 Median( IQR) | Tertile 2 Median( IQR) | Tertile 3 Median ( IQR) | | Tertile 1 Median( IQR) | Tertile 2 Median( IQR) | Tertile 3 Median( IQR) | |
| Energy (kcal) | 3.46(3.2-3.7) | 3.46(2.94-3.73) | 3.56(3.37-3.76) | 1.000 | 3.49(3.11-3.70) | 3.57(3.20-3.70) | 3.54(3.31-3.72) | 1.000 |
| Digestible Carbohydrates (g) | 2.02(1.76-2.24) | 1.97(1.49-2.11) | 2.07(1.84-2.28) | 0.312 | 1.99(1.73-2.23) | 2.11(1.70-2.23) | 2.06(1.79-2.27) | 1.000 |
| Total protein(g) | 1.41(1.1-1.65) | 1.56(1.22-1.77) | 1.53(1.34-1.75) | 0.189 | 1.43(1.05-1.63) | 1.49(1.19-1.67) | 1.41(1.22-1.73) | 1.000 |
| Total fat(g) | 1.23(0.97-1.57) | 1.31(1.04-1.67) | 1.42(1.16-1.64) | 0.159 | 1.29(0.93-1.54) | 1.26(0.91-1.57) | 1.32(1.03-1.66) | 1.000 |
| Saturated fat(g) | 0.73(0.42-0.97) | 0.83(0.49-1.09) | 0.87(0.61-1.12) | 0.259 | 0.69(0.42-1.10) | 0.71(0.28-1.03) | 0.81(0.46-1.13) | 1.000 |
| Total sugar(g) | 0.46(-0.01-1.04) | 0.66(0.00-1.16) | 0.49(-0.02-1.19) | 0.536 | 0.88(0.32-1.36) | 0.76(0.20-1.15) | 0.81(0.30-1.25) | 1.000 |
| Dietary fibre (g) | 0.79(0.51-1.08) | 0.60(0.32-0.81) | 0.69(0.35-0.93) | 0.239 | 0.88(0.48-1.00) | 0.85(0.51-1.12) | 0.85(0.51-1.08) | 1.000 |
| Iron (mg) | 0.52(0.18-0.75) | 0.49(0.11-0.69) | 0.57(0.33-0.78) | 0.339 | 0.51(0.18-0.76) | 0.59(0.26-0.77) | 0.56(0.26-0.79) | 1.000 |
| Vitamin A(mg) | 1.84(1.15-2.27) | 1.74(1.32-2.16) | 1.86(1.32-2.07) | 1.000 | 1.97(1.53-2.48) | 1.93(1.41-2.31) | 1.99(1.32-2.34) | 1.000 |
| Vitamin E(mg) | 0.16(-0.19-0.56) | 0.23(-0.04-0.75) | 0.19(-0.03-0.70) | 0.398 | 0.37(-0.17-0.78) | 0.29(-0.25-0.72) | 0.36(-0.15-0.76) | 1.000 |
| Sodium(mg) | 2.67(2.02-2.99) | 2.45(1.73-2.91) | 2.64(2.14-2.98) | 0.411 | 2.66(2.02-2.92) | 2.73(2.10-2.98) | 2.74(2.03-3.00) | 1.000 |
| Potassium(mg) | 2.76(2.41-2.99) | 2.79(2.28-3.04) | 2.86(2.57-3.07) | 0.708 | 2.88(2.57-3.02) | 2.84(2.52-3.06) | 2.87(2.49-3.04) | 1.000 |
| Zinc (mg) | 0.46(0.13-0.74) | 0.52(-0.09-0.77) | 0.55(0.26-0.82) | 1.000 | 0.48(0.03-0.67) | 0.51(0.16-0.74) | 0.53(0.21-0.77) | 1.000 |
| Calcium (mg) | 1.97(1.51-2.23) | 1.85(1.44-2.29) | 1.91(1.59-2.39) | 1.000 | 2.07(1.68-2.44) | 2.01(1.71-2.31) | 2.08(1.65-2.33) | 1.000 |
| Niacin (mg) | 0.78(0.36-1.09) | 0.94(0.64-1.23) | 0.95(0.60-1.12) | 0.053 | 0.81(0.37-1.11) | 0.83(0.51-1.16) | 0.84(0.44-1.18) | 1.000 |
| Folate (mcg) | 1.77(1.30-2.04) | 1.54(1.18-1.88) | 1.62(1.17-1.91) | 0.061 | 1.72(1.28-2.05) | 1.75(1.26-2.07) | 1.79(1.42-2.07) | 1.000 |

P< 0.05; Serum-CRP=serum C-reactive protein, IQR=interquartile range

**Table 4:** Linear Regression for the association of dietary intake and Serum-CRP levels among Ellisras young adults aged 18 to 30 years.

| | Unadjusted | | | Adjusted for age and gender | | |
|---|---|---|---|---|---|---|
| Variable | B | 95% CI | P-value | B | 95% CI | P- value |
| Serum-CRP | | | | | | |
| Total fat(g) | 0.11 | -0.51 0.73 | 0.729 | 0.05 | -0.56 0.67 | 0.863 |
| Total sugar(g) | 0.06 | -0.05 0.17 | 0.281 | 0.06 | -0.05 0.17 | 0.291 |
| Saturated fat(g) | -0.17 | -0.67 0.32 | 0.493 | -0.15 | -0.65 0.34 | 0.544 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Carbohydrates(g) | 0.23 | -0.14 | 0.59 | 0.217 | 0.24 | -0.12 | 0.59 | 0.197 |
| Total protein(g) | 0.23 | -0.49 | 0.10 | 0.527 | 0.24 | -0.47 | 0.95 | 0.501 |
| Iron (g) | 0.00 | -0.43 | 0.44 | 0.984 | 0.02 | -0.41 | 0.44 | 0.942 |
| Vitamin A(mg) | -0.00 | -0.13 | 0.13 | 0.993 | -0.01 | -0.14 | 0.12 | 0.878 |
| Vitamin E(mg) | -0.04 | -0.24 | 0.17 | 0.730 | -0.02 | -0.23 | 0.19 | 0.850 |
| Sodium (mg) | -0.01 | -0.33 | 0.13 | 0.404 | -0.07 | -0.29 | 0.16 | 0.567 |
| Potassium (mg) | -0.17 | -0.65 | 0.30 | 0.476 | -0.10 | -0.57 | 0.37 | 0.765 |
| Zinc (mg) | 0.32 | -0.23 | 0.87 | 0.253 | 0.31 | 0.23 | 0.85 | 0.260 |
| Calcium((mg) | 0.00 | -0.25 | 0.26 | 0.992 | -0.04 | -0.29 | 0.22 | 0.774 |
| Niacin (mg) | 0.01 | -0.34 | 0.36 | 0.967 | -0.02 | -0.37 | 0.33 | 0.907 |
| Folate (mg) | -0.12 | -0.35 | 0.12 | 0.325 | -0.13 | -0.36 | 0.10 | 0.276 |
| BMI(kg/m2) | 0.04 | 0.02 | 0.06 | 0.001* | 0.003 | 0.01 | 0.05 | 0.014* |
| WC(cm) | 0.00 | -0.01 | 0.01 | 0.632 | 0.00 | -0.01 | 0.01 | 0.525 |
| SBP(mmHg) | -0.01 | -0.02 | -0.00 | 0.001* | -0.01 | -0.01 | 0.00 | 0.038* |
| DBP(mmHg) | 0.00 | -0.00 | 0.01 | 0.257 | 0.00 | -0.01 | 0.01 | 0.562 |

P< 0.05; Serum-CRP=serum C-reactive protein; CI=confidence interval; β= beta; coefficient; BMI=body mass index; WC= waist circumference; SBP=systolic blood pressure; DBP=diastolic blood pressure

**Table 5:** Logistic regression indicating association of high serum CRP levels and dietary intake among Ellisras young adults aged 18 to 30 years.

| | Unadjusted | | | | Adjusted for age and gender | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | OR | 95% CI | | P-value | OR | 95% CI | | P-value |
| High Serum-CRP | | | | | | | | |
| Total protein(g) | 1.39 | 0.59 | 3.21 | 0.452 | 1.43 | 0.60 | 3.41 | 0.421 |
| Carbohydrates (g) | 1.23 | 0.61 | 2.17 | 0.471 | 1.13 | 0.64 | 2.01 | 0.674 |
| Total fat (g) | 0.61 | 0.35 | 1.35 | 0.278 | 0.73 | 0.38 | 1.43 | 0.364 |
| Iron (g) | 0.58 | 0.16 | 2.15 | 0.413 | 0.84 | 0.21 | 3.36 | 0.805 |
| Total dietary fibre (g) | 0.69 | 0.12 | 3.9 | 0.671 | 0.65 | 1.12 | 3.65 | 0.624 |
| Sodium (mg) | 0.51 | 0.17 | 1.49 | 0.216 | 0.52 | 1.17 | 1.57 | 0.246 |
| Zinc (mg) | 1.58 | 0.61 | 4.08 | 0.347 | 1.21 | 0.49 | 3.43 | 0.600 |
| Calcium (mg) | 1.64 | 0.20 | 13.42 | 0.643 | 1.84 | 0.22 | 15.31 | 0.573 |
| Niacin(mg) | 1.18 | 0.56 | 2.49 | 0.668 | 1.09 | 0.51 | 2.31 | 0.830 |
| Vitamin A(mg) | 1.58 | 0.51 | 4.84 | 0.427 | 1.53 | 0.49 | 4.77 | 0.460 |
| Vitamin E(mg) | 0.96 | 0.34 | 2.72 | 0.933 | 1.08 | 0.37 | 3.15 | 0.889 |
| BMI(kg/m2) | 0.43 | 0.19 | 0.98 | 0.044* | 0.49 | 0.21 | 1.11 | 0.087 |
| WC(cm) | 0.72 | 0.31 | 1.64 | 0.429 | 0.98 | 0.41 | 2.34 | 0.970 |
| SBP(mmHg) | 1.39 | 0.79 | 2.44 | 0.256 | 1.05 | 0.57 | 1.96 | 0.870 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DBP(mmHg) | 1.93 | 0.61 | 5.36 | 0.204 | 2.22 | 0.78 | 6.21 | 0.134 |

P< 0.05; Serum-CRP=serum c-reactive protein; CI=confidence interval; β= beta; coefficient; BMI=body mass index; WC= waist circumference; SBP=systolic blood pressure; DBP=diastolic blood pressure.

Table 3 illustrates the trend of Serum-CRP tertiles 1to 3 based on dietary intake for males and females and their 95% Confidence interval. Majority of the Ellisras rural young adults showed highest serum-CRP tertile (3.46-3.57) for energy. However, all dietary intake showed a non significant difference between different CRP tertiles. Dietary fibre showed no significant difference in all CRP tertiles for both males (p=0.239) and females (p=1.000).

Table 4 shows linear regression for the association of dietary intake and serum CRP levels. There was a significant association for BMI (body mass index) and SBP (systolic blood pressure) with serum CRP levels after unadjusted (P=0.001) (CL=0.02-0.06) (P=0.001) (CL=-0.02-0.00) and adjusted ((P=0.014) (CL=0.01-0,05) (P=0.038)(-0.01-0.00) for age and gender.

Table 5 illustrates logistic regression to assess the association of having high serum CRP levels with dietary intake. There was no significant difference between all dietary intake and serum CRP levels for both unadjusted and adjusted for age and gender except for Body mass index (BMI) which showed a significantly association with high serum CRP levels unadjusted for age and gender (OR=0.43; CL=0.19-0.98) (P<0.05).

# DISCUSSION

The aim of the study was to investigate the relationship between diet and subclinical inflammation among young adults aged 18 to 30 years from Ellisras area, South Africa. There was no significant association between dietary intake and CRP, a marker of subclinical inflammation amongst Ellisras rural young adults. Oldewage-Theron and Kruger [24] also found no significant association between dietary intake and subclinical inflammation. Several studies have also observed no significant association between hs-CRP and vitamin A, vitamin C and beta-carotene among adults [25, 26, 27]. Lazarau and Phillippou [28] reported a significant positive correlation between diet and subclinical inflammation while total fat intake showed and inverse relationship in the same study. However, Mchiza et al. [29] stated that South African rural populations are experiencing micronutrient deficiencies with very low intakes of energy and high intakes of energy in urban areas. This may be due to antioxidant nutrients being responsible for lowering hs-CRP levels [1].

In the current study linear regression showed a significant association between BMI and SBP with serum CRP levels unadjusted and adjusted for age and gender. Chaung et al. [30] reported a significant association between SBP with CRP levels among obese young adults in Taiwan. Our findings are in line with several studies that observed a positive significant association between higher BMI and serum hs-CRP and low-grade inflammation was found among overweight individuals aged <75 years old after adjusting for age, gender and BMI [31, 32]. This may increase risk of CVD and glucose intolerance which are phenomena of chronic inflammation and adipocyte itself is a key expresser of inflammatory molecules that increases CRP levels due to increased adiposity [32, 33]. Kao et al. [32] also found that higher BMI increases CRP levels indicating that overweight or obese adults are more vulnerable to adverse outcomes of chronic inflammation such as myocardial infarction and stroke. Reduction of Waist circumference is crucial in reducing the risk of low grade inflammation.The mechanism between diet and inflammation is mediated through the generation of an oxidative stress [35, 36]. The process of oxidative stress involves increased superoxide generation which in turn inactivates nitric oxide. Peroxynitrite iniates lipid peroxidation and nitrates amino acids such as tyrosine which negatively affects signal transduction [36]. This ultimately promotes the development of inflammation, which increases the risk for morbidity and mortality from cardiovascular disease.

This study has some limitation. Socio-demographic, physical activity and general health and metabolic risk markers were not included in the current data collection process. Furthermore, sample size resulting from the clotted and haemolysed samples which were excluded from the analysis could introduce bias in the interpretation of the results.

# CONCLUSION

There was no difference in dietary intake between those with normal serum CRP levels and those with high serum CRP levels. Linear and logistic regression analysis also showed no association between diet and serum CRP levels.. Future studies investigating the association of dietary intake and CRP over time in the current sample could add value in this rural South African population.

# REFERENCES

1. Navarro P, de Dios O, Jois A, Gavela-Perez T, Gorgojo L, Martin-Moremo JM, Soriano-Guillen L, Garces C et al. Vegetable and fruit intakes are associated with hs-CRP levels in Pre- Pubertal Girls. Nutrients 2017; 9:224.
2. Thompson AL, Adair L, Gordon-Larsen P, Zhang B, Popkin B et al. Environmetal, Dietary, and Behaivoral Factors Distinguish Chinese Adults with High Waist-to-Height Ratio with and without inflammation. J.Nutr. 2015; 145:44-1335.
3. Schmidt MI, Saad MJA, Duncan BB. Subclinical inflammation and obesity, diabetes and related disorders. Drug Discovery Today: Disease Mechanisms. 2005; 2:10.
4. Ko A, Kim H, Han CJ, Kim JM, Chung HW, Chang N et al. Association between high sensitive C- reactive protein in Vietnamese young women. Nutr Res Pract. 2014; 8:445-452.
5. Qureshi MM, Singer MR, Moore LL. A cross sectional study of food groups intake and C- reactive protein among children. Nutr Metab. 2009; 6:40.
6. Van Den Ende C, Twisk JW, Monyeki KD, The relationship between BMI and dietary intake of primary school children from a

rural area of South Africa: The Ellisras Longitudinal Study. Am J Hum Biol. 2014; 26:701–706.

7. Sidiropoulos E, Jeffery A, Mackay S, Gallocher R, Forgey H, Chips C. South Africa Survey 1995/1996. South African Institute of Race and Relations: Johannesburg. 1996; 234– 360.

8. Bradshaw D, Stey K. Poverty and Chronic Disease in South Africa: Technical Report. Medical Research Council: Cape Town. 2001; 38–45.

9. Statistics South Africa, Cause of Death in South Africa 1997–2001: Advance Release of Records of Death. Statistics South Africa: Pretoria 2002; 18–42.

10. Monyeki KD, Cameron N, Getz B, Growth and nutritional status of rural South African children 3–10 years old: The Ellisras growth study. Am J Hum Biol. 2000; 12: 42-49.

11. Monyeki KD, Van Lenthe FJ, Steyn NP. Obesity: does it occur in African children in a rural community in South Africa? Int.J.Epidemiol. 1999; 28: 287-292.

12. Monyeki KD, Toriola AL, de Ridder JH, Kemper HC, Steyn NP, Nthangeni ME, Twisk JW, Van Length, FJ et al. Stability of somatotypes in 4 to 10 year-old rural South African girls. Ann. Hum. Biol. 2002; 29: 37-49.