*Journal of Health Sciences and Innovative Research 2025;6(1):22-34*
DOI: https://doi.org/10.31357/jhsir.v6i01.8594

## *Research Article*

# Anaemia and anthropometric indices of obesity in early rheumatoid arthritis patients attending the rheumatology clinic at Colombo South Teaching Hospital - Necessity to screen for anemia early

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**Abstract**

Introduction: The study's objective was to determine selected nutritional and anthropometric parameters of patients with early Rheumatoid Arthritis (RA). Methods: The socio-demographic characteristics, and haemoglobin (Hb), anthropometric parameters, and seven site skin fold thicknesses of early RA patients (n=100) were compared with healthy controls (n=100) from the year 2018-2020. Body densities (BD) and body fat percentages (BF%) were calculated according to Jackson & Pollock anthropometric equations. The data were analyzed by SPSS-version-20, considering $p<0.05$ as statistically significant. Results: The mean age of the participants was 48.6±7.6 years, and the majority were female (84%). Female RA patients had significantly higher BMI (26.9±4.5 kg/m$^2$) ($p=0.04$), Waist Circumference (WC) [97.7±11.9 cm] ($p<0.001$), and waist-to-hip ratio (WHR) [0.98±0.10] values ($p<0.001$) compared to female controls (BMI-25.7±3.5 kg/m2, WC-91.0±9.5 cm, and WHR-0.93±0.06). Female patients had a significantly lower BD (1.030±0.010 g/ml) ($p<0.001$) and significantly higher BF% (26.3±5.1) ($p<0.01$) than controls. Abdominal obesity was evident among 95.0% of all RA patients and 92.0% of controls. Hb levels of male (12.5±1.2 g/dl) and female RA patients (11.9±1.1 g/dl) were significantly lower compared to healthy males (14.5±1.3 g/dl) and females (14.6±1.9 g/dl) ($p<0.001$). Anaemia was observed among 50% of total early RA patients and 5% of controls. Conclusion: A significant proportion of early RA patients was anaemic and had anthropometric impairment compared to healthy controls. Thus, the onset of nutritional impairment among RA patients should be evaluated even at the early stages of RA.

**Keywords:** Early rheumatoid arthritis, Nutritional status, Anemia, Obesity, Anthropometry

## Introduction

Rheumatoid arthritis (RA) is a chronic, systemic, polyarticular, autoimmune inflammatory disease which affects about 1% of the adult population in the world [1]. The highest incidence of RA is reported within the age limit of forty to sixty years, with a higher risk for the female gender [2]. Though precise aetiology and pathogenesis of RA are still under investigation, genetic, environmental and hormonal factors are found to trigger disease onset. Cytokines and other inflammatory mediators that develop in RA give rise to a whole range of systemic manifestations along with articular syndrome of joint and bone destruction [3]. Initiation of treatment for RA at an early stage is beneficial in clinical practice as the early stage of RA is considered to represent a

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Received: 11 September 2024; Accepted: 18 August 2025

How to cite this article:
Wijekoon, W.M.P.D.S., Warnakulasuriya S.S.P., Perera, P.P.R. Anaemia and anthropometric indices of obesity in early rheumatoid arthritis patients attending the Rheumatology Clinic at Colombo South Teaching Hospital - Necessity to screen for anemia early, Journal of Health Sciences and Innovative Research, 2025;6(1):23-34

potential window of opportunity for therapeutic intervention [4].

Anemia and nutritional imbalances are two of the most common extraarticular complications that affect two-thirds of patients with rheumatoid inflammation [3,5]. Excess production of pro-inflammatory cytokines such as tumour necrosis factor-alpha, interleukin-1, and interleukin-6 causes the development of both anaemia and nutritional impairment in RA [3,5,6].

Anemic syndrome is a widespread manifestation of rheumatoid inflammation [1], which is reported to be negatively associated with quality of life in RA [7-8]. Iron deficiency anaemia (IDA), anaemia of chronic disease (ACD), hemolytic anaemia, megaloblastic anaemia, and a combination of IDA and ACD have been reported to occur in patients with RA [5]. Changes in iron metabolism due to the therapeutic administration of steroid drugs also lead to anaemia in RA [7]. The nature and cause of anaemia in RA need to be investigated and must not be assumed to be simply ACD [6]. Anaemia is positively associated with disease activity and active symptoms of RA patients, and haemoglobin (Hb) levels could be an indicator for predicting structural damage of the disease [7]. Inflammation and obesity have been found to be closely associated [9]. Obesity is a condition in which there is existence of excess body fat which raises the risk for non-communicable comorbidities [10]. Obesity is further characterized as a low-grade systemic inflammation in which higher circulating inflammatory markers are present in overweight and obese subjects [8]. Body Mass Index (BMI), Waist to Hip Ratio (WHR) and Waist Circumference (WC) cutoffs are the commonly used anthropometrical indices which define the severity of generalized body obesity, abdominal obesity and associated metabolic risks [9-11]. RA patients have an added burden if obese, when compared to the general population as obesity further raises RA activity and reduces remission rates [12-14].

The prevalence of anaemia and nutritional imbalances due to the chronic inflammatory nature of RA have been widely discussed in previous research. However, research on the development of anaemia and body adiposity, specifically at an early stage of RA and among a South Asian RA population, is lacking.

A clear definition for early stage of rheumatoid arthritis is lacking although early initiation of treatments is considered to be important. There have been more descriptive and interventional research carried out under the early-stage category of rheumatoid arthritis. Most of that research have considered RA disease duration to define early stage of RA and the disease durations they have used range from less than 3 months to 5 years. Precisely, the patients who haven't had treatments with corticosteroids or DMARD prior to be diagnosed with RA and those who are having RA symptoms for disease duration of less than 5 years are traditionally considered as patients who have early RA for clinical trial purposes [4].

In Sri Lanka, the prevalence of early RA in sub-urban Colombo is 0.7% based on the RA classification criteria provided by the American College of Rheumatology [15]. High prevalence of anaemia among preschool (33%), non-pregnant (39%) and pregnant populations (34%) have been reported in Sri Lanka, and anaemia is considered a moderate public health problem in the country [16]. The community prevalence of BMI-based overweight and obesity and WC-based abdominal obesity in the adult population of the urban Colombo District is on the rise [17].

Reported higher measures of anaemia and nutritional impairments in the Sri Lankan general population could negatively affect the disease outcome of the Sri Lankan RA population as the

disease process of RA further worsens anaemia. Hence, this study was conducted to determine the severity of anaemia and nutritional impairment levels along with selected nutritional and anthropometric parameters of patients with early RA and age, sex, and working category matched healthy controls in Sri Lanka.

## Methods

### *Study population*

This cross-sectional group comparison study was conducted between 2018 and 2020 in the Colombo District of Sri Lanka. The study sample consisted of patients diagnosed with early RA and healthy controls. The inclusion criteria for patient group included having a medical diagnosis of rheumatoid arthritis, having RA symptoms for four years or less, patients who haven't had treatments with corticosteroids or DMARD prior to being diagnosed with RA, being employed, and were able to read, write and speak in Sinhala. Patients who were under treatment for any diagnosed chronic disease other than RA were excluded as per exclusion criteria. All the selected RA patients met the criteria for RA that has been defined by the American College of Rheumatology [18]. All participants were categorized into three work categories based on the type of occupation [19]. The inclusion criteria for recruited control group included people who did not have a medical diagnosis of rheumatoid arthritis, people who were employed, and people who could read, write and speak in Sinhala. Those who were under treatment for any diagnosed chronic disease were excluded from control sample.

Sample size was calculated following difference in means formula for case control studies [20]. Equal number of cases and controls (r=1) with 80% power and, 1.96 statistical significance were selected according to mean values of one of the nutritional parameters for RA patients and healthy controls [21], resulting in sample size calculation as 70. However, 100 patients and 100 controls were selected as the sample size to increase the sensitivity of the research findings. Participants were recruited using the convenience sampling method to maximize enrollment with the limited availability of participants adhering to inclusion and exclusion criteria. Data was collected at RA Clinic at the Colombo South Teaching Hospital, Kalubowila, Sri Lanka. Age, sex and employment status matched healthy control group was recruited from the community among the consenting people of those who had the same demographical background of the patients through an open advertisement.

Ethical clearance for this study was obtained from the Ethics Review Committee of University of Sri Jayewardenepura, Ethical Review Committee of Colombo South Teaching Hospital, and Ethical Review Committee of Sri Jayewardenepura General Hospital.

### *Data collection*

#### Anthropometric data

Anthropometric measurements were taken according to standard techniques given by the Anthropometry Procedures Manual, National Health and Nutrition Examination Survey [22]. Weight, height, hip circumference, waist circumference, thigh circumference, mid-upper arm circumferences, and chest, axilla, triceps, subscapular, abdomen, supra iliac, and mid-thigh skin fold thicknesses were measured.

Subjects were classified into BMI categories according to guidelines for South Asian populations [10]. The high risk of metabolic complications based on WC cutoff (men: >85 cm, women: >80 cm) and WHR (men: >0.89, women: >0.81) were considered by World Health Organization (WHO) guidelines for Asia [11, 23]. Body density (BD) and body fat percentage (BF%) were calculated by applying Jackson & Pollock seven-site skin fold equation and four-site skin

fold equation, respectively, adhering to relevant guidelines [24-25].

**Biochemical parameters**

Blood samples were collected from consenting patients and consenting control group on the same day the anthropometric parameters were collected. The collected blood samples were labelled, transported and stored according to standard guidelines. Serum samples were stored under -20 C° temperature until sample analysis.

Blood samples were analyzed for serum hemoglobin levels by cyanmethemoglobin method (DIRUI BCC 3000 haematology analyzer, China). Serum haemoglobin was tested by Family Practice Center of Department of Family Medicine, Faculty of Medical Sciences (FMS), University of Sri Jayewardenepura (USJ).

Presence of anaemia based on Hb levels among participants was assessed (women: Hb <120 g/l, Hb<130 g/l for men) according to WHO criteria [16] and severity of anaemia was further categorized as mild (men; 110-129 g/L, women: 110-119 g/L), moderate (men & Women: 80-109 g/L), and severe (men & Women: <80 g/L) [16,24].

***Statistical analysis***

Data were analyzed by SPSS, version 20.0. The probability of P<0.05 was considered to be statistically significant. The Kolmogrov-Smirnov and Shapiro-Wilk tests were applied to test the normality of the continuous variables. The Mann-Whitney U test was performed for nonparametric data, and the independent sample t-test was applied to compare continuous data on anthropometric and biochemical parameters of patients and controls. The differences in proportions between the groups were compared using the Chi-square test.

**Results**

The study population consisted of 84 female early RA patients and 16 male early RA patients and age, gender and job category matched control sample of 84 females and 16 males. Patient and control volunteers consisted of residents from an urban area in Colombo, with the majority (69%) being engaged in the light physical job category (Table 1).

***Weight and BMI of study participants***

The overall anthropometrical data of patients and controls are given in Table 2 and Table 3. According to BMI classifications, half of male patients (50%) were within the normal BMI range, yet by contrast, only 16.7% of female patients were within the normal BMI range, and 2.4%, 10.7%, 46.4%, and 23.8% of female RA patients were in the underweight, overweight, obese I, and obese II categories, respectively (Table 2).

***Waist circumference and abdominal obesity***

The mean WC of both male and female RA patients and controls were not within the normal range. The mean WC of male and female RA patients were 91.1±11.7 cm and 97.7±11.9 cm, respectively, while the mean WC of female RA patients was significantly high (p<0.001) compared to controls. Alarmingly, 95.0% of RA patients and 92.0% of healthy controls had abdominal obesity (Table 2) while both male (0.98±0.09) and female (0.98±0.10) RA patients had significantly high (p<0.001) mean values of WHR compared to healthy controls (Table 3).

***Skin fold thickness, body fat percentage and body density***

Mean BD and mean BF% of male RA patients were 1.061±0.008 (g/ml) and 17.9±3.9 respectively while female RA patients had a significantly lower BD (1.030±0.010 g/ml, p=0.028) but significantly high BF% (26.3±5.1, p=0.030) compared to controls (Table 3).

According to the BF%-based cutoff points for overweight and obesity, only 12.5% of male RA

**Table 1**: Demographic characteristics of patients with early RA

| **Demographic variables** | | **Patients (n=100)** | **Male (n=16)** | **Female (n=84)** |
|---|---|---|---|---|
| **Age (years)** | Mean ± SD | 48.6±7.6 | 48.9±8.9 | 48.5±7.4 |
| **Disease Duration (years)** | Mean ± SD | 2.3±1.3 | 2.4±1.2 | 2.3±1.3 |
| | <1year % (n) | 21 (21) | 12.5 (2) | 22.6 (19) |
| | 1-2 years % (n) | 30 (30) | 50.0 (8) | 26.2 (22) |
| | 2-3 years % (n) | 25 (25) | 12.5 (2) | 27.4 (23) |
| | 3-4 years % (n) | 24 (24) | 25.0 (4) | 23.8 (20) |
| **Work Category (%)** | Sedentary % (n) | 21 (21) | 12.5 (5) | 22.6 (16) |
| | Light physical % (n) | 69 (69) | 37.5 (3) | 75.0 (66) |
| | Heavy Physical% (n) | 10 (10) | 50.0 (8) | 2.4 (2) |

SD-Standard Deviation, n- Number of participants

patients were overweight, and none were obese. However, female RA patients had a higher proportion of unhealthy high BF% than men, where 20.2% of female RA patients were

**Table 2**: Body mass index, waist circumference and body fat percentage classifications of participants

| **Anthropometric measures** | | **Patients (n=100)** | **Controls (n=100)** | **Male (n=16)** | | **Female (n=84)** | |
|---|---|---|---|---|---|---|---|
| | | | | **Patients** | **Controls** | **Patients** | **Controls** |
| **BMI ($kg/m^2$)** | Underweight (<18.5) | 4.0% (n=4) | 2.0% (n=2) | 12.5% (n=2) | 12.5% (n=2) | 2.4% (n=2) | 00% (n=00) |
| | Normal range (18.5–22.9) | 22.0% (n=22) | 31.0% (n=31) | 50.0% (n=8) | 37.5% (n=6) | 16.7% (n=14) | 29.8% (n=25) |
| | Overweight (23–24.9) | 9.0% (n=9) | 24.0% (n=24) | 00% (n=00) | 37.5% (n=6) | 10.7% (n=9) | 21.4% (n=18) |
| | Obese I (25-29.9) | 41.0% (n=41) | 34.0% (n=34) | 12.5% (n=2) | 12.5% (n=2) | 46.4% (n=39) | 38.1% (n=32) |
| | Obese II (≥ 30) | 24.0% (n=24) | 9.0% (n=9) | 25.0% (n= 4) | 00% (n=00) | 23.8% (n=20) | 10.7% (n=9) |
| **BF%** | Overweight | 19.0% (n=19) | 10.0% (n=10) | 12.5% (n=2) | 25.0% (n=4) | 20.2% (n=17) | 7.1% (n=6) |
| | Obese | 02% (n=02) | 00% (n=00) | 00% (n=00) | 00% (n=00) | 2.4% (n=2) | 00% (n=00) |
| **Waist: Hip ratio** | Abdominal obesity | 95% (n=95) | 84.0% (n=84) | 87.5% (n=14) | 81.3% (n=13) | 96.4% (n=81) | 84.5% (n=71) |
| | Risk for metabolic complications | 95% (n=95) | 88.0% (n=88) | 87.5% (n=14) | 81.3% (n=13) | 96.4% (n=81) | 89.3% (n=75) |
| **WC** | Risk for metabolic complications | 93% (n=93) | 73.0% (n=73) | 75% (n=12) | 50.0% (n=50) | 96.4% (n=81) | 77.4% (n=65) |

BMI-Body Mass Index, BF%-Body Fat%, WC-Waist Circumference

overweight and 2.4% were obese under the BF% cutoff points (Table 2).

There was a statistically significant positive linear relationship between WC and BF% (P<0.001), further emphasizing the presence of central

**Table 3**: Anthropometric measurements of RA patients and control group

| Measures | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | Patients Mean±SD | Controls Mean±SD | P value | Patients Mean±SD | Controls Mean±SD | P value |
| **BMI (Kg/m²)** | 24.3±5.3 | 22.5±2.8 | 0.780 | 26.9±4.5 | 25.7±3.5 | 0.046* |
| **WHR** | 0.98±0.09 | 0.93±0.04 | 0.035* | 0.98±0.10 | 0.93±0.06 | 0.000* |
| **WC (cm)** | 91.1±11.7 | 85.9±6.5 | 0.129 | 97.7±11.9 | 91.0±9.5 | 0.000* |
| **Hip Circumference (cm)** | 92.6±8.7 | 92.7±7.4 | 0.985 | 98.9±8.9 | 97.5±6.8 | 0.232 |
| **Mid-Thigh Circumference (cm)** | 44.5±6.1 | 45.4±3.4 | 0.611 | 53.3±10.8 | 49.9±5.6 | 0.019* |
| **Mid Arm Circumference (cm)** | 28.3±3.8 | 27.9±3.1 | 0.765 | 29.8±3.7 | 29.3±3.6 | 0.024* |
| **Seven-sites skin folds measurements (mm)** | | | | | | |
| **I. Mid Arm** | 13.9±4.3 | 14.1±3.7 | 1.000 | 23.6±6.4 | 25.6±7.7 | 0.016* |
| **II. Subscapular** | 15.3±5.0 | 17.6±5.7 | 0.196 | 22.7±6.6 | 20.1±5.4 | 0.006* |
| **III. Chest** | 7.8±4.9 | 11.4±4.2 | 0.030* | 11.6±4.9 | 14.4±5.2 | 0.000* |
| **IV. Mid Axillary** | 12.8±4.7 | 13.3±2.9 | 0.688 | 21.6±7.2 | 18.9±5.2 | 0.006* |
| **V. Abdominal** | 19.1±6.3 | 20.7±4.7 | 0.435 | 30.1±13.6 | 24.6±5.9 | 0.000* |
| **VI. Supra Illiac** | 16.6±5.3 | 15.9±4.8 | 0.752 | 25.1±7.0 | 20.6±5.2 | 0.000* |
| **VII. Mid-Thigh** | 11.9±4.4 | 13.2±3.6 | 0.362 | 26.9±8.9 | 23.5±8.0 | 0.034* |
| **Body Density (gm/ml)** | | 1.060±.0082 | 0.956 | 1.030±0.010 | 1.036±0.010 | 0.001* |
| **Body Fat %** | 17.9±3.8 | 17.5±3.8 | 0.323 | 26.3±5.1 | 23.7±4.5 | 0.002* |

*p<0.05 considered as significantly different, BMI-Body Mass Index, WHR-Waist to Hip Ratio, WC-Waist Circumference

obesity in this RA population. Skin fold thicknesses, mid-arm circumference and mid-thigh circumferences of RA patients and controls are shown in Table 3.

***Haemoglobin***

The Mean Hb values of male and female RA patients were 12.45±1.18 g/dl and 11.86±1.12 g/dl, respectively, which were significantly low ($p<0.005$(?)) compared to healthy controls (Table 4). Anaemia was observed in 50.0% of early RA patients, while only 5.0% of the control group had anaemia. Among male RA patients, 75% were anaemic, and among female RA patients, 45.2% were anaemic (Table 5). Among non-anemic participants, both male and female RA patients had a significantly low ($p<0.001$) Hb level compared to non-anemic controls (Table 4).

**Discussion**

Early diagnosis of RA and recognition of disease-related complications in the early stage are vital prerequisites to implementing current therapeutic interventions to prevent joint damage and to control the further occurrence of RA-related complications [27]. Anemia is a frequent extraarticular manifestation which develops in 30-70% of patients with RA [5,28]. Anaemia in RA is common, multifactorial, and potentially both serious and correctable [7]. The commonly identified risk factors for anaemia are iron deficiency, reduced vitamin B-12 levels, and reduced folic acid levels [29], while anaemia among RA patients is further explained under the ACD category. Impaired iron uptake and transferrin binding by erythroblasts [30], blunted response to erythropoietin [28], altered red cell kinetics including hemolysis and reduced red cell lifespan due to increased phagocytic activity by activated macrophages and disturbances in iron metabolism are explained as potential contributory factors for anaemia among RA patients under ACD of those who have longer disease durations [29].

The current study assessed the status of anaemia specifically among early RA patients who have had RA-related signs and symptoms for not more than four years.

Anaemia was observed in 50% of early RA patients and only 5.0% among the control group of the present study. A similar result has been reported in a study conducted in China [8] with a larger sample (n=890) of RA patients with a longer disease duration (median:7 years, minimum:2 years, maximum:15 years). According to the findings of current study, the early onset of

**Table 4**: Haemoglobin concentrations among RA patients and controls

| Measurements | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | Patient Mean±SD | Control Mean±SD | P value | Patient Mean±SD | Control Mean±SD | P value |
| **Hb (g/dl): (Total study participants)** | 12.5±1.2 (n=16) | 14.5±1.3 (n=16) | 0.000* | 11.9±1.1 (n=84) | 14.6±1.9 (n=84) | 0.000* |
| **Hb (g/dl): (Anemic participants)** | 11.97±0.76 (n=12) | - (n=00) | - | 10.9±0.8 (n=38) | 11.5±0.7 (n=05) | 0.071 |
| **Hb (g/dl): (Non-anemic participants)** | 13.9±0.8 (n=04) | 16.0±1.3 (n=16) | 0.000* | 12.7±0.6 (n=46) | 14.7±1.7 (n=75) | 0.000* |

*$p<0.05$ considered as significantly different

**Table 5**: Proportion of anemia among RA patients and controls

| Anemia/Non-Anemia | All RA Patients %(n) | All Controls %(n) | Male | | Female | |
|---|---|---|---|---|---|---|
| | | | RA Patients %(n) | Controls %(n) | RA Patients %(n) | Controls %(n) |
| **Non-Anemia** | 50.0% (50) | 95.0% (95) | 25% (4) | 00 (00) | 54.8% (46) | 94.0% (79) |
| **Anemia** | 50.0% (50) | 5.0% (5) | 75.0% (12) | 00 (00) | 45.2% (38) | 6.0% (5) |
| **Mild Anemia** | 30.0% (30) | 4.0% (4) | 62.5% (10) | 00 (00) | 23.8% (20) | 4.8% (4) |
| **Moderate Anemia** | 20.0% (20) | 1.0% (1) | 12.5% (2) | 00 (00) | 21.4% (18) | 1.2% (1) |

anaemia in RA patients is evident even within a shorter disease duration which has not been reported in previous studies.

The severity of anaemia could become more with a longer disease duration [8]. The present study observed a negative correlation between disease duration and Hb levels of all early RA patients. In contrast, Hb levels of anaemic early RA patients did not significantly correlate with disease duration. These results predict that the incidence of anaemia can become high without affecting the severity of anaemia with longer disease duration in the early RA stage.

The current study findings emphasize the importance of implementing interventions to manage anaemia among RA patients since early stages of RA to mitigate the long-term impact.
The nutritional status of patients with established RA is reported to be poor, with a higher prevalence of obesity and altered anthropometrical measures. Studies on anthropometry-based nutritional status assessment in South Asian RA populations and specifically in early stages of RA are not reported. The nutritional status of current study participants was alarmingly poor compared to the available previous research based on European and East Asian regions. Obesity is one of the well-established risk factors for many metabolic diseases. The presence of excessively accumulated body fat is considered as obese [10], and BMI is the primary and most frequently used index to determine body adiposity. Obesity among RA patients is observed to increase over time, possibly due to a rise in obesity in the general population worldwide [32]. A comparative cohort on BMI distribution has reported obesity among 23.8% and 23.4% of the patient population in Germany with early RA and established RA, respectively [34]. Independent of disease duration, a comparatively higher percentage of female (70.2%) and male (37.5%) RA patients in the present study were obese based on Asian BMI classifications [10]. However, inter-ethnic explanations based on BMI cannot be justified as BMI does not reflect fatness uniformly in all populations [34]. For a global comparison, attention has to be paid towards reported higher obesity rates of the current study population as Asians are identified to have a disease risk at lower BMI values compared to global cutoff values for others [23].

Asians are reported to have 3% to 5% higher total BF when compared to Europeans with the same BMI [10, 35]. Moreover, BMI is known to tend to overestimate BF% levels among individuals with well-developed musculature [35]. The sum of skin folds in four sites has been considered a good measure of total BF [36]. The present study further

calculated the BF% of study participants based on skin fold thickness equations, as it has been proposed not to use BMI as a precise indicator for BF% due to its inherent inability to distinguish fat and lean tissue. Among those within the normal BMI range, only one (8.3%) female RA patient and one (25%) male RA patient were overweight based on their elevated BF%. However, the presence of a comparatively higher percentage of overweighed patients (male:12.5%, Female: 20.2%) and a lesser percentage of obese patients (male:00%, Female:2.4%) was evident based on BF% cut-off values in contrast to the presence of higher percentage of obese patients than overweight patients under BMI cutoffs.

Indians have higher upper-body adiposity, although they have lean body mass [23]. Chinese and South Asian men and women display a greater amount of visceral adipose tissue for a given WC than Europeans [34]. Similarly, a higher prevalence of abdominal obesity was evident among both patient (95.0%) and control (92.0%) samples in the present study. Directing alarming attention towards the study participants, the majority of male RA patients (37.5%) showed an increased risk for comorbidities and the majority of female RA patients showed severe risk (46.05%) for comorbidities according to the Asian WC classifications.

Current study provides novel insights into the early onset of anaemia in RA patients, demonstrating a high prevalence within a short disease duration of ≤4 years, a stage underexplored in previous research. Compared to the previous research on longer disease durations of RA, the current study revealed that incidence of anaemia increases with disease progression without affecting its severity in the early stages. Additionally, this study is the first to report a high prevalence of obesity and significant nutritional challenges among early RA patients in a Sri Lankan sample.

The usage of predictive equations derived from skinfold measurement for fat mass estimation is a limitation of this study, as dual X-ray absorptiometry would have provided even more accurate results. It would have been better if differential diagnosis of anaemia among current early arthritis patients could have been performed by measuring serum iron, erythropoietin, transferrin levels and total iron binding capacities through further biochemical analysis [5].

## Conclusion

Poor nutritional status is most pronounced among female patients in the early RA stage. Compared to the general population, a higher prevalence of obesity and anaemia was observed in both male and female patients, and they were at substantially increased risk for metabolic complications according to WHR classifications. The manifestation of poor nutritional status in early RA patients highlights the importance of providing nutritional status assessment and management through the involvement of dieticians from the commencement of the RA treatment regime irrespective of stage of disease.

## Acknowledgement

The authors acknowledge the participants and the staff of the Biochemistry Research Laboratory, University of Sri Jayewardenepura, Sri Lanka for help extended during laboratory work. University of Sri Jayewardenepura is acknowledged for funding (Grant numbers: ASP/01/RE/MED/ 2016/44 and ASP/01/RE/MED/2017/65).

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