

The moderator effects of cardiovascular risks on the determinant factors of autonomy, perceived behavioural control and motivation towards the physical activity levels among elderly in Kuala Lumpur

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KEYWORDS

Cardiovascular disease, cardiovascular disease risk, determinant factors, elderly, physical activity

ABSTRACT

Introduction/Aims: The elderly with or without cardiovascular disease (CVD), also vary in their physical, behavioural, cognitive, and health status, gender, personality, and emotional handling, all of which are factors for the elderly involving physical activity (PA). This study aims to explore the PA level of the elderly in Kuala Lumpur by evaluating the determinant factors based on the moderating effect of CVD risk factors. Methodology: A quantitative study was performed on 400 elderly from several elderly care centres in Kuala Lumpur. The questionnaire sections include demographics, PA tests, and CVD risk factors using Framingham Risk Score (FRS). The questionnaires on determinant factors include self-efficacy, social support, attitude, perceived behaviour control (PBC), autonomy, and motivation. SPSS analysis was used to test the hypothesis of this study. Results: There were significant differences ($F=4.92$; $p=0.008$) between the CVD risk factors and physical activity level. The analysis has shown the effect of the CVD risk factors towards the physical activity level among the elderly in Kuala Lumpur. The independent t-test has shown significant differences ($t=5.59$; $p<0.0001$) in CVD risk factors between genders. The CVD risk factors have been shown to be higher in males compared to females. The multiple regression analyses showed that the moderator variable of CVD risk factors moderating the association of independent variables of motivation ($F=5.382$; $p=0.001$), autonomy ($F=4.709$; $p=0.014$) and perceived behavioural control (PCB) ($F=4.709$; $p=0.014$) towards the dependent variable of physical activity (PA) levels among the Kuala Lumpur's elderly population. Whereas the analysis showed that the independent variables of self-efficacy, social support, and attitude did not support the hypothesis for predicting physical activity level. Conclusion: The determinant factors of motivation, perceived behavioural control, and autonomy were suggested as the strongest variables and positively related to the physical activity engagement among elderly in Kuala Lumpur. The current study emphasises the significance of identifying determinant factors and how they influence older adults' participation in physical activity.

1. Introduction

Cardiovascular disease (CVD) is a leading global cause of death, particularly among the elderly, with age exacerbating CVD risks. Non-communicable diseases like CVD result from a combination of genetic, physiological, environmental, and lifestyle factors. Modifiable risk factors include physical inactivity, unhealthy diet, and tobacco use, while non-modifiable factors include age and genetics. Physical activity (PA) is crucial in reducing CVD risks, with recommendations for the elderly to engage in moderate to vigorous exercise weekly (Ferraro et al., 2019). PA is highly recommended for the prevention of CVD. After an accurate risk stratification, almost all patients with CVD can engage in some form of PA (de Keijzer et al., 2024). In Malaysia, CVDs are major causes of mortality and morbidity, with modifiable risk factors like physical inactivity contributing significantly. PA is identified as an independent risk factor for CVD, with regular exercise associated with reduced CVD and mortality rates. However, many elderly individuals fail to meet recommended PA levels. Studies suggest that even moderate levels of PA can significantly reduce CVD risks among the elderly. Overall, understanding the relationship between determinant factors, cardiovascular risk, and PA levels is essential for improving elderly health outcomes (Shiroma & Lee, 2010).

The Global Recommendation on Physical activity by Health for elderly was mentioned in box below (WHO Steering Group, 2020).

A summary of the WHO recommendations for exercise for people aged 60 years and above
<ol style="list-style-type: none">1. At least 150 min of moderate- intensity aerobic activity or at 75 min of vigorous-intensity aerobic activity.2. Aerobic activity should be performed at least 10 minutes.3. Elderly with poor mobility should have physical activity two or more days.4. Muscle strengthening activities should be done two or more days.5. If elderly unable to perform according to the recommended due to health conditions, they should be physically active as they are able.

A meta-analysis of 33 studies found that engaging in 150 minutes/week of moderate-intensity physical activity led to a 14% lower risk of cardiovascular disease (CVD), while 300 minutes/week of such activity resulted in a 20% lower risk of CVD (Sattelmair et al., 2011). Additionally, a study revealed that elderly men aged 71-93 who walked approximately 1.5 miles/day were predicted to reduce their risk of CVD by 50% compared to those who walked less than 0.25 miles/day (Hakim et al., 1999).

The global age-standardised prevalence of insufficient physical activity was 31.3% in 2022, an increase from 23.4% in 2000 and 26.4% in 2010 (Strain et al., 2024). Physical activity protects us from multiple health problems including CVD. It also controls our weight, induces insulin, and increases metabolism rate. Being physically active overall will benefit blood pressure levels, cholesterol levels, blood glucose levels, and the health of blood clotting and inflammation.

According to the WHO Global Health Observatory 31% of adults aged 18 years and older were insufficiently active in 2022 (WHO 2013, 2024). In Malaysia, physical inactivity plays an important role in non-communicable diseases. The Malaysian National Health and Morbidity

Survey 2023 reported that one in three adults are not physical activity, 84% of adults not active in sport, fitness and leisure activity (Institute for Public Health, 2024). Physical inactivity constitutes an independent target for intervention. Physical activity, first and foremost, is the relationship between exercise and physical fitness (Buchner et al., 2008). Bodyweight exercise is defined in the context of physical activity as using one's body weight from free weights or exercise equipment during exercise or a workout. Using bodyweight while exercising has the advantage of not requiring any equipment or signing up to become a member of a gym; it can also be done in a comfortable home setting, such as a bedroom, dining hall, balcony, etc.; and finally, it can be done while away from home, such as in a hotel room (Lindsay Smith et al., 2017).

Increasing physical activity levels is crucial for reducing the risk of cardiovascular disease, with physical inactivity being an independent target for intervention. Recommendations suggest accumulating at least 150 minutes of moderate-intensity activities per week, such as leisurely biking or playing doubles tennis, or 75 minutes of vigorous-intensity activities, such as fast bicycling or singles tennis. Bodyweight exercises, which utilize one's own body weight as resistance, offer a convenient and accessible way to exercise without the need for equipment or gym memberships. These exercises can be performed at home or while travelling, making them suitable for individuals in various settings (WHO Steering Group, 2020).

It focuses on six key independent variables that serve as measures of PA level. Firstly, self-efficacy, which refers to individuals' belief in their capability to successfully perform PA-related tasks, is considered. Higher levels of self-efficacy are typically associated with increased engagement in PA among the elderly. Additionally, social support, encompassing encouragement, assistance, and companionship from family, friends, or peers regarding PA, is examined. Positive social support often acts as a motivating factor for elderly individuals to be more active (Steinhoff & Reiner, 2024).

Furthermore, attitudes towards PA play a significant role. Positive attitudes are conducive to greater participation in PA, while negative attitudes may serve as barriers. Perceived behavioural control (PBC), indicating individuals' perception of their ability to overcome obstacles and engage in PA, is also explored. Higher levels of perceived control are typically linked to greater PA engagement. Autonomy, representing the extent of individuals' freedom and choice in PA participation, is another variable under scrutiny. Greater autonomy often leads to higher PA levels (Parra-rizo & Sanchís-soler, 2021).

Lastly, motivation, whether intrinsic or extrinsic, is examined. Motivated individuals are more likely to participate in PA regularly (Ferraz et al., 2021). By investigating these independent variables, this study aims to provide insights into the factors influencing PA participation among the elderly population, thereby informing strategies for promoting and supporting PA in this demographic. The current study aims to explore the relationship between determinant factors, cardiovascular risk, and physical activity levels among the elderly. Globally, CVD prevalence is high, particularly in low- and middle-income countries, with significant economic burdens.

Our study aims to explore factors influencing elderly intention to engage in physical activity using the few models of determinant factors. We hypothesized that intention would be influenced by attitudes, perceived behavioural control (PBC), motivation and subjective norms, aligning with the

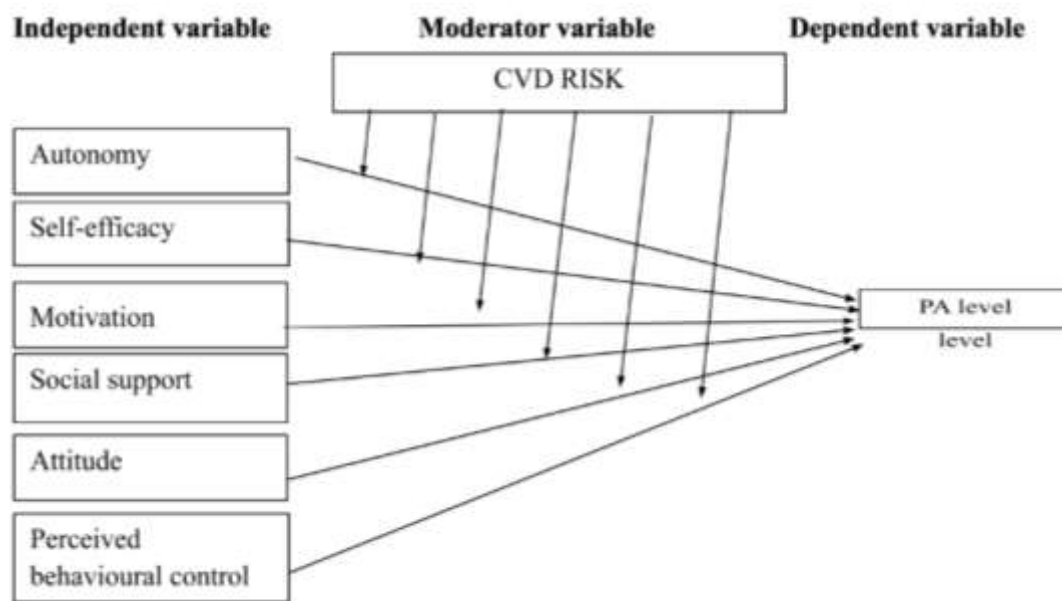
Theory of Planned Behaviour (TPB). Additionally, we expected TPB constructs to mediate the relationship between autonomous motivation and intention.

2. Methods

2.1. Conceptual Framework

The conceptual framework depicted in the image explores the moderation effect of cardiovascular disease (CVD) risk on the relationship between various independent variables and the dependent variable, physical activity (PA) level among the elderly. Conceptual framework was developed by on the selected determinant factors that mainly influence the involvement of elderly in physical activity. Meanwhile, CVD risk act as a moderation effect between determinant factors (independent factors) and PA level (dependent factors).

Fig. 1. Conceptual Framework - Independent variable and dependent variable moderated by CVD risks.



The conceptual Framework was developed based few theories, including autonomy which reflects the individual's sense of control over their actions and decisions related to physical activity and motivation that drives the willingness to engage in physical activity was identified from self-determination theory (SDT) (Ryan & Deci, 2002). Self-efficacy represents the belief in one's capability to engage in physical activity from social cognitive theory (SCT) (Bandura, 2001) and SDT. The determinant social support encompasses the encouragement and assistance from others in engaging in physical activity that was adopted from both SCT and the theory of planned behavior (TPB) (Ajzen, 1991). The determinant factor of attitude that involves the positive or negative evaluations of physical activity and perceived behavioural control where it reflects the perceived ease or difficulty of engaging in physical activity were adopted from TPB (Figure 1).

The moderator variable involves CVD risk used to assess whether the relationships between these independent variables and the dependent variable (PA level) change depending on the level of perceived CVD risk factors.

2.2 Study Design

Quantitative research was selected for this study because it allows for a determination of the factors influencing physical activity, including the moderating effect of cardiovascular disease (CVD) risk. Data collection was conducted through a questionnaire and analysed using statistical methods with SPSS software. Hypothesis testing was also performed using the questionnaire to establish relationships between determinant factors and physical activity levels influenced by CVD risk. Ethical approval from MSU Ethical Committee (MSU-RMC-02/FR01/07/L1/048).

2.3 Sampling Technique

A simple random sampling technique was used to conduct the research. Around 400 questionnaires were handed out, with 310 individuals responding to an online survey through a Google Form titled "online survey." Additionally, 73 questionnaires were distributed directly to various care centres in Kuala Lumpur. Both methods, distributing the questionnaire online via Google Forms and directly to care centres, allowed respondents to share their thoughts at their convenience. This approach facilitated easy data collection from the elderly, as they could provide information in their own time.

2.4 Sample size

This research targeted individuals aged 60 and above, focusing on a period of approximately 18 months. The sample size was determined based on records from randomly selected clinics and elderly care centres in four main districts in Kuala Lumpur. Elderly individuals were chosen as they serve as role models for younger generations through their active lifestyles. Understanding their exercise behaviour is essential. Sample size estimation was calculated using techniques from the National Education Association's research division, resulting in a suggested sample size of 383 individuals with a 4.24% non-response rate, totalling 400 participants.

2.5 Instruments and data collection

Section A is the demographic profile, where respondents must give personal information such as age, address, date of birth, education level, race, gender, marital status, district, and any supplements taken.

Section B of the questionnaire is Physical activity levels were evaluated using the International Physical Activity Questionnaire (IPAQ)-short form during interview sessions. It comprises 7 questions about physical activity conducted over the past 7 days, covering vigorous-intensity and moderate-intensity activities, walking, and sitting (Lee et al., 2011). Participants provided details on the duration of activities on both weekdays and weekends during the interviews. Physical activity was quantified using the formula: MET-min/week = minutes of activity/day × days per week × MET level. Activity levels were categorized as low (<600 MET-minutes/week), moderate (600–3000 MET-minutes/week), and high (≥3000 MET-minutes/week) based on IPAQ guidelines. To determine moderate-to-vigorous physical activity, the total IPAQ score was

utilized, using categories of sedentary (≤ 100 counts/min), light (101–1951 counts/min), moderate (1952–5724 counts/min), and vigorous (≥ 5725 counts/min) (Freedson et al., 1998).

Section C of the questionnaire is focused on assessing cardiovascular disease (CVD) risk factors as its primary outcome. The Framingham generalised CVD risk score (FRS) was employed to evaluate these factors for each participant. The FRS, based on the algorithm developed by D'Agostino et al. (2001), incorporates age, HDL cholesterol level, systolic blood pressure (BP), smoking status, and diabetes level (D'Agostino et al., 2001). The scores for each risk factor were summed up separately for men and women, as per the FRS tabulated score (Sohn et al., 2012). This score helps estimate the actual risk of developing CVD. CVD risk percentages were categorized as low risk ($<10\%$), intermediate risk (10–20%), and high risk ($>20\%$). The assessment was conducted online through a website, where participants completed the assessment via email within the specified timeframe, providing measurements of CVD risk factors in the elderly (Sohn et al., 2012).

Section D questionnaire to study the determinant factors of elderly engagement in physical activity total of 6 factors were used to evaluate involvement in elderly physical activity. To assess self-efficacy, participants used the Regulated Exercise Scale, a 9-item instrument, which evaluates confidence levels in continuing exercise, particularly during challenging times. This scale measures confidence in engaging in physical activity lasting over 20 minutes, scored on a 5-point Likert scale, where higher scores indicate greater self-efficacy for physical activity (Resnick & Jenkins, 2000). For social support, the Social Support for Exercise Survey, a 12-item questionnaire, was employed. Respondents rated their family and friends' behaviours and attitudes towards exercise on a 5-point Likert scale. Unlike typical Likert scale statements, this questionnaire utilized questions, offering flexibility in gathering data on various aspects of behaviour and experiences related to exercise (Sallis et al., 1987).

The Attitude component was assessed using the OPAPAEQ, consisting of 14 items rated on a 5-point Likert scale to gauge participants' positive attitudes towards physical activity (Pappous et al., 2006). Perceived Behaviour Control (PBC) was measured using a questionnaire with items rated on a seven-point scale, assessing both internal and external control over engaging in physical activity. Participants rated their perceived difficulty or ease of performing physical activity and their belief in having control over their behaviour (Hagger et al., 2001). The Autonomy Questionnaire measured the satisfaction of psychological needs for physical activity using a 5-point Likert scale across 18 items. Mean scores were calculated from items related to autonomy, competence, and relatedness (Wilson et al., 2006). The motivation was assessed using the Behavioural Regulation Exercise Questionnaire-2 (BREQ-3), focusing on intrinsic, integrated, and identified motivation. Participants responded to 12 items on a 5-point Likert scale, indicating the extent to which each motivation regulation applied to them. Mean scores were calculated for each motivation regulation (Markland & Tobin, 2004).

2.6 Statistical analysis

The data was analysed using descriptive, bivariate, and inferential statistics using IBM-SPSS. The reliability test was used to test the consistency and validity of all independent variable (determinant factors). The following Pearson correlation test was tested to check on the independent variables and test was done to identify the independent and dependent variables. The independent t-test and

ANOVA test were done to check the relationship between every independent and dependent variable. Regression analysis was analysed to analyse the moderation effect (CVD risk) on independent (determinant factors) and dependent variables (physical activity).

3. Results

A total of 383 subjects participated in this study. The subjects were mostly aged between 60-99 and most of the respondents are physically active which is 237 (62.2%). The most active person is from age 60-69 which is 125 respondents. The active gender is female compared to male which is 129 respondents. For CVD Risk Using FRS Score. The CVD risk level shows that 204 (53.5% of respondents) are at risk for CVD, compared to 177 (46.5%) respondents who have no risk (Table 1)

A Total of 383 subjects who participated in this study, were mostly aged between 60-99 and most of the respondents were physically active which is 237 (62.2%). The most active participants were from age 60-69 which is 125 respondents. Regarding gender, females are more active, with 129 active respondents compared to 108 males. In contrast, the number of inactive females is 31, slightly higher than the 30 inactive males.

Among the different ethnic groups, Indians have the highest number of active respondents, totalling 99, followed by Chinese at 81 and Malays at 34. For inactivity, the Chinese have the highest number of inactive respondents at 37. Married individuals lead in physical activity with 101 respondents, followed by widowed respondents at 86, and single respondents at 50. However, among the inactive group, widowed individuals are the most prevalent, with 27 respondents, compared to 21 for married and 13 for single individuals.

Regarding educational attainment, most respondents were from the tertiary education level, with 190 individuals. Secondary education follows with 26 respondents, and primary education has 15 respondents. Among the inactive group, those with tertiary education are most prevalent, totalling 46 individuals (Table 1).

Table 1 Demographic characteristics and physical activity level of the respondents

Parameter	Frequency n (%)	Physical activity level		
		Low n (%)	Moderate n (%)	High n (%)
Total	383 (100)	69 (18)	83 (22)	231 (60)
<i>Age</i>				
60-69	164 (43)	20 (12)	55 (34)	89 (54)
70-79	126 (33)	56 (44)	40 (32)	30 (24)
80-89	73 (19)	36 (37)	34 (43)	17 (20)
90-99	20 (5)	15 (72)	3 (16)	2 (12)
<i>Gender</i>				
Male	172 (45)	24 (14)	48 (28)	100 (58)
Female	211 (55)	32 (15)	49 (23)	130 (62)
<i>Ethnics</i>				
Malay	48 (13)	4 (8)	10 (21)	34 (71)

Chinese	153 (40)	38 (25)	32 (21)	83 (54)
Indian	154 (40)	11 (7)	28 (18)	115 (75)
Others	28 (7)	9 (31)	10 (38)	9 (31)
<i>Marital status</i>				
Single	74 (19)	16 (22)	18 (25)	38 (52)
Married	161 (42)	30 (18)	37 (23)	93 (59)
Windowed	148 (39)	22 (15)	27 (18)	99 (67)
<i>Education level</i>				
No formal education	6 (2)	0 (0)	0 (0)	6 (100)
Primary Education	34 (9)	10 (29)	9 (26)	15 (45)
Secondary Education	40 (10)	5 (13)	8 (21)	27 (66)
Pre-university	39 (10)	6 (15)	8 (22)	25 (63)
Tertiary Education	264 (69)	47 (18)	55 (21)	162 (61)

Table 2, shows the frequency distribution table of CVD risk. The FRS score or Framingham test estimates the 10-year risk of CVD. Below are the parameters that indicate the CVD risk level. The CVD risk level shows 199 participants are mostly at moderate risk for CVD risk followed by 121 participants who are at high risk.

Table 2 Frequency distribution table of CVD risk using Framingham Risk Score test

Parameter	Score range	Frequency (n)	Percentage (%)
Cholesterol	0	56	14.7
	1	220	57.7
	2	39	10.2
	3	49	12.9
	4	16	4.2
	5	1	3.0
HDL	-2	9	2.4
	-1	76	19.9
	0	93	24.4
	1	151	39.6
	2	52	13.6
BP	-3	18	4.7
	-2	4	1.0
	0	132	34.6
	1	134	35.2
	2	87	22.8
	4	6	1.6
Hypertension	Yes	201	52.8
	No	180	47.2
Smoking	No	317	83.2
	Yes/Women	20	5.2
	Yes/Men	44	11.5
Diabetes	No	274	71.9
	Male/Yes	56	14.7

The variables motivation and physical activity were found to be very weak correlated, ($r = .17$, $p = .005$). There was a moderation effect of CVD risk between motivation towards the PA of the elderly. Motivation influences the engagement of PA in the elderly based on CVD risk.

Among the elderly people in Kuala Lumpur, the independent variable social support and physical activity were negatively correlated, ($r = -.05$, $p = .317$). There was no moderation effect of CVD risk between social support towards physical activity of elderly. Even though CVD risk is high or low, the elderly are not influenced by social support to engage in PA.

There is no moderation effect of CVD risk between self-efficacy towards physical activity of the elderly. Even though CVD risk is high or low, the elderly are not influenced by self-efficacy to engage in PA (Table 5).

Table 5 The Pearson correlation between physical activity and determinant factors

Dependent variable	Independent variable	Pearson Correlation	Sig. (2-tailed)	Results
Physical activity (PA) of the respondents	Self-efficacy	0.075	0.144	No correlation
	Social support	-0.051	0.317	Negative correlation
	Attitude	0.073	0.158	No correlation
	PBC	0.310	0.000	Very weak correlation
	Autonomy	0.150	0.003	Very weak correlation
	Motivation	0.173	0.005	Very weak correlation

4. Discussion

The current study emphasises the significance of identifying determinant factors and how they influence older adults' participation in physical activity. It is also important to keep our bodies healthy and away from CVD diseases. Every individual must be aware of their CVD risk, as this can determine their health status. One of the most important findings is the importance of understanding the best determinant factors and how CVD risk moderating depends on physical activity level.

Engagement in physical activity can be predicted by individual intentions, motivation towards physical activity, and autonomy. However, this study suggests that employees with high determinant factors (any of them) can perform their tasks well, have the willingness to engage in physical activity and motivate each other for a better future. It is important to identify the sources of support and barriers to elderly engagement in order for them to perform well and provide them with the opportunity to increase their self-esteem (self-efficacy, social support, and attitude).

Furthermore, this research study 184 provides empirical evidence to support or reject the determinant factors identified in previous studies in advance. Based on the findings from this research, motivation, PBC, and autonomy are significant and positively related to PA engagement. In contrast, social support, self-efficacy, and attitude are not significantly related to PA engagement. Apart from that, according to the results of this study, motivation, PBC, and autonomy are the strongest variables for elderly barriers to PA engagement.

This will be useful for future academicians and researchers conducting in-depth studies on this study. In conclusion, a combination of personalized programs, social support, multifaceted exercises, achievable goals, and ongoing assessments are significant factors that empower older individuals to proactively enhance their physical activity levels by challenging their capabilities. This comprehensive approach promotes better health and well-being among seniors, enabling them to lead active and fulfilling lives as they age. This study has made one step towards an in-depth study of each determinant factor and provides a clear guide to future researchers in the field of study, more specifically in the Malaysian context.

Furthermore, the study provides an important foundation for analysing moderators simultaneously in determining the determinant factor and PA level of each elderly person. It could be the first and most important study in using SPSS to analyse moderator variables relating to independent and dependent variables.

The study investigates how cardiovascular disease (CVD) risk moderates the relationship between three psychological factors—perceived behavioural control (PBC), motivation, and autonomy—and physical activity (PA) among the elderly. The study's key findings highlight the moderating effect of cardiovascular disease (CVD) risk on the relationships between perceived behavioural control (PBC), motivation, and autonomy with physical activity (PA) among the elderly.

Firstly, the hypothesis that CVD risk moderates the relationship between PBC and PA was supported, this indicates that the elderly's perceived control over their behaviour influences their physical activity levels more strongly when considering their CVD risk. Busse & Miranda (2018) study emphasized the significant role of perceived behavioural control in predicting physical activity levels, particularly among individuals with higher health risks (Busse & Miranda, 2018) and Ghahremani et al. (2012) findings suggested that perceived behavioural control was a significant predictor of physical activity among older adults, with health status acting as a moderator (Ghahremani et al., 2012).

Secondly, the hypothesis that CVD risk moderates the relationship between motivation and PA was also supported. This suggests that higher motivation levels lead to greater engagement in physical activity among the elderly with CVD risk. This finding aligns with studies by Han and Won (2022) that higher motivation leads to greater engagement in physical activity, particularly among elderly individuals with higher CVD risk (Han & Won, 2022).

The results support the hypothesis that CVD risk moderates the relationship between autonomy and PA. This finding indicates that elderly individuals with higher autonomy are more likely to engage in physical activity, even when considering their CVD risk. Previous study has shown to emphasize the importance of autonomy in influencing physical activity engagement, particularly in health-compromised populations (Fenton et al., 2018). These findings underscore the complex interplay between psychological factors and health conditions in determining physical activity behaviours among the elderly.

Several previous studies have examined the relationships between psychological factors such as perceived behavioural control (PBC), motivation, autonomy and physical activity (PA), particularly in populations with cardiovascular disease (CVD) risk. For instance, Motalebi et. al.

(2014) study found that older individuals with higher PBC are more likely to engage in regular PA (Motalebi et al., 2014). The authors noted that interventions aimed at increasing PBC, such as skill-building activities and providing supportive environments, were effective in enhancing PA levels among older adults. Barak et al. (2022) highlighted that PBC significantly predicts PA among the elderly, especially when coupled with tailored health messages that address individual health risks. The study emphasized the need for personalized approaches that consider an individual's health status, including CVD risk (Barak et al., 2022). Azizan et al. (2013) demonstrated that elderly participants with higher PBC showed better adherence to PA programs. The study also noted that the impact of PBC on PA was stronger among those with higher perceived health risks, suggesting that health concerns might amplify the influence of PBC on PA behaviours (Azizan et al., 2013).

Regarding motivation and physical activity, Han and Won (2022) investigated the relationship between social motivation and physical activity in patients with coronary artery disease (CAD), finding a significant positive correlation that indicated higher motivation was associated with increased physical activity levels (Han & Won, 2022). Santaularia and Jaarsma (2013) examined the role of motivation in engaging in physical activity among the elderly with cardiac conditions, finding that motivation significantly influenced their PA levels (Santaularia & Jaarsma, 2013). Other studies on CVD patients consistently show that motivation is a critical factor in determining physical activity levels, with higher motivation correlating with greater engagement in PA (Klompstra et al., 2022; Perry et al., 2023).

Autonomy and its impact on physical activity have also been studied. Chatzisarantis et al. (2007) explored the psychological need for autonomy and its impact on physical activity, finding that individuals with higher autonomy had a greater intention to engage in PA (Chatzisarantis et al., 2007). Yeom and Lee (2022) investigated the role of autonomy in physical activity among populations with health risks, including CVD, concluding that supporting autonomy can positively influence physical activity engagement, even in the face of illness and health risks (Yeom & Lee, 2022). Autonomy in physical activity engagement among elderly individuals is associated with positive psychosocial outcomes. These include improved mood, reduced stress levels, enhanced self-esteem, and increased social interaction opportunities. Such benefits contribute to overall well-being and quality of life, which are important considerations in managing CVD risk in older adults.

These studies collectively reinforce the findings in this research, those determinant factors that are not significant towards physical activity among the elderly such as perceived behavioural control, motivation, and autonomy are significant predictors of physical activity, especially in elderly populations at risk for cardiovascular disease. The moderating effect of CVD risk on these relationships highlights the complex interplay between psychological factors and health conditions in determining physical activity behaviours.

While self-efficacy is generally associated with better adherence to physical activity, its impact can vary among elderly individuals with CVD risk. Some studies have found that despite high self-efficacy beliefs, actual participation in physical activity may not increase significantly. This discrepancy suggests that while self-efficacy is important, other factors such as physical limitations or fear of exacerbating health conditions can override its influence. A study by Smith et al. (2014) observed that while self-efficacy was positively correlated with intentions to exercise among

elderly individuals, actual behaviour change in terms of increased physical activity was not consistently supported. This indicates that while self-efficacy may motivate intentions, it may not always translate into sustained behaviour change, especially in the context of managing CVD risk (Lindsay Smith et al., 2017).

Social support, including encouragement from family, friends, or healthcare providers, is traditionally seen as beneficial for promoting physical activity in elderly populations. However, its impact can vary based on the type and quality of support received. Some studies suggest that perceived support may not always translate into increased physical activity levels if the support is not perceived as helpful or if individuals do not feel autonomous in their exercise choices. Research by Smith et al. (2023) found that while social support was associated with initial engagement in physical activity among elderly individuals, its long-term impact on sustained behaviour change was less clear (Smith et al., 2023). This suggests that while social support can be motivating, its influence may diminish over time without concurrent autonomy-supportive interventions.

Attitude towards physical activity, including perceptions of its benefits and enjoyment, is crucial for initiating behaviour change. However, attitudes alone may not always predict sustained engagement, particularly in elderly individuals managing CVD risk factors. Factors such as perceived barriers eg. health concerns, lack of time and external constraints e.g., weather, and accessibility to facilities can mitigate the influence of positive attitudes (Akenine et al., 2020). Attitudes towards physical activity were found to be less predictive of long-term adherence among elderly individuals compared to factors like perceived autonomy and personalized exercise plans (Pappous et al., 2006). This underscores the complexity of behaviour change in older populations, where multiple factors interact to influence physical activity outcomes.

5. Conclusion

In conclusion, while self-efficacy, social support, and attitude are important determinants of physical activity behaviour, their impact on elderly engagement, particularly in the context of managing CVD risk, can be influenced by various factors. Studies have shown that while these factors may motivate initial intentions or behaviour change, their sustained influence may be limited without addressing broader issues such as autonomy in exercise decision-making, adaptation to health conditions, and personalized intervention strategies. Future research should continue to explore how these determinants interact with autonomy-supportive approaches to optimize physical activity promotion among elderly populations with diverse health needs.

The current study emphasises the significance of identifying determinant factors and how they influence elderly people's participation in physical activity. One of the most important findings is the importance of understanding the best determinant factors and how CVD risk moderating depends on CVD risk level. This study contributes to our ability to optimize cardiovascular risk status by identifying the determinant factors that influence one to exercise. Engagement in physical activity can be predicted by individual intentions, motivation towards physical activity, and autonomy.

Consent

All participants provided their written informed consent before participating in the study.

Declaration of competing interest

The authors have no relevant financial or non-financial interests to disclose.

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Ethical approval statement

This study was granted the ethical approval from MSU Ethical Committee (MSU-RMC-02/FR01/07/L1/048).

Author contributions

Zulhabri Othman: Conceptualization, Methodology, Supervision, Reviewing Kishenthi Kerisnan: Visualization, Investigation, Data curation, Writing- Original draft preparation Norshafarina Shari: Conceptualization, Methodology, Supervision, Validation, Reviewing Lilik Herawati: Writing- Reviewing and Editing.

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