Chronic Energy Deficiency and Its Determinant Factors among Adults Aged 18–59 Years in Ethiopia: A Cross-Sectional Study

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Background. The prevalence of undernutrition in low- and middle-income countries is still remarkably high. Undernutrition during adulthood is a greater risk factor for low productivity, poor health, and mortality. There is limited information on the prevalence and determinants of chronic energy deficiency in Ethiopia. Objective. To assess the prevalence and determinants of chronic energy deficiency among adults aged 18–59 years in Ethiopia. Method. A secondary data analysis was conducted using the data obtained from the 2016 Ethiopia Demographic and Health Survey. Data were collected using a multistage stratified cluster sampling technique, and the analytic sample consisted of 9,280 adults aged 18–59 years. The chi-square test and multivariable logistic regression analyses were used, and p value <0.05 was taken as statistically significant. Result. A total of 9280 adults aged 18–59 years were included in the study and 2911 (28.7%) (95% CI: 27.0%–30.4%) of whom were chronic energy deficient. Adults who have no work (AOR = 1.41, 95% CI: 1.16, 1.72), male adults from Tigray region (AOR = 2.23, 95% CI: 1.61, 3.09), Afar region (AOR = 2.98, 95% CI: 2.04, 4.36), Somali region (AOR = 3.14, 95% CI: 2.19, 4.52), Gambella region (AOR = 1.89, 95% CI: 1.29, 2.76), Harari region (AOR = 1.54, 95% CI: 1.09, 2.19), Amhara region (AOR = 1.53, 95% CI: 1.09, 2.13), Oromia region (AOR = 1.53, 95% CI: 1.07, 2.19), Dire Dawa (AOR = 1.45, 95% CI: 1.03, 2.05), adults live lonely (AOR = 1.44, 95% CI: 1.21, 1.71), and adults residing in poor wealth index households (AOR = 1.26: 95% CI: 1.07, 1.49) were significantly associated with chronic energy deficiency. Conclusion and recommendation. Chronic energy deficiency among male adults in Ethiopia was a high public health problem. Marital status, wealth index, occupation, and region were significant predictors of chronic energy deficiency. The Ministry of Health with other partners should strictly monitor and evaluate interventions that are being applied and should give focus to adult men to prevent malnutrition.

1. Introduction

Nowadays, low- and middle-income countries are currently attacked by a double burden of malnutrition. The rates of overweight and obesity are increasing much faster in the developing world. The prevalence of undernutrition is still remarkably high [1–4]. Chronic energy deficiency (CED) is defined as a steady-state at which a person is in energy balance, although at a "cost" either in terms of health risk or as an impairment of functions and health [5]. Chronic energy deficiency can also be defined based on body mass index (BMI) as <18.5 kg/m² [6, 7].

Chronic energy deficiency during adulthood is associated with different adverse functional consequences. It increases the risk of morbidity, and mortality together with decreased mental and cognitive development reduces educational achievement and labor productivity [8–11].

The most common contributing factors to chronic energy deficiency among adults include inadequate diet intake, socioeconomic status, and infection [12–14].

Today, nearly one in three persons globally suffers from at least one form of malnutrition: wasting, stunting, vitamin and mineral deficiency, overweight or obesity, and diet-related noncommunicable diseases (NCDs). In 2003, about
7.2% of adults worldwide were underweight [3]. In 2014, about 462 million (18.5%) adults worldwide were underweight. Of this, 40.6 million (8.8%) were men. More than 20% of men in India, Bangladesh, Timor-Leste, Afghanistan, Eritrea, and Ethiopia were underweight [15].

According to the 2011 Ethiopia Demographic Health Survey (EDHS), the prevalence of male adult thinness or underweight was 28.9%. Of these, 21.4% was mild underweight and 7.3% was moderate to severe underweight [16]. The prevalence of CED was highest in the Somali region (62.0%) and lowest in Addis Ababa (22.0%) [16]. In Ethiopia, the prevalence of male adult CED increased from 10.8% in 2003 to 25.3% in 2011 [3, 16].

The United Nations set the sustainable development goal (SDG) targets a reduction in a different form of malnutrition by 2030 [17–19]. The World Health Organization (WHO) also sets a policy brief called double-duty actions for nutrition to end all burdens of malnutrition by 2030 [20].

The Ethiopian government identified different forms of undernutrition in the selected group such as children, adolescents, pregnant, and lactating women as the key priority indicators for national development. Besides global initiatives, the Ethiopian government had exerted many efforts, and bold actions were taken in health and other nutrition-sensitive and specific interventions. The Sequa declaration reflects the commitment to ending undernutrition by 2030 using the multisectoral National Nutrition Program (NNP-II) as a guiding framework to achieve this goal [19, 21–24].

Although there is limited documented data on male adult CED in Ethiopia, available sources documented increments in the prevalence of CED from 10.8% to 28.9% between 2003 and 2011 [3, 16]. However, almost all nutrition-related policies, strategies, and programs in Ethiopia give priority to undernutrition among special target groups such as children, adolescents, pregnant, and lactating. To some extent, little attention is also given to the current emerging adult obesity. But, chronic energy deficiency among male adults is a forgotten agenda in Ethiopia. Moreover, lifecycle malnutrition can be tackled by intervening at all stages of life and all forms of malnutrition.

At the same time in Ethiopia, though there is too huge available data on published literature on undernutrition and concurrent morbidity, studies on CED among male adults are too limited. Finding from this study also helps to draw conclusions and to translate findings into policies and practices. Therefore, this study aimed to investigate the prevalence and determinant factors of CED among adults aged 18–59 years old in Ethiopia.

1.1. Study Design and Setting. Secondary data analysis was conducted using the data obtained from 2016 EDHS. EDHS was a cross-sectional community-based study that was conducted from January to June 2016. A detailed description of study design and methods for the 2016 EDHS is available elsewhere [25]. In brief, a two-stage stratified cluster sampling technique was used using the 2007 Ethiopia Population and Housing Census as the sampling frame. In the first stage, 645 enumeration areas (EA) were selected using probability proportional to the EA size. In the second stage, 28 households per EA were selected with an equal probability of systematic selection. Eligible participants included all adult men aged between 18 and 59 years. Additionally, in all selected households, weight and height measurements were collected from male adults aged 18–59 years (n = 11, 100). After excluding adult male participants who did not have a response to the outcome variable, we restricted our analytical sample to 9,280 males aged 18–59 years.

2. Measurement

2.1. Dependent Variable. The nutritional status of adult men was screened by measuring height and weight and calculating BMI. The height of adult men aged 18–59 years was measured using a height scale. The men standing upright with their barefoot and the men’s heads, shoulders, buttocks, knees, and heels were made to touch the height scale. The reading was recorded to the nearest 0.1 cm. The weight of study participants was measured with minimum/light/clothing and no shoes with the reading recorded to the nearest 0.1 kg [26]. BMI was calculated by dividing weight in kilograms by height in meters squared (kg/m²). Adult men with a BMI of less than 18.5 kg/m² were considered as exhibiting chronic energy deficiency [5, 27]. The body mass index (BMI) values of less than 16, 16–16.99, and 17–18.4 were used to classified adults as severe, moderate, and mild CED, respectively. BMI of 18.5–24.9 was classified as normal weight [6].

2.2. Independent Variables. Based on existing literature, the following covariates were selected: anemia, age, household head sex, number of children in the household, family size, education level, occupational status, marital status, and place of residence, religion, household wealth index, region, alcohol intake, and chat chewing. Anemia in adults was defined based on the WHO recommendation, and hemoglobin level <13 g/dl was categorized as anemic [6]. The household wealth index was computed using principal components analysis on the household asset and was categorized into five wealth quintiles (lowest, second, middle, fourth, and highest) [28]. In this study, lowest and second wealth quintiles were grouped to poor, while the fourth and highest wealth quintiles were grouped to rich. A detailed description of the calculation of the household wealth index is available elsewhere [25].

2.3. Data Management and Statistical Analysis. Data were extracted from EDHS 2016, and further coding and analysis were performed using SPSS version 20. Throughout the analysis, sample weights were carried out to adjust for nonproportional allocation of the sample to strata and regions during the survey process and to restore the representativeness. Descriptive statistics were conducted to provide a summary of the characteristics of the study sample. Bivariate analysis with chi-square statistics was performed to test the independence of distribution between the independent variables and chronic energy deficiency. A multiple
logistic regression model was then fitted to identify the determinants of chronic energy deficiency. To control the confounding effect, all variables with a \( p \) value less than 0.25 in the bivariate analysis were included in the final regression model. In the final model, variables with a \( p \) value less than 0.05 were considered as significantly associated with CED. The corresponding odds ratio with 95% confidence intervals was reported. Sampling weights that accounted for complex survey design were incorporated in all analyses. All statistical analyses were conducted using SPSS version 20.0.

3. Results

Table 1 presents the characteristics of the study population. Most of the households, 5664 (64.9%), had five or more family sizes. About 3709 (44.0%) adults had a primary education level. The majority of study participants, 6874 (83.8%), were rural residents. About 3661 (35.9%) adults reside in poor wealth index households. About 4304 (48.3%) study subjects had a history of alcohol intake (Table 1).

The nutritional status of subjects is shown in Figure 1. The mean height, weight, and body mass index (BMI) of the subjects were 168.5 cm, 55.7 kg, and 19.6 kg/m², respectively. The overall frequencies of CED (BMI < 18.5 kg/m²) was 28.7% (95% CI: 27.0%–30.4%). About 1.8% and 5.8% of subjects had severe and moderate CED, respectively. Based on the WHO (1995) classification, the prevalence of CED among this population was high (20–39%), and thus, the situation is a serious public health problem.

Differences in the proportions of chronic energy deficiency by participant characteristics are presented in Table 2. The prevalence of CED was higher among households with \( \geq 5 \) family size than households with <5 family members (\( p < 0.001 \)). The proportion of CED was higher among households with a poor wealth index than households with a high wealth index. Factors that were associated with CED included anemia, sex of head of household, educational status, place of residence, religion, wealth status, marital status, occupational status, adults age, family size, alcohol consumption, and region (Table 2).

Chronic energy deficiency and anemia comorbidity are shown in Figure 2. A higher proportion of chronic energy deficiency was observed in anemic (33.0%) male adults than nonanemic (28.3%) adults.

Table 3 presents the multivariable-adjusted association between factors and CED.

In the bivariate regression analysis, anemia, educational status, place of residence, religion, wealth status, marital status, occupational status, adults age, alcohol consumption, and region had a \( p \) value <0.05. In the multivariable analysis, only occupation, marital status, household wealth index, and region were independent predictors of CED at a \( p \) value <0.05.

Compared to adults who have work, the odds of CED were higher in adults who have no work (95% CI: 1.23, 1.82). Compared to adults who have married, the odds of CED

| Table 1: Descriptive statistics of the study sample (N = 9280). |
|------------------|------------------|
| Characteristics  | Overall, n (wt.%) |
| Family size      |                  |
| <5               | 3616 (35.1)      |
| \( \geq 5 \)     | 5664 (64.9)      |
| Number of children in the household |                  |
| <5               | 7051 (74.5)      |
| \( \geq 5 \)     | 2229 (25.5)      |
| Anemia           |                  |
| Yes              | 694 (7.0)        |
| No               | 8586 (93.0)      |
| Sex of household head |              |
| Male             | 8035 (89.2)      |
| Female           | 1245 (10.8)      |
| Age              |                  |
| 18–29            | 4297 (44.4)      |
| 30–44            | 3390 (35.7)      |
| 45–59            | 1593 (18.0)      |
| Educational status |                |
| No education     | 2949 (34.2)      |
| Primary          | 3709 (44.0)      |
| Secondary        | 1519 (13.9)      |
| Higher           | 1103 (8.0)       |
| Occupational status |            |
| Not working      | 1233 (8.4)       |
| Working          | 8047 (91.6)      |
| Marital status of the respondent |          |
| Married          | 5845 (63.7)      |
| Others*          | 3435 (36.3)      |
| Place of residence |            |
| Urban            | 2406 (16.2)      |
| Rural            | 6874 (83.8)      |
| Religion of respondent |        |
| Orthodox         | 4020 (45.2)      |
| Catholic         | 68 (0.7)         |
| Protestant       | 1638 (22.0)      |
| Muslim           | 3462 (31.0)      |
| Traditional      | 27 (0.3)         |
| Others           | 65 (0.9)         |
| Household wealth index |          |
| Poor             | 3661 (35.9)      |
| Middle           | 1383 (20.2)      |
| Rich             | 4236 (43.9)      |
| Region           |                  |
| Tigray           | 979 (6.3)        |
| Afar             | 515 (0.6)        |
| Amhara           | 1403 (27.5)      |
| Oromia           | 1304 (36.5)      |
| Somalia          | 710 (2.3)        |
| Benishangul      | 728 (9.9)        |
| SNNNPR           | 1271 (21.0)      |
| Gambella         | 655 (0.3)        |
| Harari           | 420 (0.2)        |
| Dire Dawa        | 558 (0.5)        |
| Addis Ababa      | 737 (3.8)        |
| Alcohol intake   |                  |
| Yes              | 4304 (48.3)      |
| No               | 4976 (51.7)      |
| Chat chewing     |                  |
Table 1: Continued.

| Characteristics                        | Overall, n (wt.) |
|-----------------------------------------|------------------|
| Yes                                     | 3002 (28.6)      |
| No                                      | 6278 (71.4)      |

Chronic energy deficiency

| Characteristics            | Yes, n (wt.) | No, n (wt.) |
|---------------------------|--------------|-------------|
| Yes                       | 2911 (28.7)  | 6369 (71.3) |
| No                        | 6278 (71.4)  | 2911 (28.7) |

*Separated, widowed, divorced, living with a partner, and single. SNNPR, Southern Nations, Nationalities, and Peoples’ Region. Weighted percentages were obtained to control for complex sample design.

Figure 1: Nutritional status of adults aged 18–59 years in Ethiopia: EDHS 2016 (N = 9280).

Table 2: Characteristics of the study sample by chronic energy deficiency (N = 9280).

| Characteristics                        | Chronic energy deficiency |
|-----------------------------------------|----------------------------|
|                                        | Yes, n (wt.) | No, n (wt.) | p      |
| Family size                             |              |             |        |
| <5                                      | 1040 (27.4)  | 2576 (72.6) | <0.001 |
| ≥5                                      | 1871 (29.3)  | 3793 (70.7) |        |
| Number of children in the household     |              |             |        |
| <5                                      | 2227 (29.4)  | 4824 (70.6) |        |
| ≥5                                      | 684 (26.5)   | 1545 (73.5) | 0.425  |
| Anemia                                  |              |             |        |
| Yes                                     | 272 (33.0)   | 422 (67.0)  | <0.001 |
| No                                      | 2639 (28.3)  | 5947 (71.7) |        |
| Sex of household head                   |              |             |        |
| Male                                    | 2477 (28.4)  | 5558 (71.6) | 0.004  |
| Female                                  | 434 (30.9)   | 811 (69.1)  |        |
| Age                                     |              |             |        |
| 18–29                                   | 1514 (32.7)  | 2783 (67.3) | <0.001 |
| 30–44                                   | 925 (24.5)   | 2465 (75.5) |        |
| 45–59                                   | 472 (27.3)   | 1121 (72.7) |        |
| Educational status                      |              |             |        |
| No education                            | 1019 (29.4)  | 1930 (70.6) |        |
| Primary                                 | 1153 (29.3)  | 2556 (70.7) |        |
| Secondary                               | 469 (28.5)   | 1050 (71.5) |        |
| Higher                                  | 270 (22.3)   | 833 (77.7)  | <0.001 |
| Occupational status                     |              |             |        |
| Not working                             | 549 (40.3)   | 684 (59.7)  | <0.001 |
| Working                                 | 2362 (27.6)  | 5685 (72.4) |        |

Figure 2: Chronic energy deficiency anemia comorbidity among adults aged 18–59 years old in Ethiopia: EDHS 2016 (n = 9280).
were higher in adults who live lonely (95% CI: 1.21, 1.71). Male adults who lived in Tigray region were 2.2 times (AOR = 2.23, 95% CI: 1.61, 3.09), Afar region were 2.9 times (AOR = 2.98, 95% CI: 2.04, 4.36), Amhara region were 1.5 times (AOR = 1.53, 95% CI: 1.09, 2.13), Oromia region were 1.5 times (AOR = 1.53, 95% CI: 1.07, 2.19), Somali region were 3.1 times (AOR = 3.14, 95% CI: 2.19, 4.52), Gambella region were 1.9 times (AOR = 1.89, 95% CI: 1.29, 2.76), Harar region were 1.5 times (AOR = 1.54, 95% CI: 1.09, 2.19), and Dire Dawa town were 1.5 times (AOR = 1.54, 95% CI: 1.03, 2.05) more likely to be chronic energy deficient compared to adults from Addis Ababa, respectively.

The likelihood of chronic energy deficiency was higher among adults residing in poor wealth index households than

| Table 3: Factors associated with chronic energy deficiency among adults aged 18–59 years in Ethiopia: EDHS 2016 (N = 9280). |
|---------------------------------------------------------------|
| Family size | Unadjusted OR (95% CI) | p | *Adjusted OR (95% CI) | p |
| <5 | 0.91 (0.79, 1.04) | 0.181 | 0.95 (0.82, 1.10) | 0.524 |
| ≥5 | Reference | | Reference | |
| Anemia | Yes | 1.23 (1.05, 1.55) | 0.045 | 1.17 (0.93, 1.48) | 0.163 |
| No | Reference | | Reference | |
| Sex of household head | Male | 0.88 (0.72, 1.09) | 0.254 | 1.09 (0.87, 1.36) | 0.437 |
| Female | Reference | | Reference | |
| Age | 18–29 | 1.29 (1.08, 1.54) | 0.006 | 1.09 (0.87, 1.37) | 0.438 |
| 30–44 | 0.86 (0.71, 1.05) | 0.142 | 0.87 (0.71, 1.06) | 0.164 |
| 45–59 | Reference | | Reference | |
| Education status | No education | 1.44 (1.12, 1.86) | 0.004 | 1.25 (0.91, 1.71) | 0.169 |
| Primary | 1.44 (1.12, 1.87) | 0.006 | 1.21 (0.90, 1.61) | 0.207 |
| Secondary | 1.39 (1.04, 1.84) | 0.024 | 1.11 (0.82, 1.48) | 0.515 |
| Higher | Reference | | Reference | |
| Occupation status | Not working | 1.77 (1.48, 2.11) | <0.001 | 1.49 (1.23, 1.82) | 0.001 |
| Working | Reference | | Reference | |
| Marital status | Married | 1.51 (1.33, 1.71) | <0.001 | 1.44 (1.21, 1.71) | <0.001 |
| Others | Reference | | Reference | |
| Place of residence | Urban | 0.69 (0.56, 0.86) | 0.001 | 0.79 (0.58, 1.06) | 0.122 |
| Rural | Reference | | Reference | |
| Household wealth index | Poor | 1.43 (1.24, 1.65) | <0.001 | 1.25 (1.06, 1.48) | 0.009 |
| Middle | 1.11 (0.91, 1.36) | 0.309 | 1.03 (0.83, 1.28) | 0.757 |
| Rich | Reference | | Reference | |
| Region | Tigray | 2.89 (2.27, 3.67) | <0.001 | 2.23 (1.61, 3.09) | <0.001 |
| Afar | 4.17 (3.02, 5.75) | <0.001 | 2.98 (2.04, 4.36) | <0.001 |
| Amhara | 1.83 (1.43, 2.35) | <0.001 | 1.53 (1.09, 2.13) | 0.012 |
| Oromia | 1.98 (1.53, 2.57) | <0.001 | 1.53 (1.07, 2.19) | 0.021 |
| Somalia | 4.45 (3.38, 5.87) | <0.001 | 3.14 (2.19, 4.52) | <0.001 |
| Benishangul-Gumuz | 1.95 (1.42, 2.67) | <0.001 | 1.58 (1.06, 2.35) | 0.021 |
| SNNPR | 1.59 (1.22, 2.07) | 0.001 | 1.26 (0.87, 1.82) | 0.211 |
| Gambella | 2.19 (1.56, 3.08) | <0.001 | 1.89 (1.29, 2.76) | 0.001 |
| Harari | 1.80 (1.33, 2.45) | <0.001 | 1.54 (1.09, 2.19) | 0.014 |
| Dire Dawa | 1.77 (1.29, 2.43) | <0.001 | 1.45 (1.03, 2.05) | 0.033 |
| Addis Ababa | Reference | | Reference | |
| Alcohol intake | Yes | Reference | 0.006 | | 0.318 |
| No | Reference | | | |

OR, odds ratio; CI, confidence interval; SNNPR, Southern Nations, Nationalities, and Peoples’ Region; MDDS, minimum dietary diversity score. *Widowed, separated, divorced, and living with a partner. The final regression model was adjusted for anemia, educational status, place of residence, wealth status, marital status, occupational status, adults’ age, family size, alcohol consumption, and region.
4. Discussion

Chronic energy deficiency among adults is one of the abandoned nutritional problems and is one of the contributors to morbidity and mortality together with decreased mental and cognitive development. It also reduces educational achievement and labor productivity [8–10, 29–31]. The prevalence of CED among adults in Ethiopia remains significantly high. The development of effective interventions aimed at reducing rates of undernutrition requires the identification of key risk factors of CED [2, 4, 20].

In a representative sample of Ethiopian adults aged 18–59 years, we found that the overall prevalence of CED was 28.7%. Marital status, occupation, household wealth index, and region were significantly associated with chronic energy deficiency.

The prevalence of CED in this study was higher than from study performed in Uganda (22.3%) [32], India (19.5%) [33], Botswana (19.5%) [14], and Tharu population, India (26.2%) [34], Malaysia 8.5% [35], and Colombia (2.8%) [36]. However, it was lower than the study report from west India (40.1%) [37]. These discrepancies might be due to sampling size, socioeconomic, and feeding habit differences between study setups.

The odds of CED among adult men who lived alone were higher compared with married adult men. This might be explained by married adult men unlike adult lived lonely counterparts are more likely to be younger; they have a high risk of being underweight due to low intake of diet and dependency on the family. This finding is similar to many studies conducted elsewhere [14, 32]. Marriages mostly expose adults to be overweight/obese [38–40].

Compared to men who have work, the odds of CED were higher in adults who have no work. This might be explained by those men who have no work may not get enough money for food. The other possible justification could be because men with no work mostly consume less nutritious food which exposed them to CED. This finding is similar to many studies conducted elsewhere [41–44].

The likelihood of chronic energy deficiency was higher among adults residing in poor wealth index households than adults residing in rich wealth index households. Similar findings were reported from studies conducted elsewhere [3, 14, 29, 41, 45]. This could be due to those poorer households that are unable to purchase nutritionally adequate and diversified food for their family. This leads to inadequate food intake, exposure to infections, and lack of access to basic health services.

The odds of CED among Somali, Afar, Tigr, Gambella, Benishangul-Gumuz, Harari, Oromia, Amahara, and Dire Dawa adult men were 3.1, 2.9, 2.2, 1.9, 1.6, 1.5, 1.5, 1.5, and 1.5 times higher than adults from Addis Ababa, respectively. The possible hypothesis could be feeding habits and the type of food production difference in the northeastern parts of Ethiopia.

The main strength of this study was that it used nationally representative data with a large sample size which could enhance the generalisability of the findings. However, this study had limitations that the EDHS survey is relied on respondents’ self-report and might have the possibility of recall bias and social desirability bias as data were collected by a self-reported interview. Again, this study is a cross-sectional study design, and it is difficult to establish causality between the outcome of interest and these important independent variables.

5. Conclusion and Recommendation

Chronic energy deficiency among male adults in Ethiopia was a high public health problem. Marital status, wealth index, occupation, and region were significant predictors of chronic energy deficiency. The Ministry of Health with other partners should strictly monitor and evaluate interventions that are being applied and should give focus to adult men to prevent malnutrition.

Abbreviations

AOR: Adjusted odd ratio  
BMI: Body mass index  
CED: Chronic energy deficiency  
CSA: Central statistics agency  
CI: Confidence interval  
EDHS: Ethiopian Demographic Health Survey  
NCDs: Noncommunicable diseases  
NPP: National Nutrition Program  
SDG: Sustainable development goal  
WHO: World Health Organization

Data Availability

The DHS data analyzed during the current study are available in the repository (https://dhsprogram.com/data).

Ethical Approval

The Institutional Review Board (IRB) of ICF and the National Ethics Review Committee at the Ministry of Science and Technology approved the protocol for the 2016 EDHS. Permission was obtained from the DHS program to download and use the data for this analysis.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors’ Contributions

All authors conceived and designed the study. SD, YM, YW, and AA performed data analysis and interpretation. SD, SA, GD, and ML drafted the manuscript. ZH assisted in critically reviewing the manuscript. All authors read and approved the final manuscript.
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