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*Research Article*

# Physical activity in patients undergoing coronary artery bypass graft surgery (CABG)

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## Abstract

**Background:** Worldwide, cardiovascular diseases are the main cause of death, accounting for 25 to 45 percent of all fatalities. Low levels of physical activity pose a serious risk to cardiovascular health. Aim of the study was to determine the physical activity in patients undergoing coronary artery bypass graft surgery. **Methods:** A hospital-based cross-sectional study was conducted among 210 patients attending cardiothoracic outpatient clinic or were admitted to the internal ward in Assiut university heart hospital, Egypt. **Results:** Male patients had significant higher mean levels than females regarding; duration of vigorous/ moderate activity per day, duration of walking and using bicycle, duration of vigorous/moderate sports per day ($p < 0.0001$). The mean duration of moderate activity per week (day) was significantly higher in less than 60 years than in 60 years or more (P=0.002). **Conclusion:** More than three quarter (77%) of the study population have insufficient physical activity. To overcome this, national awareness campaigns about physical activity should be increased.

**Keywords:** CABG, physical activity, risk, CVD

## Introduction

World Health Organization (WHO) defined cardiovascular diseases (CVDs) as a group of disorders of the heart and blood vessels and include coronary heart disease (CHD), cerebrovascular disease, peri-pheral arterial disease**,** rheumatic heart disease (RHD)**,** congenital heart disease, deep vein thrombosis and pulmonary embolism. (1)

Worldwide, CVDs are the main cause of death. Recently, The American Heart Association (AHA) figures on heart disease and stroke show that the prevalence of CVDs in the US is about 121.5 million, or 48% of adults ≥20 years of age, or almost one in every two persons ≥20 years of age. (2)

There's a widespread misconception that CVDs primarily impact males, but the reality is different. In 2017, around 420,000 American females lost their lives as a result of CVDs, a number significantly higher than the just over 42,000 fatalities from breast cancer. Heart disease caused by coronary artery disease (CAD) contributes to almost half of all heart disease cases and remains the leading cause of death in the US for individuals over 35 years old. (3)

Considering advanced development leads to changes in society as well as economy, it is expected that the mortality rate from CAD will continue to rise in developing countries. It is predicted that as rural, agrarian, economically impoverished societies change their way to urbanized, industrialized modern societies, the chance for developing CAD increases. (4)

CVD is currently a leading cause of death, accounting for 25 to 45 percent of all fatalities. With almost three ischemic heart disease (IHD) deaths for every stroke fatality, IHD is the leading cause of CVD. Although RHD continues to be a significant cause of morbidity and mortality, the incidence of RHD hospitalizations is rapidly declining. (5)

Low levels of physical activity pose a serious risk to cardiovascular health. Inadequate physical activity was expected to be the cause of 0.686 million deaths overall in 2021, including 0.397 million deaths from CVD. Low physical activity was associated with 193.0 disability-adjusted life years per 100,000 people in 2021. (6)

Sixty percent of the global population falls short of the minimum recommended 30 minutes of daily moderate physical activity. People who adopt sedentary lifestyles have a 1.5-fold higher risk of CVD. Sedentary lifestyles account for 2 million annual fatalities and 22% of all IHD cases. A greater increase in CVD is anticipated because of young people's low levels of physical exercise. (7)

Frequent physical activity is protective and has many advantages; it lowers blood pressure, lipid levels, body weight, blood sugar, and other risk factors, all of which directly impact the reduction of pre-existing vascular lesions and lower the incidence of coronary disease. It slows down the advancement of atherosclerosis, shields the patient from oxidative stress, enhances insulin sensitivity, lowers the occurrence of malignant arrhythmias, and maintains balance in the vegetative system. As a result, it decreases overall cardiovascular mortality. Promotion of physical activity ought to begin right from childhood. Physical activity is a crucial component of CVD prevention strategies for all age groups.(8,9)

An important surgical procedure is CABG surgery. By restoring blood flow, the bypass helps to alleviate anginal symptoms and restore function and viability to the ischemic myocardium. With about 400,000 operations annually, CABG is the most frequently carried out major surgical treatment. (10)

Although Egypt is the most populated country in the Eastern Mediterranean Region, data on the pattern of risk factors for patients undergoing CABG surgery is lacking. (11)

**Aim of the study**

The aim of the study is to determine physical activity as a modifiable risk factor of CVDs that may predispose to CABG surgery.

## Methods

It is a hospital-based cross-sectional study that had been conducted in Assiut University Heart Hospital, one of the tertiary care teaching hospitals located in Assiut University, Assiut Governorate. The study was conducted from 1st April 2022 to 31st March 2023.

The study included 210 patients who seek care at the cardiothoracic outpatient clinic or were admitted to the internal ward. All patients who underwent CABG surgery and accepted to participate were included in the study. Patients who refused to participate or sought medical care for reason other than CABG surgery was excluded from the study.

The researcher interviewed the patients and took written consent from them to be included in the study and explained the purpose of the study and the patients' rights. Moreover, a full revision of the medical record was done to complete the clinical data.

Data collection was conducted using the STEPS instrument questionnaire. It`s a tool used to collect data and measure non-communicable diseases risk factors within the WHO STEP wise approach to surveillance. The STEPS Instrument covers three different sections of risk factor assessment: The first section contains: socio-demographic factor as (age, gender, marital status, education, and residence), behavioral risk factor as (tobacco use,

alcohol consumption, fruits and vegetable intake and physical activity). The second section contained: Physical measurements that were done for all participants such as height, weight, and blood pressure. The third section contain-ned: Biochemical measurements that were obtained from the medical records of the patients such as: blood glucose, urinary sodium and creatinine, blood lipids, triglycerides and HDL cholesterol.

A pilot study was carried out on 30 study subjects to assess the duration of the interview and the wording of the questionnaire. This step did not result in the exclusion or rephrasing of any item; thus, the subjects of the pilot study were included in the results.

**Statistical analysis:**
Revision of the data and coding of the variables was done before data entry. Entered data were checked for accuracy (logic sequence, skip pattern, and missing), then for normality, using Shapiro-Wilk tests of normality and almost were proved not to be normally distributed. Data management including data entry, cleaning, statistical analysis, and tabulation were taking place using IBM SPSS (Statistical Package of the Social Sciences) statistical software, version 23.

Data was presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, while means and standard deviations for quantitative variables. Chi-square test was used to compare qualitative categorical variables. Mann Whitney test used to compare independent means of two groups. Statistical significance was considered at p-value <0.05.

**Ethical approval:**
The study was approved by the ethics committee of Minia University Faculty of Medicine. Written consent was taken from all participants.

## Results

All patients (210 patients) who were admitted from 1st April 2022 to 31st March 2023 to Assiut university hospital and fulfilled the inclusion criteria were included in the study. Old age represented (72.4%) of the study patients with mean age (65.8 ± 8.31). Male patients represented (60%). Most of the study population was employed. More than half of them were rural residents. Nearly half of the study population had college or university education (table 1). Number of patients who perform vigorous activity in the study population was 48 (22.9%), while number of patients who perform moderate activity in the study population was 113 (53.8%). The number of patients who use a bicycle in the study population was 162 (77.1%). Also, the number of patients who perform vigorous sports in the study population was 76 (36.2%). The number of patients who perform moderate sports in the study population was 118 (56.2%) (table 2).

It is clarified that more than three quarters (77.1%) of the study patients have insufficient physical activity, while more than fifth (22.9%) of the study patients have sufficient physical activity (Fig.1).

The percentage of patients who perform vigorous activity at work was significantly less among male patients 35.4% than female patients 64.6% (p= 0.0001). However, the mean duration of vigorous activity per day and moderate activity per day were significantly higher in male patients (17.7±2.7, 25.5±13.8) than in female patients (10.0±2.5, 20.8±15.8) (p= 0.0001 and 0.0001) (table 3).

On the other hand, the mean duration of walking or using a bicycle per day in male patients (36.7±7.7) was statistically significantly higher than the mean duration in female patients (18.7±6.6) (p=0.0001). Also, vigorous sport and moderate sport was significantly higher in male patients than in female patient (P=0.0001, 0.0001 respectively) (table 3).

Regarding the mean duration of vigorous sport per day, moderate sports duration per week and moderate sports duration per day it was found that the mean was significantly higher in male patients (17.7±2.8, 35.5±6.6 and 7.1±1.3 respectively) than in female patients (2.1±0.8, 20.0±5.4 and 4.0±1.1 respectively) (p=0.0001) (table 3).

Regarding physical activity at work it was found that the percentage of those who do vigorous activity and moderate activity at work was significantly less among patients aged less than 60 years (39.6, 37.2 respectively) than patients aged 60 years or more (60.4, 62.8 respectively) (p= 0.043, 0.001 respectively). However, the mean duration of moderate activity per week (day) was significantly higher in less than 60 years than in 60 years or more (2.9±1.1, 2.4±1.1 respectively) (P= 0.002) (table 4).

Regarding physical activity performed during travel to and from places, it was found that the percentage of those who walk or use a bicycle was significantly less among less than 60 years compared to those 60 years or more (22.2%, 77.8% respectively) (p= 0.002) (table 4).

**Table (1): Socio-demographic characteristics among patients undergoing CABG surgery, Assiut University Heart Hospital, Assiut University, 2022**

| Variables | Study population (n = 210) |
|---|---|
| **Age** | |
| Less than 60 | 58 (27.6) |
| 60 years or more | 152 (72.4) |
| Mean ± SD. | 65.8 ± 8.31 |
| Median (IQR) | 67 (59 - 72) |
| Range (Min-Max) | 34 (48 - 82) |
| **Gender** | |
| Male | 126 (60%) |
| Female | 84 (40%) |
| **Employment Status** | |
| Employed | 192 (91.4%) |
| Unemployed | 18 (8.6%) |
| **Marital Status** | |
| Never Married | 14 (6.7%) |
| Currently married | 175 (83.3%) |
| Divorced or widowed | 21 (10%) |
| **Residence** | |
| Urban | 77 (36.7%) |
| Rural | 133 (63.3%) |
| **Highest level of education** | |
| Illiterate | 5 (2.4%) |
| Read and write | 19 (9.1%) |
| Primary education | 25 (11.9%) |
| Secondary education | 43 (20.5%) |
| College or university | 88 (41.9%) |
| Postgraduate education | 30 (14.3%) |

On the other hand, physical activity regarding recreational activities the percentage of those who do vigorous sports was significantly less among those less than 60 years than patients aged 60 years or more (15.8%, 84.2% respectively) (p= 0.006) (table 4).

**Table (2): Physical activity among patients undergoing CABG surgery in Assiut University Heart Hospital, Assiut University, 2022**

| Variables | Study population (n = 210) |
|---|---|
| **Physical activity at work** | |
| Vigorous activity no. (%) | 48 (22.9%) |
| Vigorous activity duration per week (day) Mean±SD | 2.0 ± 0.4 |
| Vigorous activity duration per day (min) Mean±SD | 14.6 ± 4.6 |
| Moderate activity no. (%) | 113 (53.8%) |
| Moderate activity duration per week (day) Median (IQR) | 2(2-3) |
| Moderate activity duration per day (min) Median (IQR) | 20(15-30) |
| **Physical Activity regarding Travel to and from places** | |
| Walk or use a bicycle no. (%) | 162 (77.1%) |
| Walk or usage of bicycle duration per week (day) Mean±SD | 2.1 ± 0.8 |
| Walk or usage of bicycle duration per day (min) Mean±SD | 29.5 ± 11.4 |
| **Physical Activity regarding recreational activities** | |
| Vigorous sports no. (%) | 76 (36.2%) |
| Vigorous sports duration per week (day) Mean±SD | 2.1 ± 0.9 |
| Vigorous sports duration per day (min) Mean±SD | 14.61 ± 4.6 |
| Moderate sports no. (%) | 118 (56.2%) |
| Moderate sports duration per week (day) Mean±SD | 29.3 ± 9.8 |
| Moderate sports duration per day (min) Mean±SD | 5.9 ± 2.0 |
| **Physical Activity regarding sedentary behavior** | |
| Sitting duration per day (min) Mean±SD | 98.1 ± 15.2 |

***SD:*** *standard deviation* ***IQR:*** *interquartile range*

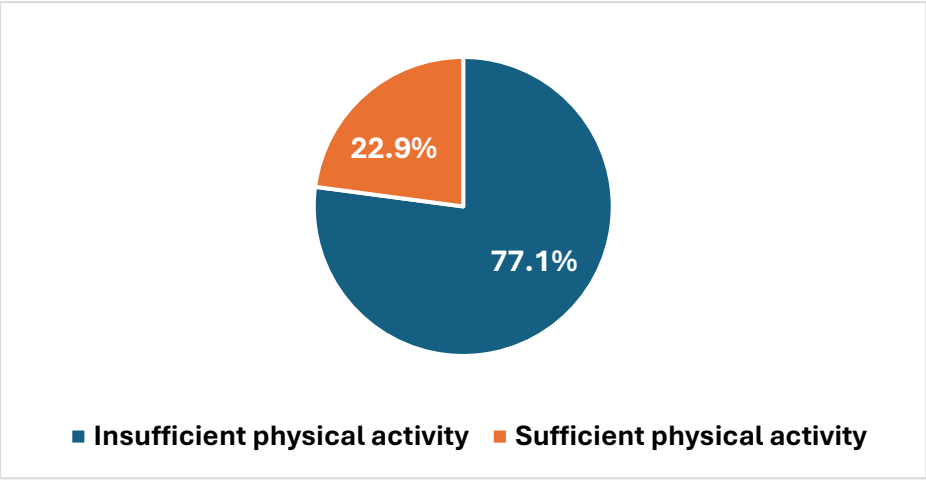


**Figure (1): Physical activity status among patients undergoing CABG surgery in Assiut university Heart Hospital, Assiut University, 2022**

**Table (3): Distribution of patients undergoing CABG surgery by gender in relation to physical activity in Assiut university Heart Hospital, Assiut University, 2022**

| Variable | | Male (n= 126) No (%) | Female (n= 84) No (%) | P-value |
|---|---|---|---|---|
| **Physical activity at work** | | | | 0.0001* |
| Vigorous activity© | Yes | 17(35.4%) | 31(64.6%) | |
| | No | 109(67.3%) | 53(32.7%) | |
| Vigorous activity duration per week (day)• (mean ± SD.) | | 2.0±0.5 | 2.0± 0.3 | 0.691 |
| Vigorous activity duration per day (min)• (mean ± SD.) | | 17.7±2.7 | 10.0±2.5 | 0.0001* |
| Moderate activity© | Yes | 65(57.5%) | 48(42.5%) | 0.481 |
| | No | 61(62.9%) | 36(37.1%) | |
| Moderate activity duration per week (day)• (mean ± SD.) | | 2.5±1.1 | 2.5±1.2 | 0.850 |
| Moderate activity duration per day (min)• (mean ± SD.) | | 25.5±13.8 | 20.8±15.8 | 0.0001* |
| Physical Activity regarding Travel to and from places | | | | |
| Walk or use a bicycle© | Yes | 126(77.8%) | 36(22.2%) | 0.0001* |
| | No | 0(0%) | 48(100%) | |
| Walk or usage of bicycle duration per week (day)• (mean ± SD.) | | 2.1±0.8 | 2.0±0.9 | 0.421 |
| Walk or usage of bicycle duration per day (min)• (mean ± SD.) | | 36.7±7.7 | 18.7±6.6 | 0.0001* |
| Physical Activity regarding recreational activities | | | | 0.0001* |
| Vigorous sportsΩ | Yes | 76(100%) | 0(0%) | |
| | No | 50(37.3%) | 84(62.7%) | |
| Vigorous sports duration per week (day)• (mean ± SD.) | | 2.9±0.9 | 2.1±0.8 | 0.348 |
| Vigorous sports duration per day (min)• (mean ± SD.) | | 17.7±2.8 | 10.1±2.6 | 0.0001* |
| Moderate sports© | Yes | 87(73.7%) | 31(26.3%) | 0.0001* |
| | No | 39(42.4%) | 53(57.6%) | |
| Moderate sports duration per week (day)• (mean ± SD.) | | 35.5±6.6 | 20.0±5.4 | 0.0001* |
| Moderate sports duration per day (min)• (mean ± SD.) | | 7.1±1.3 | 4.0±1.1 | 0.0001* |
| Physical Activity regarding sedentary behavior | | | | 0.194 |
| Sitting duration per day (min)• (mean ± SD.) | | 97.2±16.3 | 99.4±13.3 | |

©Chi-square test. Ω Fisure exact test. •Mann Whitney test.
***SD:*** *standard deviation.* *Significant difference at <0.05.

**Table (4): Distribution of patients undergoing CABG surgery by age in relation to physical in Assiut University Heart Hospital, Assiut University, 2022**

| Variable | | Less than 60 years (n= 58) No. (%) | 60 years or more (n= 152) No. (%) | p value |
|---|---|---|---|---|
| **Physical activity at work** | | | | 0.043* |
| Vigorous activity© | Yes | 19(39.6%) | 29(60.4%) | |
| | No | 29(24.1%) | 123(75.9%) | |
| Vigorous activity duration per week (day)• (mean ± SD.) | | 2.0±0.4 | 2.0±0.5 | 0.773 |
| Vigorous activity duration per day (min)• (mean ± SD.) | | 14.7±4.9 | 14.6±4.5 | 0.903 |
| Moderate activity© | Yes | 42 (37.2%) | 71 (62.8%) | 0.001* |
| | No | 16(16.5%) | 81 (83.5%) | |
| Moderate activity duration per week (day)• (mean ± SD.) | | 2.9±1.1 | 2.4±1.1 | 0.002* |
| Moderate activity duration per day (min)• (mean ± SD.) | | 23.3±14.8 | 23.8±14.8 | 0.824 |
| **Physical Activity regarding Travel to and from places** | | | | |
| Walk or use a bicycle© | Yes | 36 (22.2%) | 126 (77.8%) | 0.002* |
| | No | 22 (45.8%) | 26 (54.2%) | |
| Walk or usage of bicycle duration per week (day)• (mean ± SD.) | | 2.0±0.9 | 2.1±0.8 | 0.294 |
| Walk or usage of bicycle duration per day (min)• (mean ± SD.) | | 30.5±12.7 | 29.1±10.9 | 0.421 |
| **Physical Activity regarding recreational activities** | | | | |
| Vigorous sports© | Yes | 12 (15.8%) | 64 (84.2%) | 0.006* |
| | No | 46 (34.3%) | 88 (65.7%) | |
| Vigorous sports duration per week (day)• (mean ± SD.) | | 2.1±0.9 | 2.1±0.9 | 0.943 |
| Vigorous sports duration per day (min)• (mean ± SD.) | | 14.7±4.9 | 14.6±4.6 | 0.916 |
| Moderate sports© | Yes | 28 (23.7%) | 31(76.3%) | 0.164 |
| | No | 30 (32.6%) | 62 (67.4%) | |
| Moderate sports duration per week (day)• (mean ± SD.) | | 30.0±10.6 | 29.0±9.5 | 0.527 |
| Moderate sports duration per day (min)• (mean ± SD.) | | 6.0±2.2 | 5.8±1.9 | 0.502 |
| **Physical Activity regarding sedentary behavior** | | | | 0.475 |
| Sitting duration per day (min)• (mean ± SD.) | | 99.3±13.6 | 97.6±15.8 | |

*©Chi-square test, •Mann Whitney test, SD: standard deviation, *significant difference at 0.05*

## Discussion

CAD is a chronic, progressive, multi-factorial disease that is the leading cause of morbidity and mortality worldwide, especially in developing countries. CABG surgery has been an exquisite treatment for complex CAD since the 1960s. Despite the increasing rate of percutaneous coronary

intervention, CABG is still the most prevalent cardiac surgery.[12]
Physical inactivity is considered a major independent risk factor for heart disease. About 12% of the global burden for myocardial infarction is due to physical inactivity after accounting for other CVD risk factors. The AHA identifies 150 or more minutes of moderate-intensity activity or 75 or more minutes of vigorous-intensity activity to be a component of ideal cardiovascular health. [13]

In this study we found that the mean age of the patients was (65.8 ± 8.31). The finding is directly in line with previous finding in a study that has been conducted by Sattartabar et al., who evaluated 24,328 patients and underwent CABG in Tehran heart center from 2007 to 2017. The mean age was 60.8 ± 9.52, The mean age of patients increased from 60.7 ± 9.46 to 61.7 ± 9.5 and the male to female ratio remained nearly constant at approximately 2.8. Also, Nicolini et al., study found that male group received significantly more bypass grafts than the female group, moreover Sattartabar et al., found that male patients were more than female patients representing (73.6% and 26.4% respectively). These results are like our study which found that 60% of the patients were males and (40%) were females. [14,15]

From the results, it is clear that gender was significantly associated with some variables like age, age groups and marital status. Mean age of male patients was significantly higher (67.7 ± 6.9) than female patients (62.9 ± 6.4) (P= 0.0001). Regarding age group 60 years or more male patients, percentage was significantly higher than that of female patients (P= 0.0001). Contrary to the findings of Kundu and Kundu who found that among the older adults, the self-reported prevalence of diagnosed CVDs was higher among women (32%) than men (26%) the reason for this could be that the study only included individuals 45 years of age or older, and there were more female participants than male participants.[16] Also, Sadeghi et al., found that women were older than males (62.40±9.03 vs. 59.99±9.81 years, p= 0.011).[17] Moreover, Okunrintemi et al., found that CVD commonly presents at an older age among women compared with men. This may be due to the vasodilatory and antioxidant properties of endogenous estrogen provide some protection from CVD in younger premenopausal women. [18]

Our results demonstrated a higher percentage of insufficient physical activity (77.1 %) among study patients, while more than fifth (22.9%) of the study patients have sufficient physical activity and those who perform vigorous activity at work was significantly more among female patients (64.6%) than male patients (35.4%) (p= 0.0001). Overall, these finding is in accordance with the finding reported by Gadallah et al., who found that insufficient physical activity was reported by 968 (98.4%) participants, with females being significantly more active than males (p= 0.021). [19]

In this study we cleared that regarding physical activity at work it was found that the percentage of those who do vigorous activity and moderate activity at work was significantly less among less than 60 years (39.6%, 37.2% respectively) than 60 years or more (60.4%, 62.8% respectively) (p= 0.043, 0.001 respectively). In line with previous studies the findings of Kundu and Kundu found that CVD prevalence was higher among the physically inactive older adults, and this difference was statistically significant ($p < 0.001$).[16] Similarly, Sazlina et al., found that physical inactivity was associated with higher CVD risk among older people. Also, the majority of older people were physically inactive, of which health promotion to engage in physical activity in older age is needed.[20]

## Conclusion

The present study highlights the finding that physical activity is an important cardiovascular risk factor that must be considered. Generally, women need to increase the physical activity in relation to men even though in our community the

increase in physical activity of men is mostly due to the type of work which usually harder than women. Also, the type of physical activity should be directed to sports.

**Recommendations:**

- National awareness campaigns and health education sessions about the importance of physical activity should be increased especially for females.
- Further studies are suggested to evaluate the effects of physical activity in a larger number of patients undergoing CABG surgery.
- Patients with cardiovascular risk factors are recommended to be trained regarding healthy lifestyle behaviors as they are crucial for achieving optimal cardiovascular health. Also, prevention strategies can play an important role in reducing patient morbidity and mortality.

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## References

1. World Health Organization (WHO). Cardiovascular diseases (CVDs). 2021.https://www. who.int/newsroom/factsheets/detail/cardiovascular-diseases-(cvds) [Last accessed on 2022 Jan 22].
2. CDC. Multiple Cause of Death, 1999–2020. CDC WONDER Online Database website. Atlanta, GA: Centers for Disease Control and Prevention. Centers for Disease Control and Prevention, National Center for Health Statistics, 2020.
3. Benjamin, E. J., Muntner, P., Alonso, A., Bittencourt, M. S., Callaway, C. W., Carson, A. P., et al., heart disease and Stroke Statistics-2019 Update: A Report From the American Heart Association. Circulation. 2019;139 (10), e56–e528.
4. Sanchis-Gomar, F., Perez-Quilis, C., Leischik, R., & Lucia, A. Epidemiology of coronary heart disease and acute coronary syndrome. Annals of translational medicine. 2016;4(13).
5. Gaziano, T., Reddy, K. S., Paccaud, F., Horton, S., & Chaturvedi, V. Cardiovascular Disease. Disease Control Priorities in Developing Countries. 2006. https://www.ncbi.nlm.nih.gov/books/NBK11767/
6. Vaduganathan, Muthiah, George, Mensah, Justine Varieur Turco, Valentin Fuster, Gregory A. Roth. "The Global Burden of Cardiovascular Diseases and Risk: A Compass for Future Health." Journal of the American College of Cardiology. 2022;80.25: 2361-2371.
7. Lacombe, J., Armstrong, M. E. G., Wright, F. L., & Foster, C The impact of physical activity and an additional behavioural risk factor on cardio-vascular disease, cancer and all-cause mortality: a systematic review. BMC Public Health. 2019;19: 1-16.
8. Tofas, T., Draganidis, D., Deli, C. K., Georgakouli, K., Fatouros, I. G., & Jamurtas, A. Z. Exercise-induced regulation of redox status in cardiovascular diseases: the role of exercise training and detraining. Antioxidants. 2019;9.1: 13.
9. Winzer, E. B., Woitek, F., & Linke, A. Physical activity in the prevention and treatment of coronary artery disease. Journal of the American Heart Association. 2018;7.4: e007725.
10. Bachar, B. J., & Manna, B. Coronary Artery Bypass Graft. Cardiac CT, Second Edition. 2022;191–198. https://doi.org/10.1007/978-3-642-41883-9_15.
11. Reda, A., Soliman, M., El Kersh, A., Abdou, W., Mostafa, M., Beshay, M., Gamal, A., et al., The pattern of risk-factor profile in Egyptian patients with acute coronary syndrome: phase II of the Egyptian cross-sectional Cardio Risk project. Cardiovascular Journal of Africa. 2019; 30(2), 87–94. https://doi.org/10.5830/CVJA-2018-074.
12. Agrawal, H., Choy, H. H. K., Liu, J., Auyoung, M., & Albert, M. A. Coronary artery disease. Arterioscl-

erosis, thrombosis, and vascular biology. 2020; 40.7: e185-e192.
13. Go, A. S., Mozaffarian, D., Roger, V. L., Benjamin, E. J., Berry, J. D., Borden, W. B., ... & Turner, M. B. Heart disease and stroke statistics—2013 update: a report from the American Heart Association. Circulation. 2013;127.1: e6-e245.
14. Sattartabar, B., Ajam, A., Pashang, M., Jalali, A., Sadeghian, S., Mortazavi, H., ... & Hosseini, K. Sex and age difference in risk factor distribution, trend, and long-term outcome of patients undergoing isolated coronary artery bypass graft surgery. BMC Cardiovascular Disorders. 2021;21.1: 1-10.
15. Nicolini, F., Vezzani, A., Fortuna, D., Contini, G. A., Pacini, D., Gabbieri, D., ... & RERIC (Registro dell'Emilia Romagna degli Interventi Cardio-chirurgici) Investigators. Gender differences in outcomes following isolated coronary artery bypass grafting: long-term results. Journal of cardiothoracic surgery. 2016;11: 1-12.
16. Kundu, J., & Kundu, S. Cardiovascular disease (CVD) and its associated risk factors among older adults in India: evidence from LASI Wave 1. Clinical Epidemiology and Global Health. 2022;13: 100937.
17. Sadeghi, R., Miri, R., Kachoueian, N., Sistanizad, M., & Hassanpour, R. Differences in gender and outcomes following isolated coronary artery bypass graft (CABG) surgery. ARYA Atherosclerosis. 2023;19: 1-11.
18. Okunrintemi, V., Tibuakuu, M., Virani, S. S., Sperling, L. S., Volgman, A. S., Gulati, M., et al. Sex differences in the age of diagnosis for cardiovascular disease and its risk factors among US adults: trends from 2008 to 2017, the Medical Expenditure Panel Survey. Journal of the American Heart Association. 2020;9. 24: e018764.
19. Gadallah, M., Megid, S. A., Mohsen, A., & Kandil, S. Hypertension and associated cardiovascular risk factors among urban slum dwellers in Egypt: a population-based survey. Eastern Mediterranean Health Journal. 2018;24.5: 435-42.
20. Sazlina, S. G., Sooryanarayana, R., Ho, B. K., Omar, M. A., Krishnapillai, A. D., Mohd Tohit, N, et al., Cardiovascular disease risk factors among older people: Data from the National Health and Morbidity Survey 2015. PLoS One. 2020; 15.10: e0240826.