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# Ageing in the working population associated with obesity and cardiovascular risk parameters

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## Abstract

**Objective:** The shift experienced in recent decades in developed countries, with an aging population, also affects the working population. This is associated with an increase in diseases such as obesity and cardiovascular risk. The objective of this study is to understand the relationship between aging in men and women with respect to obesity and cardiovascular risk in a working population.

**Materials and methods:** A cross-sectional descriptive study was conducted on 389 workers in the chemical industry sector of the Autonomous Community of Murcia. The relationship between age and BMI, CUN BAE, and RCV SCORE in men and women was calculated.

**Results:** In both sexes, people ≥ 50 years show a higher BMI and body fat percentage than those < 50 years with p <0.001. In the female population aged ≥ 50 years, an increase in body fat percentage is observed compared to those aged < 50 years with p <0.001. CUN BAE shows higher values in individuals aged ≥ 50 years in both sexes (p <0.001), being higher in women. The RCV SCORE in both sexes is low in the studied population, with no significant differences observed by sex and age.

**Conclusions:** Significant differences are observed in workers aged ≥ 50 years in obesity, BMI, and CUN BAE. Therefore, in order to act in primary prevention and health promotion in obesity and RCV related to aging within companies, it is useful to include parameters such as: BMI, CUN BAE, and RCV SCORE in health surveillance protocols.

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## Introduction

Over the last decades, humanity has experienced a demographic change with an increase in life expectancy and low birth rates, resulting in a higher aging of the population (1). This, coupled with the delay in retirement age due to people extending their working lives after education and career advancement, associated with the limited social resources of governments to support retirements at earlier ages, has led to a delayed entry of the younger population into the labor market, leading to an increase in the older population in organizations (2).

There is no consensus age that regulates aging, although most authors place it between 50-55 years (1,3). Aging entails a series of changes in cellular metabolism that lead to a decrease in an individual's physical and mental capacity, increasing the risk of chronic diseases such as obesity and cardiovascular pathologies (4).

Obesity is a multifactorial disease characterized by an excess of total body fat (5) and has become a global problem, with an increasing prevalence in both low socio-economic populations and those with higher resources. Obesity rates have doubled since 1980, and almost a third of the world's population is in the overweight or obese category (6), with subsequent negative impacts on health and high costs for healthcare systems (7,8).

Cardiovascular disease (CVD) is associated with aging and is considered the leading cause of disability and death globally in middle-aged and older adults. It includes different types of diseases such as coronary heart disease, cerebrovascular diseases, peripheral artery disease, rheumatic heart disease, congenital heart diseases, deep vein thrombosis, and pulmonary embolism, among others (9). Cardiovascular risk (CVR) is defined as the probability of experiencing a CVD within a specific period, usually between five and ten years (10).

From the perspective of occupational health, the aging of the population poses an increase in pathologies with a tendency to become chronic, resulting in negative consequences for individuals and economic repercussions for companies, including decreased productivity and increased absenteeism, with high socio-sanitary costs for countries (11).

Preventive strategies are proposed to prevent or delay the consequences of physical and mental aging, promoting the integration of older groups both socially and professionally, while maintaining their level of performance and work productivity (12).

The objective of this study is to understand the relationship between aging in men and women associated with obesity and CVR in a population of workers, in order to facilitate subsequent control and monitoring actions from companies in prevention, surveillance, and health promotion, maintaining the quality of life and productivity of the people who work in organizations.

## Materials and methods

This is a descriptive cross-sectional study conducted on a Spanish working population from the chemical industry sector in the Autonomous Community of the Region of Murcia. The study included a representative sample of 389 workers, consisting of 311 males and 78 females, aged between 18 and 65 years. Data were collected during health surveillance examinations conducted by the company from November 2018 to September 2021. Participation in the study was voluntary, and informed consent was obtained for the epidemiological use of the results, following Spanish legislation (13,14).

Inclusion criteria were voluntary participation, not being on sick leave at the time of the health examination, and providing informed consent for data use for epidemiological purposes.

The study was approved by the Ethics Committee for Clinical Research of the Balearic Health Area (IB 4383/20).

Obesity was calculated using the Body Mass Index (BMI), which is obtained by dividing weight (kg) by height (m) squared (BMI = kg/m2). The BMI ranges defined by the World Health Organization (WHO) were used: Normal weight between 18.5 and 24.9; Overweight between 25 and 29.9; Obesity grade I between 30 and 34.9; Obesity grade II between 35 and 39.9; and Obesity grade III ≥ 40 (15,16). Weight and height measurements were taken using an OMRON BF 400 scale and a SOEHNLE Professional stadiometer, respectively.

The CUN BAE formula was used as an indicator of adiposity. It considers males as 1 and females as 0, with values stratified as follows: for males: normal 10-20%, overweight 20-25%, obesity > 25%; for females: normal 20-30%, overweight 30-35%, obesity > 35% (17).

Cardiovascular risk (CVR) was calculated using the SCORE model, which is accepted by the scientific community for studying European populations. It estimates the probability of developing cardiovascular-related death (coronary heart disease, cerebrovascular disease, peripheral arterial disease) within a 10-year

period. The following values were considered: low ≤ 3%, moderate 4-5%, and high > 5% (18).

Social and occupational variables included in the study were:

- Age ranges: 18-30 years, 31-45 years, 46-60 years, > 60 years. Obesity and cardiovascular risk in men and women were compared using 50 years as the cutoff age.
- Sex: male or female.
- Marital status: married, separated, or single.
- Type of cohabitation: living with family or living alone.
- Social class and type of work: based on the National Classification of Occupations for the year 2011 (CON-11) (19). For this study, it was simplified into three categories: Class I. Managers, university professionals, athletes, and artists. Class II. Intermediate occupations and self-employed workers without employees. Class III. Unskilled workers. The type of work was classified as manual or non-manual, as per the authors.
- Shift work: night/rotating shifts or fixed shifts without night work.

The somatometric and lifestyle variables included were:

- BMI: Waist circumference: normal < 102cm in men and < 88cm in women, and high ≥ 102cm in men and ≥ 88cm in women (20).
- Waist-to-height ratio: normal < 0.5 and high > 0.5 for both men and women (21).
- Type of diet: healthy or unhealthy (based on Mediterranean diet consumption) (22).
- Physical activity: yes or no, considering at least 3 days/week (≥150min/week) (23).
- Smoking status: smoker or non-smoker.

Variables included in the calculation of CVR were:

- Systolic blood pressure (SBP): < 130 mmHg considered normal, ≥ 130 mmHg considered elevated (24).
- Hypertension (HTN) under treatment: yes or no.
- Fasting blood glucose: normoglycemia < 100mg/dl, prediabetes 100-125mg/dl, diabetes > 125mg/dl (25).
- Total cholesterol < 200 mg/dl considered normal, ≥ 200mg/dl considered high; low-density lipoprotein cholesterol (LDL-C) < 100 considered normal or ≥ 100 considered high (26).

### Statistical analysis

A descriptive analysis of categorical variables was conducted, calculating frequency and distribution. Mean and standard deviation were calculated for quantitative variables. Bivariate association analysis was performed using the t-student test for means and chi-square prevalence test for independent samples. The statistical program SPSS 28.0 was used for the analysis, considering a p-value < 0.05 as statistically significant.

## Results

The characteristics of the study population correspond to 389 workers, with a majority of males (79.9%) and a mean age of 46.18 years for both sexes. The age distribution is 64.01% below 50 years and 35.98% aged 50 years or older. The majority of the population is married and lives in a family environment (78.5% of males and 62.8% of females). Both males and females belong mostly to social class III (72.7% of males and 42.7% of females), with secondary education and manual labor jobs. Regarding shift work, it is predominantly men who work in shifts (61%). As for lifestyle habits, the majority follow a healthy diet (68.5% of males and 87.2% of females), with both sexes tending to engage in regular physical activity (68.5% of males and 60.2% of females) and not smoking (81% of males and 79.5% of females) (**Table 1**).

The mean values of the studied parameters related to obesity: BMI, waist circumference, and waist-to-height ratio (ICA) show statistically significant differences between sexes, with worse results for males except for CUN BAE, which is higher in females. The cardiovascular risk factors (FRCV) also show significant differences between both sexes, with higher values in males, but always within normal parameters (**Table 2**).

Regarding obesity according to BMI with stratified values, differences by sex with statistical significance are observed, with the male population showing higher percentages of overweight and obesity. The highest values for waist circumference are found in females, although without statistical significance, unlike ICA, which is higher in males than in females and with significant differences.

In the ranges of FRCV, males have a higher percentage of hypertensive individuals under treatment with significant differences compared to females. The ranges of glucose and total cholesterol levels show a higher percentage of high values in males, although without statistical significance except for the cLDL fraction,

which has higher levels in males, with significant differences compared to females. In RCV Score, both sexes show results of low risk, with a tendency to present moderate/high values earlier in males than in females, but without statistical significance (**Table 2**).

Taking the age of 50 years as a reference, the results obtained show differences between males and females: in the case of males, obesity quantified with BMI shows worse results in ≥ 50 years with statistical significance (**Figure 1**). In body fat assessed by CUN BAE, the results for obesity are also worse in ≥ 50 years with statistical significance, while overweight is higher in <50 years. There are no significant differences in RCV Score in males by age (**Table 3**) (**Figure 1**); in females, there are no significant differences in BMI, but there are in estimated fat with CUN BAE, with higher values in ≥ 50 years. The RCV Score in females shows more unfavorable values in <50 years, with slight statistical significance (**Table 3**) (**Figure 2**).

**Table 1:** Characteristics of the population sample: Sociodemographic, labor variables, and lifestyle habits.

| | | Male (n=311) | Female (n=78) | |
|---|---|---|---|---|
| **Parameters** | | **%** | **%** | ***p*-value** |
| **Age** | 18-30 | 0.64 | 2.56 | <0.001 |
| | 31-45 | 39.55 | 64.10 | |
| | 46-60 | 58.20 | 33.33 | |
| | >61 | 1.61 | 0 | |
| **Marital status** | Married | 78.46 | 62.82 | 0.014 |
| | Separated | 7.07 | 10.26 | |
| | Single | 14.47 | 26.92 | |
| **Family coexistence** | Yes | 11.90 | 8.97 | 0.307 |
| | No | 88.10 | 91.03 | |
| **Social class** | Social calss I | 17.36 | 24.36 | <0.001 |
| | Social calss II | 9.97 | 26.92 | |
| | Social calss III | 72.67 | 48.72 | |
| **Type of work** | Manual labor | 72.67 | 48.72 | <0.001 |
| | Non-manual labor | 27.33 | 51.28 | |
| **Level of education** | Primary education | 1.61 | 0 | 0.001 |
| | Secondary education | 71.38 | 52.56 | |
| | University | 27.01 | 47.44 | |
| **Shift work/ Night work** | Yes | 38.91 | 56.41 | 0.004 |
| | No | 61.09 | 43.59 | |
| **Healthy eating** | Yes | 31.51 | 12.82 | <0.001 |
| | No | 68.49 | 87.18 | |
| **Physical activity** | Yes | 31.51 | 39.74 | 0.107 |
| | No | 6.49 | 60.26 | |
| **Tobacco consumption** | Yes | 81.03 | 79.49 | 0.434 |
| | No | 18.97 | 20.51 | |

A p-value of less than 0.05 is considered significant.

**Table 2:** Characteristics of the population sample. Obesity parameters and cardiovascular risk

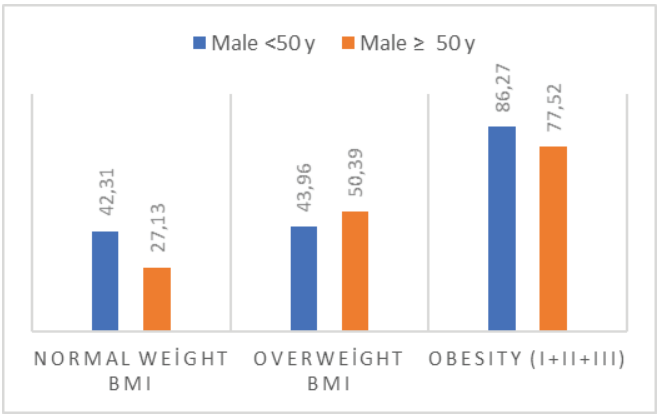
| **Parameters** | | **Male** | **Female** | |
|---|---|---|---|---|
| | | **Mean (SD)** | **Mean (SD)** | ***p*-value** |
| | Age | 47.09 (7.28) | 42.53 (6.31) | <0.001 |
| **Obesity** | Wight | 82.94 (13.15) | 65.86 (11.52) | <0.001 |
| | Height | 1.76 (0.07) | 1.65 (0.06) | <0.001 |
| | BMC | 26.86 (3.85) | 24.16 (4.44) | <0.001 |
| | CUN BAE | 26.69 (5.27) | 34.20 (6.06) | <0.001 |
| | Waist | 95.60 (10.78) | 82.13 (11.52) | <0.001 |
| | Waist/Height index | 0.54 (0.06) | 0.50 (0.08) | <0.001 |
| **CVD risk factors** | Systolicblood pressure | 122.34 (15.01) | 106.21 (11.38) | <0.001 |
| | Blood glucosa | 87.73 (16.67) | 81.91 (9.04) | 0.003 |
| | Cholesterol | 197.48 (32.80) | 185.29 (30.61) | 0.003 |
| | LDL-C | 120.64 (29.96) | 106.03 (27.36) | <0.001 |
| | | **Male** | **Female** | |
| | | % | % | |
| **BMI** | Normal weight | 36.01 | 66.67 | <0.001 |
| | Overweight | 46.62 | 23.08 | |
| | Obesity I | 11.25 | 6.41 | |
| | Obesity II | 3.86 | 3.85 | |
| | Obesity III | 2.25 | 0 | |
| **Waist circumference** | Normal | 75.56 | 70.51 | 0.220 |
| | High | 24.44 | 29.49 | |
| **Waist/Height index** | Normal | 22.51 | 57.69 | <0.001 |
| | High | 77.49 | 42.31 | |
| **Arterial hypertension under treatment** | No | 69.45 | 96.15 | <0.001 |
| | Yes | 30.55 | 3.85 | |
| **Blood glucose** | Normoglycemia | 89.39 | 96.15 | 0.059 |
| | Prediabetes | 8.04 | 3.85 | |
| | Diabetes | 2.57 | 0 | |
| **Total cholesterol and LDL fraction** | Normal cholesterol | 54.34 | 65.38 | 0.051 |
| | High cholesterol | 45.66 | 34.62 | |
| | Normal LDL | 62.38 | 79.49 | 0.003 |
| | High LDL | 37.62 | 20.51 | |
| **CVD-SCORE** | Low | 96.14 | 100 | 0.212 |
| | Moderate | 2.89 | 0 | |
| | High | 0.96 | 0 | |

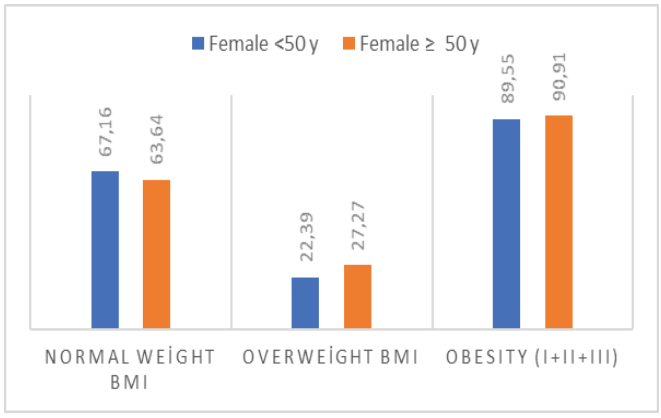
SD: standard deviation; CVD: cardiovascular risk; BMI: body mass index

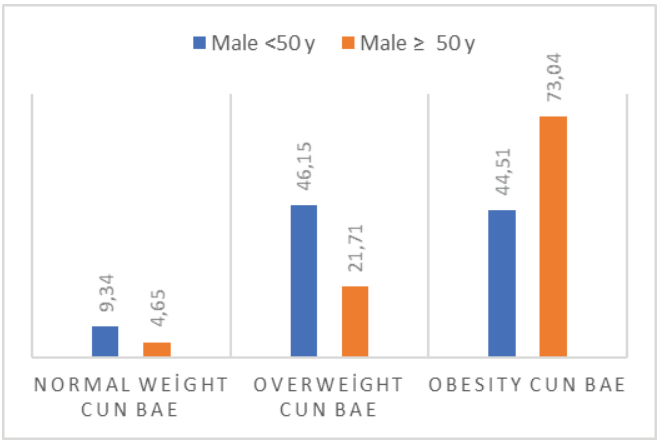
**Table 3:** Relationship of age-associated aging with obesity parameters and cardiovascular risk. Differences by genders.

| Parameters | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|
| | | < 50 (n=182) | ≥ 50 (n=129) | | < 50a n=67 | ≥ 50a n=11 | *p*-value |
| | | % | % | *p*-value | % | % | |
| **Obesity BMI** | Normal weight | 4231 | 27.13 | <0.001 | 67.16 | 63.64 | 0.089 |
| | Overweight | 43,96 | 50.39 | | 22.39 | 27.27 | |
| | Obesity I | 9.89 | 13.18 | | 5.97 | 9.09 | |
| | Obesity II | 2.75 | 5.43 | | 4.48 | 0.00 | |
| | Obesity III | 1.10 | 3.88 | | 0.00 | 0.00 | |
| **Obesity CUN BAE** | Normal weight CUN BAE | 9.34 | 4.65 | <0.001 | 31.34 | 18.18 | <0.001 |
| | Overweight CUN BAE | 46.15 | 21.71 | | 31.34 | 36.36 | |
| | Obesity CUN BAE | 44.51 | 73.64 | | 37.31 | 45.45 | |
| **RCV-SCORE** | Low | 99.45 | 100 | 0.458 | 91.47 | 100 | 0.01 |
| | Moderate | 0 | 0 | | 6.98 | 0 | |
| | High | 0.55 | 0 | | 1.55 | 0 | |

A value of p<0.05 is considered significant. CVD=Cardiovascular Risk; BMI=Body Mass Index.



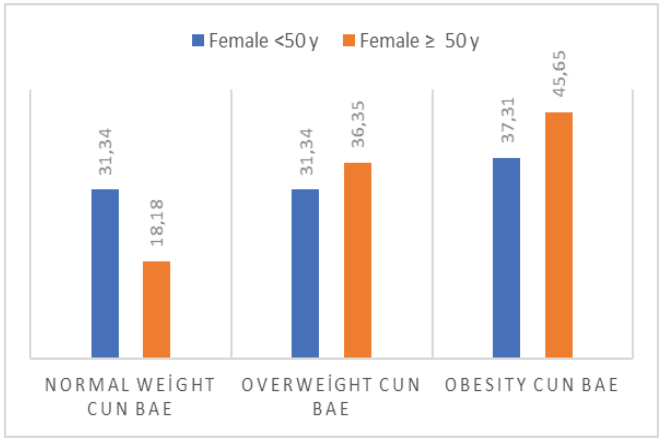




**Figure 1:** Obesity of the males

**Figure 2:** Obesity of the females

## Discussion

In this study, aging is considered with a reference age of 50 years, as a factor of deterioration that is related to certain diseases such as obesity or cardiovascular risk (RCV), where early detection in the workplace can reduce disability and improve the quality of life of the population.

Our results show differences between males and females by age in both cardiovascular risk factors (FRCV) and obesity parameters, and these age-related differences between sexes are maintained with varying levels of significance, both in obesity estimated by BMI and adiposity estimated by CUN BAE. In our population, the results of RCV-SCORE do not show significant differences between sexes or with respect to age, as the population is under 45 years old, considered young.

As previously mentioned by Converso et al., this perspective of early detection, prevention, and promotion of occupational health is reflected in other previous studies from a perspective of physical, psychological, and psychosocial deterioration, showing the effectiveness of health promotion programs in companies with positive results (27,28). We currently know that aging in the workforce will lead to increased work absenteeism and lower performance due to an association with a greater number of pathologies.

Achieving a slowdown in the aging process in the working population through early intervention on obesity and cardiovascular risk factors, as mentioned by Veronese et al., would be a significant advancement in occupational health by promoting early treatment and continuous and coordinated monitoring and control.

Our results show a higher prevalence of obesity in males than in females, increasing as both age, and they align with a study conducted on Italian industrial sector workers with similar characteristics to ours (29). In other research on workers not belonging to the industrial sector, a higher obesity rate was also related to increasing age, although this study highlights the influence of night work, which was not a determining factor in our study (30).

The negative results obtained in our study in males regarding cardiovascular risk factors and lifestyle, such as systolic blood pressure, sedentary behavior, and analytical values of glucose and cholesterol, coincide with other studies conducted on active working population belonging to the same sector. However, in our study, the majority of participants were living a healthy lifestyle, which was not observed among workers in the other study.

As previously mentioned by Chooi et al, obesity is related to aging-associated pathologies such as metabolic, cardiovascular, musculoskeletal, neurodegenerative, or cancer diseases due to the actions of adipose tissue on cardiometabolic, immune, and endocrine levels (31). This poses the need, as previously referred to by Mohammed et al, not to rely solely on BMI for diagnosing obesity but to study the percentage of body fat through methods like CUN BAE, allowing for different classifications and earlier detection.

In our study, the results of BMI and CUN BAE were higher for men aged ≥ 50 years, despite the relatively young working population. Studies that, like ours, included workers from the industrial sector and of a young age show consistent results, indicating an increased prevalence of overweight and obesity in men (32). Some studies suggest that mean obesity indices and optimal cutoff points should be applied according to age groups, with specific cutoffs varying for men and women based on their age and different obesity parameters (33).

Our CUN BAE results align with other studies conducted on the Spanish population, showing a greater increase in body fat in women compared to men and an earlier appearance of high values (34). Regarding cardiovascular risk (RCV), our results are not significant, with the majority of values falling within the normal range for both sexes. This is because we are dealing with a relatively young population, with an average age of 46 years. Most published studies focus on individuals over 50 years of age, and some even did not associate age with an increased estimated prevalence of cardiovascular diseases (ECV) in the last 15 years. Instead, they linked this prevalence more to other cardiovascular risk factors such as physical inactivity and smoking. These factors are less prevalent in the population studied in our work, which demonstrates maintaining a healthy diet, regular physical activity, and mostly no tobacco consumption, justifying the low detected risk, in addition to the age factor (35).

There is a global trend towards an aging population and later retirement ages. Therefore, preventive activity within companies should be focused on early

detection of cardiovascular risk factors (FRCV), obesity, and early detection of cardiovascular diseases (ECV), using tools such as BMI, CUN BAE, and RCV-SCORE, which provide relevant information to initiate health programs such as smoking cessation, healthy diets, physical activity, and blood pressure control in the young and middle-aged working population, without waiting for the onset of disease and more severe complications (36).

The strengths of this study lie in the estimation of cardiovascular and metabolic risk at early ages using BMI, CUN BAE, and RCV-SCORE, with the perspective of acting from health surveillance in early detection, control, and continuous monitoring in the working population. Moreover, these tools are simple and quick to use, providing valuable information for health promotion efforts aimed at reducing body fat associated with obesity and, thus, future complications.

However, some weaknesses of the study include the sample size and its gender inequality, given that the industrial sector is predominantly composed of men. Therefore, the results cannot be fully extrapolated, and the relatively young age of the study population, which has not yet shown symptoms of cardiovascular or metabolic diseases, should be considered. Nevertheless, the study provides insights into early diagnosis of pathologies and, thereby, early intervention to prevent disease progression and complications. These simple procedures are useful for implementing primary prevention activities and health programs within the preventive services, focusing on fundamental aspects such as good adherence to smoking cessation, healthy eating habits, obesity reduction, and blood pressure control, which are challenging to maintain over time and contribute to improving the overall health of the population.

## Conclusions

There is a relationship between aging using the age of 50 as a reference point, with differences between men and women, especially in obesity estimated by BMI, which shows worse results for men, and CUN BAE, which tends to show worse results in women. The estimated cardiovascular risk with SCORE does not show significant results in the studied working population, neither related to age nor sex.

## Conflict of interest:

The authors report no conflict of interest.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## Contributions

Research concept and design: AMFR, JCRG, RLS, AALG
Data analysis and interpretation: AMFR, JCRG, AALG, MTVH
Collection and/or assembly of data: AMFR, JCRG, RLS, MTVH
Writing the article: AMFR, RLS, AALG, MTVH
Critical revision of the article: JCRG, RLS, AALG, MTVH
Final approval of the article: AMFR, JCRG, RLS, AALG, MTVH

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