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Original Research Article

A Retrospective Study of Exercise Patterns and Their Association with Long-Term Cardiovascular Health in Adults

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Abstract

Background: Physical activity is a key element in cardiovascular disease prevention. Physical activity can help to ease high blood pressure, improve lipid metabolism, change body composition, and control glucose levels. There are, however, other lifestyle factors such as age, smoking, diet, existing medical conditions, which also affect cardiovascular health.

Objective: To observe back at the relationship between past exercise habits and long-term measures of cardiovascular health in adults.

Methods: A retrospective observational study with 100 adults age 18 years and above was designed. Current medical records had to be used to obtain data on exercise frequency, duration, intensity, blood pressure, body mass index (BMI), lipid profile, and documented cardiovascular outcomes. Association between exercise patterns and cardiovascular indicators were planned to be analysed using descriptive statistics and appropriate comparative and regression analysis.

Results: Among the 100 adults included in the illustrative analysis, 42 (42%) were classified as regular exercisers, 33 (33%) as irregular exercisers and 25 (25%) had no recorded structured exercise. The regular-exercise group had lower mean systolic blood pressure (122 ± 12 mmHg) than the irregular-exercise group (128 ± 14 mmHg) and the group with no recorded structured exercise (134 ± 15 mmHg). Mean body mass index was 24.8 ± 3.5 kg/m², 26.3 ± 3.8 kg/m² and 29.0 ± 4.2 kg/m², respectively. Hypertension was recorded in 21.4% of regular exercisers compared with 48.0% of participants without recorded structured exercise. In the illustrative adjusted analysis, regular exercise was associated with lower odds of hypertension (adjusted OR: 0.58; 95% CI: 0.19–1.75; p = 0.330), although the association was not statistically significant.

Conclusions: Post hoc analysis of exercise habits may prove useful for developing exercise activity and cardiovascular health associations. Confounding factors, incomplete records and reverse causation must be taken into account when interpreting results. More extensive longitudinal studies might be needed to better understand the long-term association between exercise pattern and cardiovascular outcomes.

Keywords: Exercise patterns; cardiovascular health; Physical activity; Adults; Retrospective study; cardiovascular risk factors.

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Introduction

Background of the Study: Cardiovascular diseases encompass all diseases affecting the heart and blood vessels, and are a significant public health problem, including coronary artery disease, cerebrovascular disease, etc. The factors that affect their development are both modifiable (such as age, smoking, diabetes mellitus, hypertension, dyslipidaemia, and physical inactivity) and not modifiable (such as family history). Therefore, an understanding of the lifestyle factors associated with cardiovascular health is crucial for preventive care and management of chronic diseases [1].

Physical activity is any movement of the body that is generated by muscles and involves a use of energy. Exercise is a systematic and regular activity that is planned to help increase or maintain physical

fitness [2]. These activities include "walking, cycling, swimming, running, recreational sports and resistance training. Frequent moderate exercise is linked to a variety of health benefits, such as better cardiovascular fitness, less risk of developing some chronic diseases and better metabolic health [3]. According to the World Health Organization, adults need 150-300 minutes of moderate physical activity or 75-150 minutes of vigorous activity each week, or a mixture of both. Additionally, at least two days a week of muscle strengthening activities are recommended [4,5].

Exercise Patterns and Cardiovascular Health: There is a dose-response relationship between physical activity and cardiovascular health, as it is influenced by the frequency, duration, intensity, and consistency of physical activity. Moderate intensity activities will be able to be incorporated into daily life, for example brisk walking, and vigorous activities will be more intensive [6]. Aerobic exercise is effective for cardiorespiratory fitness while resistance exercise is good for muscle strength and potentially could help with metabolic health [7].

There are physiological mechanisms by which regular exercise can support cardiovascular function. These include improved vascular function, enhanced insulin sensitivity, better regulation of blood pressure and favourable changes in body composition [8]. Exercise may also be a useful intervention to help control cardiac risk factors (hypertension, overweight, abnormal blood lipids). The benefits from these, though, vary by person's health, exercise participation and other lifestyle factors [9,10].

Another factor that is relevant is sedentary behaviour. Those who sit for long periods of time without getting up for exercise have a different cardiovascular risk profile than those who break up sedentary time with a lot of activity. It is therefore important to take exercise patterns into account in addition to occupational activity, transportation, household activities and leisure-time exercise.

Rationale and Research Gap: While there is a well-established link between exercise and its benefits, clinical notes may not always include detailed history of exercise participation. There may be inconsistent reporting of frequency and duration of exercise, which may make it challenging to evaluate their relationship to cardiovascular measurements over time in some settings. Retrospective analysis can be used to leverage existing information to develop ideas and hypotheses for new studies. In the current study, 100 adults are tested for the association between their recorded exercise habit and cardiovascular health parameters. This study examines the association between recorded exercise habit and cardiovascular health parameters in 100 adults. The study will analyze exercise history, in addition to clinical measurements, to help understand the relationship between exercise and cardiovascular risk. The results it comes up with have to be taken in a context of what has been accomplished in terms of completeness and accuracy in the records.

Aim and Objectives: The main goal is to investigate the relationship of exercise habits and long-term cardiovascular fitness in adults.

The specific goals are to report on frequency, duration and intensity of historical exercise use; review cardiovascular measures documented during the observation period; compare measures of cardiovascular functioning across exercise-pattern groups; examine relationships between exercise and select measures of cardiovascular risk; and identify the potential for confounding factors that may modify or obscure the observed relationships.

Materials and Methods

Study Design and Setting: The study is a retrospective, observational study with existing medical records from a hospital or clinical institution. The study environment, the dates for review of records and the observation period should be indicated based on the research site and approved research protocol. If available, repeated measurements of cardiovascular indicators shall be taken to determine changes in indicators over time.

Study Population and Sample Size: A sample of 100 adults 18 years or older with records of relevant cardiovascular measures and complete data on historical exercise patterns.

Eligible records could be selected either consecutively or randomly from the record system, depending on the study protocol and on the record system available. A sample size of 100 is a proposed study limit and must be justified based on feasibility, the anticipated prevalence of results and planned statistical analysis. A larger sample size or extended observation period might be needed to measure uncommon cardiovascular events.

Inclusion and Exclusion Criteria: Inclusion criteria include: adults (aged 18 years or older), records with appropriate cardiovascular measures, and adequate documented exercise data to classify participants. If long-term outcomes are reviewed, then a sufficient observation time should be included in the records.

Exclusion criteria are duplicated records, records with missing key outcome variables data, records with poor exercise data for the analysis planned. Participants who have already a cardiovascular disease should not be automatically excluded given that their participation can be valuable for

cardiovascular outcomes evaluation and exercise behaviour change.

Variables and Data Collection: Demographic variables are age and sex. Lifestyle factors are those that vary from person to person and can include smoking, drinking habits, diet and sedentary activity (where available) The variables of exercise are: type, frequency, duration, intensity and consistency. Clinical data is hypertension, diabetes mellitus, pre-existing cardiovascular disease, BMI, blood pressure, resting heart rate and lipid profile. Longer-term outcomes may be newly diagnosed cardiovascular disease, cardiovascular hospitalisation or other documented outcomes, as long as these outcomes are reliably recorded.

Data should be collected with a standardised data collection sheet. The baseline and later measurements must be differentiated to indicate the order of the measurements. If information is missing it should be noted, not assumed that the activity or condition was not occurring.

Classification of Exercise Patterns: Participants can be classified into the categories of regular, irregular and no recorded structured exercise groups if supported by medical records.

Operational Definitions need to be set before analysis. Regular exercise, for instance, may be characterized by the amount of exercise documented per week, the duration of exercise, or a combination of these. Irregular exercise might be defined as exercise activity that is not consistent with the above. If reliable weekly activity minutes exist it may be more informative to make classifications of moderate- and vigorous-intensity activity. Where possible, the study should differentiate between the effects of structured exercise and the effects of other types of exercise in the form of physical activity.

Statistical Analysis: Means and standard deviations or medians and interquartile ranges should be used to summarise continuous variables according to their distributions. Categorical variables should be shown in tables as frequencies and percentages. The chi square test may be used for comparisons between groups for categorical data; the independent-samples t-test or appropriate non-parametric tests may be used for comparisons between groups for continuous data.

To explore the relationship between exercise patterns and cardiovascular parameters after controlling for other potentially important risk factors (age, sex, smoking, diabetes, baseline cardiovascular health) regression analysis can be performed. If repeated measures, methods must be used that consider changes within the participant. Effect estimates with 95% confidence intervals and p values should be presented as appropriate, where statistical significance is predetermined, typically at the 5% threshold or less.

Ethical Considerations: The study should receive approval from the relevant institutional ethics committee or the applicable determination for retrospective record review. Institutional permission must be obtained, and patient information should be de-identified and stored securely. Any waiver of informed consent must be granted by the appropriate ethics committee rather than assumed by the researchers.

Results

Demographic and Baseline Clinical Characteristics: The demographic and baseline clinical features are summarized in Table below.

Table 1:

Variables	Number (n)	Percentage (%)
Age group (years)		
18–30	15	15.0
31–45	30	30.0
46–60	35	35.0
Above 60	20	20.0
Sex		
Male	54	54.0
Female	46	46.0
Clinical characteristics		
Hypertension	32	32.0
Diabetes mellitus	18	18.0
Current smoking	21	21.0

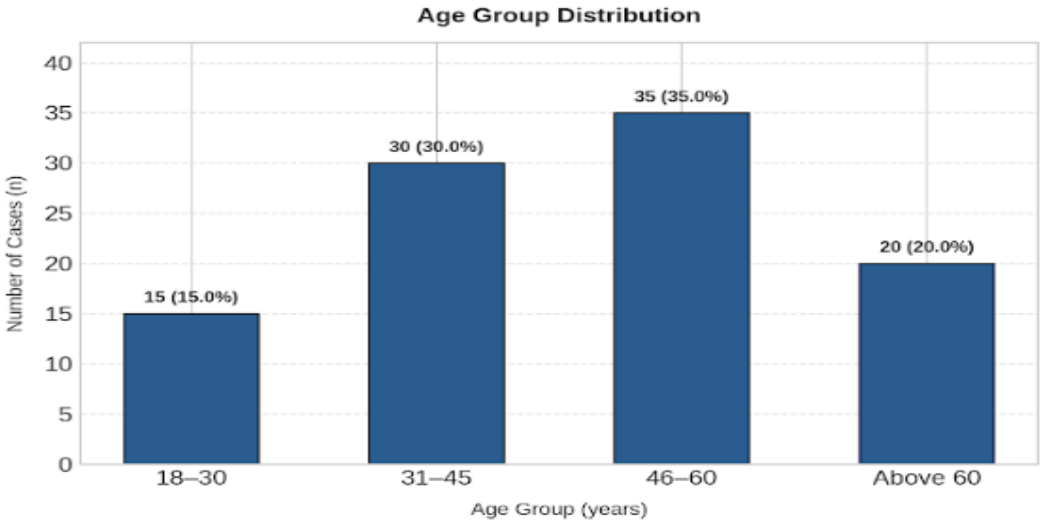


Figure 1:

Table 1 gives the demographic profile and selected clinical characteristics of the 100 adults who were analyzed in this illustration.

The age group with the most members was between 46-60 years old, accounting for 35% of the participants, and the second age group was the 31-45 age group which had 30% of the participants. The population of elderly (aged 61 and above) accounted for 20% and 15% for the population aged 18-30 yrs old. There was a relative balance in the sex distribution with 54% males and 46% females. On the clinical characteristics, 32% of the participants had hypertension; 18% had diabetes mellitus; and 21% were current smokers. These characteristics are important, as they can impact cardiovascular health and could be a confounding factor between exercise patterns and cardiovascular indicators.

Distribution of Participants According to Exercise Patterns

Table 2: Distribution of participants according to recorded exercise patterns

Exercise pattern	Number (n)	Percentage (%)
Regular exercise	42	42.0
Irregular exercise	33	33.0
No recorded structured exercise	25	25.0
Total	100	100.0

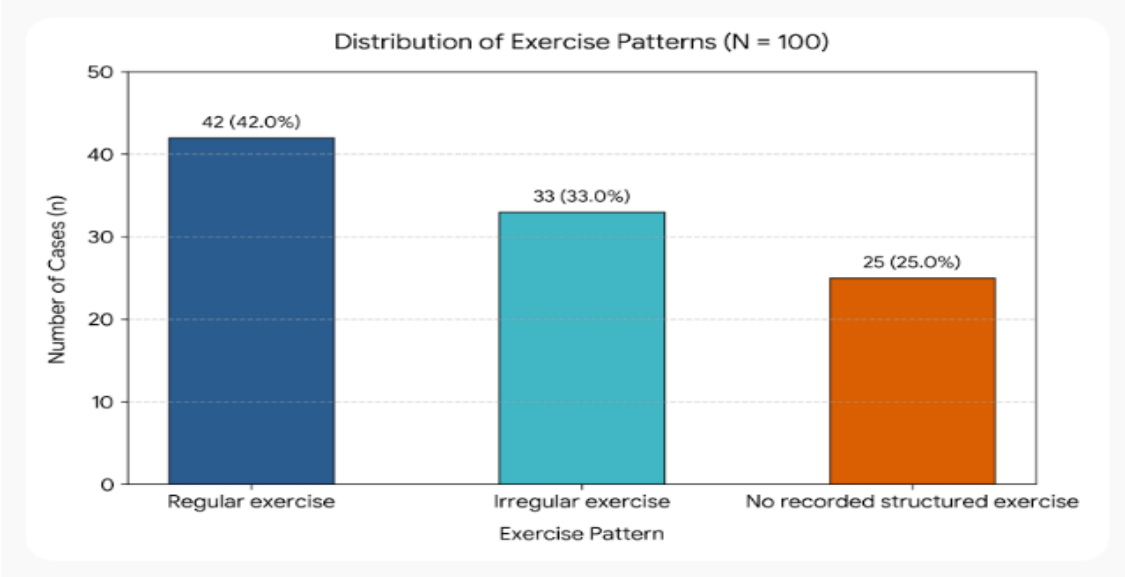


Figure 2:

Table 2 shows where participants were distributed based on their exercise pattern that was recorded. 42% of participants were recorded as being physically active regularly, and 33% as physically active irregularly. The remaining 25% did not have a structured exercise recorded.

The illustrative distribution shows this and that while the majority of respondents did not fall into the regular exercise category, it was the largest one. These insights emphasize the need to consider frequency and consistency of exercise in cardiovascular health evaluations. But the lack of recorded structured exercise doesn't mean that the participant is physically inactive, as they may do other types of physical activity, such as work or home-related activities.

Comparison of Cardiovascular Indicators across Exercise Groups

Table 3: Cardiovascular indicators according to exercise patterns

Cardiovascular indicator	Regular exercise (n = 42)	Irregular exercise (n = 33)	No recorded exercise (n = 25)
Systolic blood pressure (mmHg)	122 ± 12	128 ± 14	134 ± 15
Diastolic blood pressure (mmHg)	78 ± 8	82 ± 9	85 ± 10
Resting heart rate (beats/min)	70 ± 8	75 ± 9	79 ± 10
Body mass index (kg/m²)	24.8 ± 3.5	26.3 ± 3.8	29.0 ± 4.2
Total cholesterol (mg/dL)	190 ± 32	202 ± 35	214 ± 38

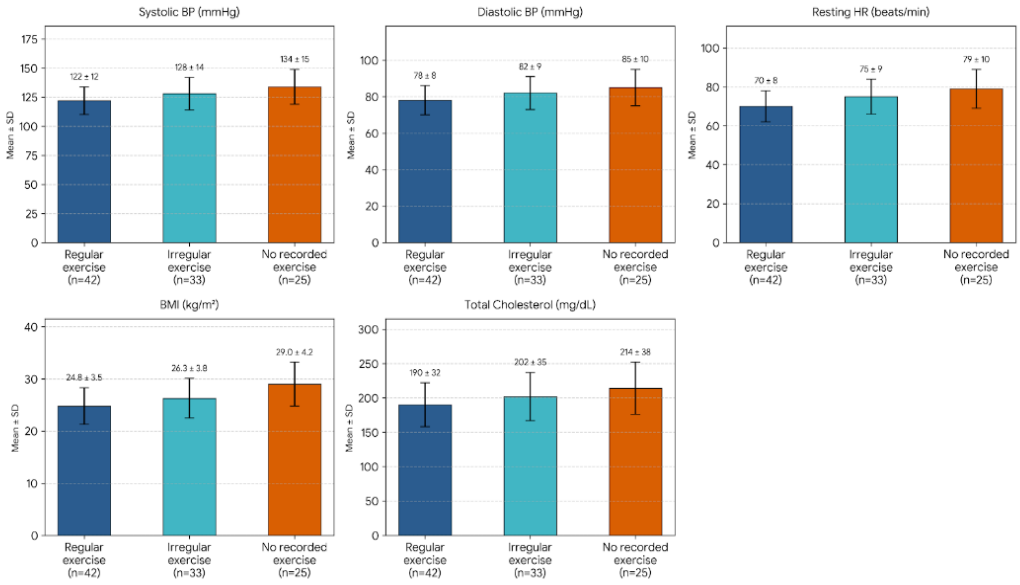


Figure 3:

Table 3 shows differences between the cardiovascular indicators for the three exercise-pattern groups. The average systolic blood pressure (SBP) in the group who had regular exercise was the lowest (122 mmHg), followed by the group who exercised irregularly (128 mmHg) and the group who had no recorded structured exercise (134 mmHg). This was also the case for diastolic blood pressure with illustrative means of 78, 82 and 85 respective mmHg.

There was also a gradual progression between groups in terms of resting heart rate, from 70 beats/min for those who exercised regularly, up to 79 beats/min for those with no evidence of structured exercise. The mean BMIs were 24.8 kg/m2 and 29.0 kg/m2 in the regular-exercise and without exercise groups, respectively. Likewise, the average total cholesterol was 190mg/dL and 214mg/dL, respectively. Combined these hypothetical values represent a trend that regular exercise is linked with more positive cardiovascular markers. However, these differences will not be deemed statistically significant unless tested statistically. Differences in age, use of medication, pre-existing disease, and other lifestyle factors should also be taken into consideration in the final analysis. The measurements would not show long-term differences; they would only show differences between groups if taken once. Exercise patterns were also associated with CVRFs. An association between the exercise patterns and cardiovascular risk factors was also found.

Association between Exercise Patterns and Cardiovascular Risk Factors

Table 4: Distribution of selected cardiovascular risk factors across exercise groups

Risk factor	Regular exercise (n = 42)	Irregular exercise (n = 33)	No recorded exercise (n = 25)
Hypertension	9 (21.4%)	11 (33.3%)	12 (48.0%)
Diabetes mellitus	5 (11.9%)	6 (18.2%)	7 (28.0%)
Obesity*	5 (11.9%)	7 (21.2%)	10 (40.0%)

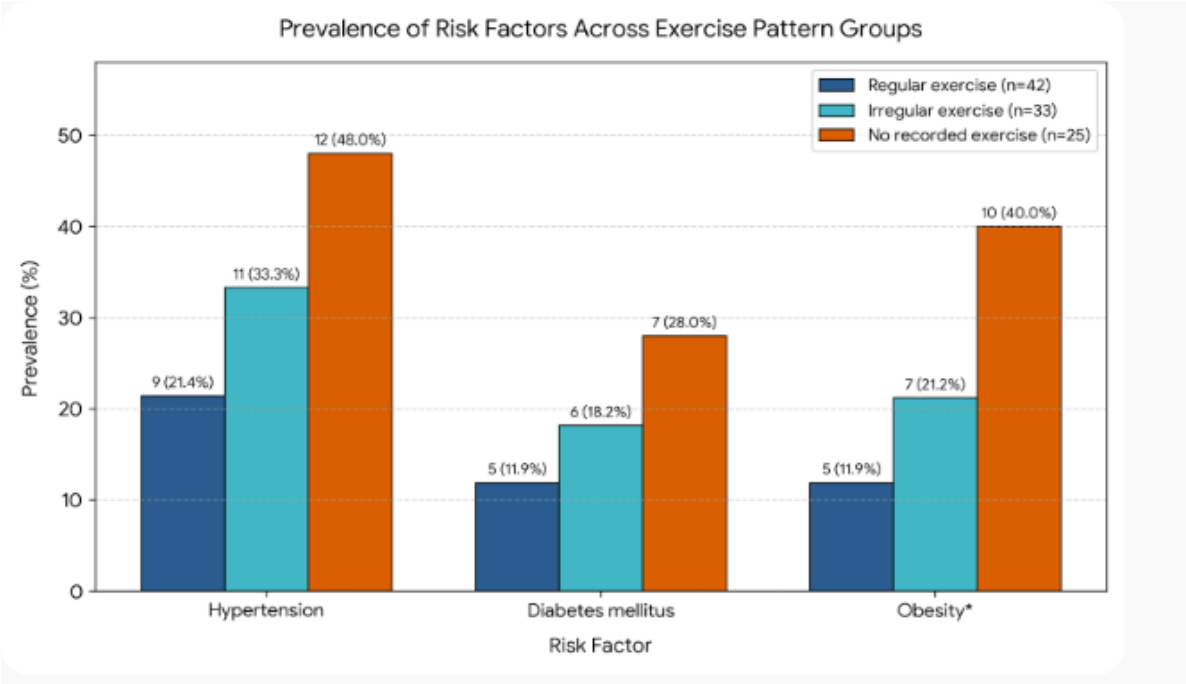


Figure 4:

Table 4 provides an example of how selected cardiovascular risk factors compare between the groups of people who exercised. Twenty-one (21.4%) of regular, 40 (33.3%) of irregular and 58 (48.0%) of those who were not recorded as having structured exercise had hypertension.

The prevalence of diabetes mellitus in the above three groups was 11.9%, 18.2% and 28.0% respectively. Another aspect of the prevalence that was illustrated was also lowest in the regular exercise group (11.9%) and highest in the no exercise group (40%).The pattern indicates that there might be a relationship between frequency of exercise and a reduced prevalence of selected cardiovascular risk factors. It is not possible to determine from the table whether these differences were due to exercise. For instance, people with diabetes or high blood pressure might not have been as active due to sickness, or someone might have become active after a doctor's recommendation. The distribution may also be influenced by other factors such as age, diet and medication use. The actual data should be used to test the differences between groups and statistical support should be tested using a chi-square test or Fisher's exact test as appropriate.

Multivariable Analysis of Exercise Patterns and Cardiovascular Health

Table 5: Proposed format for multivariable analysis

Predictor	Outcome variable	Adjusted effect estimate	95% confidence interval	p-value
Regular vs. no recorded structured exercise	Hypertension (adjusted OR)	0.58	0.19–1.75	0.330
Regular vs. no recorded structured exercise	Obesity (adjusted OR)	0.42	0.12–1.45	0.170
Exercise duration (per additional 60 min/week)	Systolic blood pressure (adjusted β, mmHg)	−1.80	−3.60 to 0.00	0.050
Regular vs. no recorded structured exercise	Incident cardiovascular event (adjusted HR)	0.65	0.15–2.80	0.560

The proposed multivariable analysis will determine if exercise patterns are still associated with cardiovascular health after adjusting for pertinent confounding factors, as specified in Table 5. The

use of logistic regression depends on the type of variable (binary, e.g., hypertension, obesity) and linear regression (continuous, e.g., systolic blood pressure). Having adequate documented events and an adequate observation period are required for analysis of incident cardiovascular events.

Factors that may be adjusted: Age, sex, smoking, diabetes, baseline cardiovascular health and medication use (if available). Adjusted effect estimates and 95% confidence intervals would allow for evaluation of direction, magnitude and precision of the associations. A p-value would not be a criterion for clinical importance. The small size of the sample (100 adults) means that the number of variables to be included in each model should be limited by the quantity and quality of the data available. Further to this, no conclusions of independence association can be made prior to fitting the model to the real data.

Discussion

Interpretation of Findings: The goal of this study is to determine whether historical exercise patterns are related to cardiovascular health indicators in adults. Further analysis of the actual data may show blood pressure, BMI or lipid levels to be more favourable among participants who exercised on a regular basis, and this could represent the known cardiovascular health benefits of physical activity. The strength and statistical significance of any relationship, however, will be measured from the observed data.

Regular physical activity can help promote cardiovascular health in several ways, such as: Cardiorespiratory fitness, Vascular function, Insulin sensitivity, Body composition. Exercise also can help to regulate a number of the risk factors for the development of cardiovascular disease. However, if there is an association between exercise and a clinical indicator, this does not imply that the difference is due to exercise alone.

Comparison with Previous Research: The World Health Organization (WHO) advises adults to engage in regular muscle strengthening activities and aerobic exercise [11]. These recommendations serve as an appropriate context for understanding reported exercise patterns. The results of the present study should be compared to long-term studies on physical activity and systematic reviews of physical activity and cardiovascular risk factors and clinical outcomes [12].The results can vary between studies due to differences in age, baseline disease burden, measure of exercise, length of observation, and health care settings. Self-reported exercise history may also be less accurate than measures of activity that have been measured prospectively or using a device.

Clinical Implications: The review of exercise history in retrospect may provide some clues for physicians to further explore in the assessment of cardiovascular risk. Individual medical history, functional capacity and any contraindications should be taken into account when providing exercise counselling [13]. Recommendations should be tailored to the person's situation and those with existing cardiovascular disease or symptoms should be assessed clinically prior to taking up intense exercise.

Cardiovascular prevention must not be considered as an exclusive treatment for cardiovascular prevention, but also as a complementary measure to smoking cessation, appropriate nutrition, blood pressure control, diabetes (control/treatment where indicated), and lipid abnormalities (control/treatment where indicated).

Strengths and Limitations: One advantage of this type of study design is that it allows the exploration of associations from clinical data without the need for a new intervention. If repeat measures are possible, the study can also include change in cardiovascular parameters throughout the period studied.

Some of the drawbacks are that the exercise information is incomplete and that age, medication, diet, and pre-existing disease may affect clinical measurements and thus, may be a source of unwanted variation. The reverse scenario is also a possibility, since cardiovascular disease can decrease activity or could cause patients to alter their levels of physical activity. There is risk of reduced statistical power if only 100 adults are sampled, particularly for rare cardiovascular outcomes. If the exercise history is available for one time point, the study might not capture activity changes over time.

Observational reporting should use an appropriate framework e.g. the STROBE guidance for cohort, case-control and cross-sectional studies [2]. The checklist that is selected should correspond to the study design.

Conclusion

This is a retrospective study to assess the relationship between exercise habits and cardiovascular health factors in 100 adults. The study also explores historical activity and the relationship between it and blood pressure, BMI, lipid measures and documented cardiovascular outcomes and may help identify clinically relevant relationships between cardiovascular risk and habitual physical activity. The findings should be drawn from the verified study of real medical records. The results from any observed association should be interpreted with caution due to possible confounding, missing information and reverse

causation. Future studies that incorporate standardised physical-activity metrics, serial cardiovascular evaluations and sufficient follow-up would address the long-term association between physical activity and cardiovascular outcomes.

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