



# Utrecht University

## Stepping Stones to Stress Relief: Examining the relation Between Physical Activity, Self-Efficacy, and School-Related Stress in Adolescents

Master thesis

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This thesis has been written as a study assignment under the supervision of a Utrecht University teacher. Ethical permission has been granted for this thesis project by the ethics board of the Faculty of Social and Behavioural Sciences, Utrecht University, and the thesis has been assessed by two university teachers. However, the thesis has not undergone a thorough peer-review process so conclusions and findings should be read as such.

### **Abstract**

The mental health of young people is increasingly challenged. A prevalent issue among them is school-related stress, which adversely affects overall mental health. Physical activity has been proposed as a potential protective factor against stress. However, there has been little research on whether it also protects against school stress and whether this effect may be mediated by self-efficacy. This study aimed to investigate the relationship between physical activity and school stress in Dutch adolescents aged 12-18, and whether this relationship is mediated by self-efficacy. A cross-sectional design was employed, utilizing data from the Dutch HBSC study conducted in 2021. A sample of 5637 secondary education students was analysed using mediation analyses. The results show that physical activity was negatively associated with school stress, explaining 1.5% of its variance. Additionally, physical activity positively influenced self-efficacy, which in turn negatively predicted school stress. The indirect effect of physical activity on school stress through self-efficacy was significant. Even though the effects found are small, these findings highlight the potential role of physical activity in reducing school-related stress among Dutch adolescents, mediated by enhanced self-efficacy. So, interventions promoting physical activity may contribute to improving adolescent mental health and well-being in educational settings.

*Keywords:* adolescents, physical activity, self-efficacy, school stress, HBSC

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Nowadays, the mental health of young people is under significant pressure, with many experiencing a range of mental health problems. In recent years, there has been a noticeable increase in mental health issues among adolescents. According to a survey conducted by the CBS, in 2019 and 2020, 11 percent of individuals aged 12 to 25 reported experiencing mental health issues. This percentage increased to 18 percent in 2021 (CBS, 2022). This is a serious matter, because mental health issues represent the main threat to the future potential of young people around the world (McGorry et al., 2022). These complaints can hinder academic achievement (Agnafors et al., 2020) and reduce productivity at work (Bubonya et al., 2017), which can create challenges for young individuals in achieving their personal goals.

One issue that affects many young people is stress (Pascoe et al., 2019) and this can lead to various other health issues. Persistent stress can have detrimental effects on one's health due to physiological changes (Van Der Zwan et al., 2015), including changes in the nervous and immune systems (Steptoe et al., 2007). Additionally, it can result in elevated cortisol levels, increased heart rate, and elevated blood pressure (Schneiderman et al., 2005). Besides physiological health, it may also contribute to mental health disorders such as depression (Hammen, 2004) and anxiety disorders (Tye & Deisseroth, 2012).

Stress can be caused by various factors, but one common type is school-related stress (Pascoe et al., 2019). Education and academic performance are a significant source of stress to students. Academic-related stress encompasses, among other things, pressure to achieve high grades, concerns about receiving low grades and anxiety about school examinations (Pascoe et al., 2019). One in four young individuals experiences stress as a result of school (Kleinjan et al., 2020). Particularly in higher education, stress affect 97% of the students (Dopmeijer et al., 2022). A possible explanation of this issue is the performance pressure prevalent in society. 54% of the students in higher education also suffer from performance pressure (Dopmeijer et al., 2022) and one out of every three students faces difficulty in coping with the

pressure to meet either their own or others' expectations (Kleinjan et al., 2020). As mentioned before, stress can lead to mental health disorders, and this also applies to school stress. For example, research indicates a positive and significant correlation between academic-related stress and depressive symptoms (Moksnes et al., 2014). Adolescents burdened by school stress face a 2.4 times higher risk of depression compared to their stress-free counterparts (Jayanthi et al., 2015).

A factor that potentially reduces school stress is physical activity (Chekroud et al., 2018). It serves as a coping strategy by influencing behaviours and cognitive processes that help individuals manage, tolerate, and reduce stress (Folkman & Lazarus, 1980). Physical activity is already worldwide acknowledged as an intervention for enhancing mental well-being (Vella et al., 2023). Extensive research has explored the relationship between physical activity and stress. Individuals who are physically active experience less stress in general (Chekroud et al., 2018) and physical activity can significantly improve mental health and reduce stress symptoms (Mikkelsen et al., 2017). This is substantiated by the finding that physical activity triggers the release of endorphins and reduces the stress hormone cortisol (Paluska & Schwenk, 2000). The overall findings from research suggest that exercise can lead to different physiological changes, resulting in enhanced mood and reduced stress levels (Mikkelsen et al., 2017).

Furthermore, physical activity offers additional advantages such as self-initiated engagement, flexibility in scheduling, and it is not restricted to a specific location (Cavanagh et al., 2013; Henriques et al., 2011; Jazaieri et al., 2012). Despite this, many young people engage in insufficient physical activity. In 2021, the majority of Dutch individuals aged between 12 and 17 failed to meet the recommended levels of physical activity (RIVM, 2023b). Therefore, addressing exercise as a potential solution to the stress problem requires further attention.

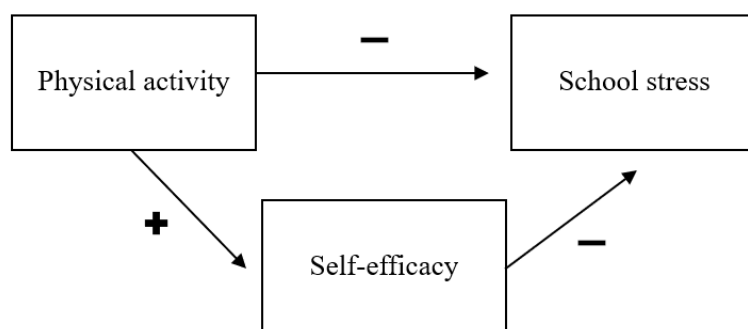
Moreover, psychological benefits of physical activity may include positive emotions linked to self-efficacy (Mikkelsen et al., 2017). Self-efficacy refers to individuals' confidence in their ability to achieve specific levels of performance and influence outcomes in their lives (Bandura & Wessels, 1994). Research shows that regularly exercising enhances self-efficacy (Tikac et al., 2021) and that self-efficacy scores strongly correlate with the exercise levels of individuals, with non-exercisers having low confidence in their own ability (Paluska & Schwenk, 2000). Multiple factors may potentially imply enhanced self-efficacy. For example, successfully adopting regular physical activity can result in improved mood, increased self-confidence and enhanced coping abilities in managing mental health challenges (North et al., 1990; Gauvin & Spence, 1996).

Self-efficacy plays a crucial role in human functioning, including influences on both physical and mental health (Maddux, 2016). Research underscores the significant role of individuals' self-efficacy in shaping their stress levels and outcomes (Shelley and Pakenham 2004; Abouserie 1994; Wiedenfeld et al. 1990). Multiple studies have discovered a notable inverse relationship between self-efficacy and level of stress (Hackett et al., 1992; Moeini et al., 2008; Wiedenfeld et al., 1990). By fostering a sense of control, self-efficacy enables individuals to effectively respond to stress (Bandura et al. 1988).

So, physical activity strengthens self-efficacy, and self-efficacy reduces stress. However, little research has been conducted on whether self-efficacy mediates the relationship between physical activity and school stress. Figure 1 shows a conceptual model of the possible associations and this results in the following research question: *To what extent is physical activity related to school stress in Dutch adolescents aged 12-18, and is this mediated by self-efficacy?*

**Figure 1**

*Conceptual model: relationship between Physical activity, Self-efficacy and School Stress*



### **School Stress**

Stress arises when the demands of the environment surpass one's perceived ability to cope. It results in feelings of fear, anxiety, emotional strain, and challenges in adapting (Fink, 2016). Individuals may share the same physiological stress response, but stress triggers can vary greatly because of differences in origins and outcomes (Reddy et al., 2018).

Within an academic environment, common stressors include heavy workloads, poor time management, social difficulties, and peer competition (Fairbrother & Warn, 2003). The structure of the educational system can increase stress, with increased emphasis on performance metrics like grades and high-stakes tests, often at the expense of student well-being and worsening social inequalities (Högberg et al., 2019). Additional stressors within the educational environment may include overcrowded classrooms, limited resources, extensive syllabi, long study hours, and emphasis on rote memorization (Agrawal & Chahar, 2007; Deb et al., 2015).

In 2023, 1,668 Dutch adolescents with mental health issues were asked why they were feeling stressed and unhappy. Among other results, performance pressure emerged as a significant factor. Nowadays performance pressure is prevalent in society, with parents, schools, and peers all expecting young individuals to consistently excel (RIVM, 2023a). Parents and educational institutions often cause a fear of failure, thereby raising expectations

and further worsening stress levels (Ang & Huan, 2006). For example, research has demonstrated that academic stress is positively correlated with parental pressure (Deb et al., 2015). Many young people report feeling overwhelmed and pressured to succeed, resulting in fully planned schedules and constant comparison to others' achievements (RIVM, 2023a), which significantly contributes to their stress levels.

### **Physical activity**

Physical activity refers to the movement of the body's skeletal muscles, which consumes energy and can vary greatly based on individual preferences and changes over time. It can be categorized into various types, such as leisure-time physical activity, which includes activities undertaken during free time. Leisure-time physical activity can further be subdivided into categories such as sports, conditioning exercises, and gardening (Caspersen et al., 1985).

The distinction between "exercise" and "physical activity" is often blurred. Both involve bodily movement and are positively correlated with physical fitness as the intensity, duration, and frequency of movements increase. However, exercise is a specific subcategory of physical activity. It encompasses planned, structured, repetitive activities with a clear purpose, aiming for the improvement or maintenance of various aspects of physical fitness (Caspersen et al., 1985). This research will examine both terms as they both aim to promote movement. Therefore, while exercise aligns closely with this objective, activities such as walking or cycling will also be considered.

Multiple studies show that individuals who engage in regular physical activity and maintain physical fitness have a reduced stress response (Crews & Landers, 1987; Hegberg & Tone, 2015; Tsatsoulis & Fountoulakis, 2006). Physical activity is seen as an important explanation for reduced stress because of several physiological effects. For example, lower stress-induced cortisol levels are measured in physically trained individuals, involving



reduction of the hypothalamic pituitary-adrenal (HPA) axis response to stress (Rimmele et al., 2009). Also, physically fit individuals maintain greater parasympathetic control during stress (Hamer & Steptoe, 2007). This suggests that the autonomic nervous system is better able to respond to stress which can aid to relaxation of the body and facilitate recovery from the stress response.

Besides the physiological explanations, there exists a psychological reasoning. The distraction hypothesis provides a plausible explanation for why exercise helps alleviate anxiety and stress (Bahrke, 1978). According to this hypothesis, exercise redirects attention from stressors, offering a time-out period (Bahrke & Morgan, 1978; Morgan, 1985). This shift in focus enables individuals to temporarily escape negative thoughts (Mikkelsen et al., 2017) and provides a form of recovery, regardless of fitness level (Carmack et al., 1999). Additionally, the response style theory suggests that active distraction is more effective than passive distraction (Nolen-Hoeksema et al., 1993), which strengthens the positive effects proposed by the distraction hypothesis.

Engaging in exercise and physical activity can be a beneficial distraction, as research has shown it reduces stress and anxiety. Exercise effectively reduces tension, promotes relaxation, and serves as a distraction, all of which are recognized as effective strategies for coping with stress (Martin & Wade, 2000). Furthermore, exercise is found to be driven by intrinsic motivation and consciously used for this purpose as a stress reduction method (Cairney et al., 2014).

### **Self-efficacy**

Perceived self-efficacy refers to individuals' confidence in their ability to achieve specific levels of performance and influence outcomes in their lives. These beliefs influence people's emotions, thoughts, motivation, and actions. Such beliefs generate diverse effects through four major processes: cognitive, motivational, affective, and selection processes.

Most actions stem from thoughts, with people's self-efficacy shaping various scenarios they construct and rehearse. Self-efficacy determines people's goals, effort exertion, perseverance in difficulties, and resilience to failure. It also influences the level of worry about problems, affecting task performance and avoidance of difficult situations. Additionally, our choices are influenced by self-efficacy; people avoid tasks in which they doubt their ability to handle them, but pursue those they feel confident in. This shapes their skills, interests, and social networks, thereby influencing development and career paths (Bandura & Wessels, 1994).

One activity that potentially enhances self-efficacy is engaging in exercise and physical activity. The self-efficacy hypothesis suggests that accomplishing a significant and challenging task, like completing an exercise session, induces a sense of mastery, which also improves mood (Mikkelsen et al., 2017). Believing in one's ability to succeed (self-efficacy) is positively correlated with engaging in exercise (Middelkamp et al., 2017). Research shows that participants with low exercise levels also have low self-efficacy scores and thus little confidence in their abilities (Paluska & Schwenk, 2000). The greater the perceived self-efficacy after exercise, the more likely it is for an individual to stick to their own goals (Middelkamp et al., 2017). So when someone has developed high self-efficacy, they will continue to strive, for example, to achieve a high grade and manage schoolwork more effectively. This effect does not just arise in intense exercising, but also for example after frequently walking (Gary, 2006).

Enhancing self-efficacy is essential for the successful adoption and maintenance of nearly all behaviours critical to health, such as managing stress. It influences the body's physiological responses to stress, including the functioning of the immune system, but also the activation of hormones that are crucial for stress management (Maddux, 2016). In addition, self-efficacy and stress are closely related as self-efficacy beliefs critically influence the evaluation of environmental demands (Lazarus and Folkman, 1984). These demands can

be perceived either as a 'threat' or a 'challenge'. The level of self-efficacy of a person determines whether a particular task is perceived as stressful or threatening, rather than as a challenge (Zajacova et al., 2005). Individuals with high self-efficacy more often evaluate demands as a challenge (Chemers, Hu, and Garcia, 2001), leading to greater persistence in tasks perceived as challenges (Zajacova et al., 2005).

Self-efficacy and perceived stress are inversely related, as evidenced by studies among college students revealing a moderate to strong negative correlation (Zajacova et al., 2005; Gigliotti and Huff, 1995; Hackett et al., 1992; Solberg et al., 1993; Solberg and Villarreal, 1997; Torres and Solberg, 2001). Research shows that students with higher self-efficacy set more ambitious goals, earn higher grades, and report better concentration and control during homework compared to those with lower self-efficacy (Bassi et al., 2006). Beliefs in one's control can be as important as actually having control (Shapiro, Schwartz, and Astin 1996), because the stronger their perceived self-efficacy, the more effort individuals will put into completing daily tasks and attempting more complex tasks (Bandura 1986). So, self-efficacy mediates the relation between external stressors and psychological stress (Bandura, 1995).

### **Hypotheses**

The current study investigates the effect of physical activity on school stress, and the possible mediation of self-efficacy. With regards to the existing literature, two hypotheses were formulated:

H1: Physical activity is negative related to school stress

H2: The relationship between physical activity and school stress is explained by self-efficacy

## Methods

### Design and Respondents

This quantitative study uses a cross-sectional research design. It uses an existing dataset derived from the Dutch HBSC study conducted in 2021. The target population of this dataset consists of youth (11 to 16 years old) in Dutch secondary education. The aim was to involve a minimum of 80 to 90 secondary schools. According to the HBSC protocol, there should be at least 1800 students per age group, averaging 11.5, 13.5, and 15.5 years old.

Stratified sampling was used for representativeness. First, schools were selected and checked whether they were representative in terms of urban and rural areas. Then the classes were selected. In secondary education, classes were randomly selected, with the number depending on school size. Three classes were chosen at small schools (fewer than 500 students), four classes at medium-sized schools (550-1000 students), and five classes at large schools (more than 1000 students). Classes with fewer than ten students were not selected.

Between May and September of 2021 171 secondary education schools were contacted. 77 agreed to participate, but six of these schools later withdrew. The final response consisted of 71 schools, involving 288 classes and 5733 students. The sample consists of an equal number of boys and girls. The average age is 13.9 years. More than half of the respondents live in a large city and less than 10 percent live in a small village. About a quarter of the respondents have a migration background, meaning that the child itself or at least one of the parents was not born in the Netherlands. Moroccan and Turkish backgrounds were most common. Students from multiple school levels participated: 24.4% VWO, 30% HAVO, and 45.6% VMBO variations.

### Sample

For this specific study, only secondary education students aged 12-18 years were included, with a mean age of 14.11. Respondents of other ages (9, 10, 11, 19, and 20) were

filtered out for the analyses. Primary school students were also excluded. All educational levels (VWO, HAVO, and VMBO) are represented. This resulted in a sample size of N = 5637. The final sample and demographics are detailed in Table 1.

**Table 1**

*Demographic characteristics*

Variable	<i>N</i>	%
Male	2860	50,74
Female	2777	49,26
VMBO-b/t	882	15,65
VMBO-t/HAVO	1556	27,60
HAVO/VWO	1591	28,22
VWO	1608	28,53

**Procedure and Ethics**

The research was submitted to the Ethical Review Committee of the Trimbos-Institute and approved after some adjustments. Data was collected between October 2021 and January 2022. The survey was conducted online at secondary schools. The questionnaires were administered at the schools by research assistants from the Trimbos-Institute, who briefly explained the research in advance and answered students' questions about the research and the questionnaire. The research assistants also mentioned that participation in the study is voluntary and that it is not mandatory to answer all questions. The young people were referred to the GGD website ([www.jouwggd.nl](http://www.jouwggd.nl)) and the 'kindertelefoon' if they wanted to go somewhere for help/questions after the investigation.

To ensure anonymity, students received a web address and login code for a digital questionnaire, without registration of who received which code. The answers were also not shared with third parties. Participating schools were requested to inform parents about the

study at least one week in advance. The schools received a sample email and an information brochure for this purpose. Parents who objected to participation could indicate this to their child's teacher or mentor.

### **Measurement instruments/Operationalization**

#### ***Independent Variable (X): Physical Activity:***

In terms of physical activity (moderate to high effort), respondents could answer the following question: “How many days out of the last seven days were you engaged in at least 60 minutes of physical activity per day?” (Prochaska et al., 2001). The answer options consisted of: 0 to 7 days. In terms of exercise (high effort), the respondents could answer the following question: “How often do you approximately engage in a sport or play in your free time (outside of school hours) to the point where you become out of breath or start sweating?” (Booth et al., 2001). The answer options included: every day, 4 to 6 times a week, 3 times a week, 2 times a week, once a week, once a month, less than once a month, never. To construct the variable 'Physical Activity,' the response options for the second question were reversed, because option 8 indicated no physical activity, unlike the first question. After reversing, the scores from both questions were summed to create the new variable. The higher the score, the greater the level of physical activity performed by the individual. Instrument's internal consistency was assessed using Cronbach's alpha ( $\alpha = .681$ ).

A Cronbach's alpha of .60 – .70 is considered questionable. Therefore, it is recommended to add an extra question that also measures the construct (Van Heijst, 2021). Since no additional questions were available in the HBSC survey and a value of .70 and above is considered acceptable, it was decided to approve the Cronbach's alpha.

#### ***Dependent Variable (Y): School Stress:***

To measure school stress in secondary education, students were asked the following question: “How much stress did you have in the past six months due to the following

situations?” An example of such a situation is: “Having too much homework”. (See Appendix C for the other situations.) The answer options consisted of: (1) No stress at all (never happened), (2) A little stress, (3) Average stress, (4) Quite a lot of stress, (5) A lot of stress. Furthermore, a question about school pressure was added to create a new variable. This question was: “Do you feel pressure from the schoolwork you have to do?” The response options were: (1) not at all, (2) a little, (3) quite a lot, (4) a lot. Ultimately, the mean score of these nine items was computed. A higher score indicates a greater level of school stress experienced by an individual. A Cronbach's alpha of ( $\alpha = .911$ ) was found.

***Mediator (M): Self-efficacy:***

Originally, there were two questions in the questionnaire that measured self-efficacy: “How often do you find a solution to a problem if you really try?” and “How often do you manage to do what you planned to do?” The response options were: (1) never, (2) almost never, (3) sometimes, (4) usually, (5) always. However, to create a variable for this study, 4 additional questions were added that might also indicate a certain degree of self-efficacy. One of these questions is: “How often did you feel you had no influence on important things? (Past month)”. (See Appendix C for the other questions.) The response options were: (1) never, (2) almost never, (3) sometimes, (4) fairly often, (5) very often. To match the original two questions, questions 1 and 4 of the added questions were reversed. The degree of self-efficacy was then determined by summing up the six items. So, the higher the sum, the higher the level of self-efficacy. A Cronbach's alpha of ( $\alpha = .728$ ) was found.

**Analysis plan**

The analysis was performed in the statistical software program JASP (version 0.18.3). A regression analysis was used for this to see whether there is a significant relationship. The indirect relation of physical activity and school stress through self-efficacy was examined, but

also the direct relation of physical activity and school stress. To determine if these relationships are significant, a threshold of  $p < .05$  was used.

A reliability analysis was conducted, including the following assumption checks: normality of residuals, homoscedasticity, linearity, multicollinearity, and identification of outliers. To assess the normality of residuals, a Q-Q plot was utilized, where the quantiles of the observed data was plotted against the expected normal distribution. This assumption is considered valid when the observed data is evenly distributed alongside the reference line. Homoscedasticity was checked by creating a scatterplot of the residual values against the predicted values. If the points are evenly spread across the horizontal axis and show no clear pattern, then homoscedasticity is present. For Linearity, we examined whether school stress is linearly related to physical activity, using a scatter plot. This assumption is considered valid when a straight line fits the data best. For multicollinearity, the variance inflation factors (VIF) were examined ( $VIF < 10$ ). Outliers were identified by examining standardized residuals and Cook's distance. If standardized residuals exceeded 3 or if Cook's distance exceeded 1, it was examined whether the scores of the outliers exhibited abnormal values; if so, these scores would be removed. However, no outliers were found and ultimately, all assumption checks were satisfied (see Appendix B). Respondents with missing data on school stress, physical activity or self-efficacy were automatically excluded through listwise exclusion. Physical activity had 9 missing values, self-efficacy had 196 missing values, and school stress had 268 missing values.

## **Results**

### **Descriptive statistics**

In Table 2, the descriptive results per variable are displayed. The table shows the three main variables, but also school stress and physical activity per education level. As shown,



both the average stress score and the level of physical activity increase as the school level rises.

**Table 2**

*Descriptive Statistics*

		Valid	Mean	Std. Deviation	Minimum	Maximum
<b>Physical activity</b>		5628	10.97	3.24	2.00	16.00
<b>Self-efficacy</b>		5441	21.22	3.78	6.00	30.00
<b>School stress</b>		5369	2.70	1.00	1.03	5.000
Physical activity	VMBO-b/t	881	10.50	3.37	2.00	16.00
Physical activity	VMBO-t/HAVO	1555	11.01	3.30	2.00	16.00
Physical activity	HAVO/VWO	1586	11.05	3.20	2.00	16.00
Physical activity	VWO	1606	11.12	3.11	2.00	16.00
School stress	VMBO-b/t	811	2.49	1.04	1.03	5.00
School stress	VMBO-t/HAVO	1460	2.59	1.01	1.03	5.00
School stress	HAVO/VWO	1540	2.75	.98	1.03	5.00
School stress	VWO	1558	2.87	.96	1.03	5.00

**Correlation analysis**

In Table 3, the correlation matrix is presented, which indicates the interrelationships among the variables in this study. It should be noted that a Pearson's correlation coefficient of .10 is considered small, .30 medium, and .50 large (Field, 2009). It can be observed that physical activity and school stress are negatively correlated ( $r = -.122, p < .001$ ). This means that students who are more physically active experience less school stress. Physical activity and self-efficacy are positively correlated ( $r = .176, p < .001$ ). This means that students who are more physically active also experience greater self-efficacy. Self-efficacy and school stress are negatively correlated ( $r = -.478, p < .001$ ). This means that students who experience greater self-efficacy experience less school stress.

**Table 3***Pearson's Correlations*

Variable	1	2	3
1. Physical activity	—		
2. Self-efficacy	.176*	—	
3. School stress	-.122*	-.478*	—

*Note.* \* =  $p < .001$ **Regression analysis of Physical Activity and School Stress**

In this section, hypothesis 1 (Physical activity is negative related to school stress) is tested and explained based on the regression analysis in Table 4. As indicated in this table, it is found that physical activity has a significant negative effect on school stress ( $\beta = -.121$ ;  $p < .001$ ). Further exploration of this effect reveals that 1.5% of the variance in school stress can be explained by physical activity (Adjusted  $R^2 = .015$ ). While this effect size is very small, it speaks to the contribution of physical activity to school stress. This leads to the acceptance of hypothesis 1.

**Table 4***Linear Regression between Physical activity and School Stress*

Model		B	SE (B)	$\beta$	LLCI	ULCI	Adjusted $R^2$
H <sub>0</sub>	(Intercept)	2.703*	.014		2.677	2.730	
H <sub>1</sub>	(Intercept)	3.115*	.048		3.021	3.208	
	Physical activity	-.037*	.004	-.121*	-.046	-.029	.015

*Note.* \* =  $p < .001$ **Mediation analysis**

In this section, hypothesis 2 (The relationship between physical activity and school stress is explained by self-efficacy) is tested using mediation analysis. The mediation analysis (Table 5) reveals that there is a small significant direct effect of physical activity on school

stress ( $\beta = -.039$ ;  $p = .001$ ). In addition to this direct effect, physical activity has a small significant effect on self-efficacy ( $\beta = .176$ ;  $p < .001$ ), and self-efficacy has a small significant effect on school stress ( $\beta = -.471$ ;  $p < .001$ ). These two paths together constitute an indirect significant effect between physical activity and school stress when self-efficacy is used as a mediator ( $\beta = -.083$ ;  $p < .001$ ). However, this effect is very small. Based on the 95% bootstrap confidence interval  $[-.098, -.070]$ , it can be stated with 95% certainty that there is an indirect effect of self-efficacy in the relationship between physical activity and school stress. Consequently, the indirect effect is deemed significant. Thus, concerning this hypothesis, it is demonstrated that the relationship between physical activity and school stress is explained by self-efficacy as a mediator. Therefore, it can be concluded that hypothesis 2 is accepted.

**Table 5**

*Path coefficients & Mediation effect*

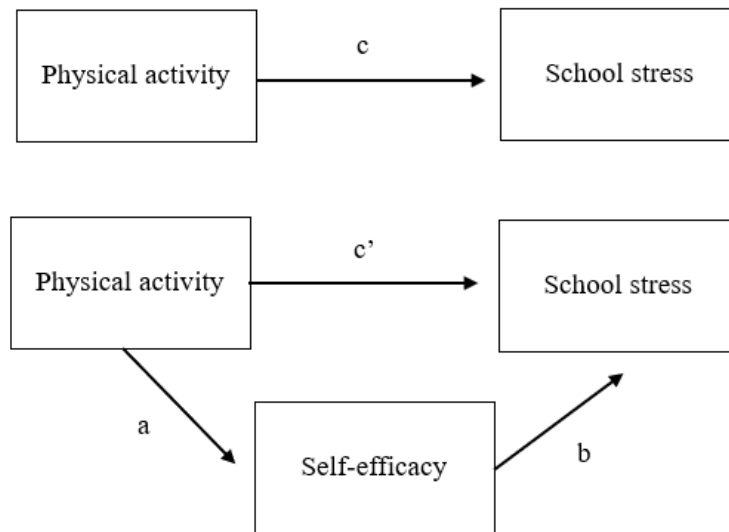
	$\beta$	Std. Error	LLCI	ULCI
Physical activity $\rightarrow$ School stress	-.039*	.012	-.066	-.014
Self-efficacy $\rightarrow$ School stress	-.471*	.012	-.497	-.446
Physical activity $\rightarrow$ Self-efficacy	.176*	.013	.150	.205
Physical activity $\rightarrow$ Self-efficacy $\rightarrow$ School stress	-.083*	.007	-.098	-.070

*Note.* \* =  $p \leq .001$

The results model (Figure 2) serves as a summary of the findings regarding the conceptual model.

**Figure 2**

*Results model: relationship between Physical activity, Self-efficacy and School Stress*



a: Effect of physical activity on self-efficacy ( $\beta = .176$ )

b: Effect of self-efficacy on school stress ( $\beta = -.471$ )

ab: Indirect effect of physical activity on school stress ( $\beta = -.083$ )

c': Direct effect of physical activity on school stress ( $\beta = -.039$ )

c: Total effect of physical activity on school =  $ab + c'$  ( $\beta = -.121$ )

**Discussion**

Physical activity has been proposed as a potential protective factor against stress. However, there has been little research on whether this also applies to school stress and whether self-efficacy plays a role in this. This study investigated the relationship between physical activity and school stress and whether this relationship is mediated by self-efficacy. In summary, the findings of this study suggest that physical activity can play a small, but significant role in alleviating school stress among students. Results also showed that the effect of physical activity on school stress was mediated by self-efficacy.

In line with H1, the regression analysis confirms that physical activity has a significant negative effect on school stress, although the effect size is small. This finding is consistent with previous research, because multiple studies show that individuals who engage in regular

physical activity and maintain physical fitness have a reduced stress response (Crews & Landers, 1987; Hegberg & Tone, 2015; Tsatsoulis & Fountoulakis, 2006). Lower stress-induced cortisol levels are measured in physically trained individuals (Rimmele et al., 2009). This finding is also consistent with the distraction hypothesis provided by Bahrke (1978). According to this hypothesis, exercise redirects attention from stressors, offering a time-out period (Bahrke & Morgan, 1978; Morgan, 1985) and provides a form of recovery.

The mediation analysis supports H2, demonstrating that self-efficacy mediates the relationship between physical activity and school stress. Again, the effect size is small. This indicates that part of the stress-reducing effect of physical activity can be attributed to enhancing individuals' self-efficacy. Engaging in physical activity could improve self-efficacy by providing a sense of control over outcomes, which subsequently translates to control over academic tasks and reduced school stress. This finding aligns with prior research indicating a positive association between exercise and self-efficacy (Middelkamp et al., 2017; Paluska & Schwenk, 2000), and a negative association between self-efficacy and stress (Zajacova et al., 2005; Gigliotti and Huff, 1995; Hackett et al., 1992; Solberg et al., 1993; Solberg and Villarreal, 1997; Torres and Solberg, 2001). Self-efficacy levels determine whether a task is seen as challenging or stressful. When tasks are perceived as a challenge, individuals are more persistent (Zajacova et al., 2005), leading to less stress.

However, the observed mediating effect is small. This could possibly be explained by the fact that self-efficacy is domain-specific (Muris, 2001). Academic self-efficacy does not always translate to other domains of life (McKay et al., 2014), like physical activity. Thus, when an individual engages in sports frequently and consequently perceives that they have control over outcomes in this domain, their sense of self-efficacy in the educational domain may still remain low. As a result, significant stress may still be experienced in the school environment despite the individual's successes and high self-efficacy in sports.

In addition, the results show that both the average score of school stress and physical activity increase as the school level rises. Despite expectations from the theoretical framework and findings, suggesting that the group with the highest physical activity score (VWO) would experience the least school stress, this is not observed. One possible explanation is that higher school levels, like VWO, are often associated with higher academic expectations and pressure. Even though these students may engage in more physical activity, the heightened demands can contribute to increased school stress, making the amount of physical activity insufficient to reduce stress. Moreover, the type of physical activity may also influence outcomes. While VWO students may exercise more frequently, the effectiveness of their physical activities may vary. The impact of physical activity on mental health depends on factors such as exercise type (strength vs. cardiovascular), social environment (team vs. individual), and physical environment (indoor vs. outdoor) (Vella et al., 2023). For instance, cardiovascular exercise is associated with greater stress reduction compared to strength training (Pálfi et al., 2021). So, despite VWO students exercising more, the increased academic pressure and the way they approach physical activity may result in higher levels of school stress than expected.

This study makes a small contribution to the growing body of literature on the psychological benefits of physical activity. Although the physiological benefits of exercise are well-documented, there is still much to explore and understand in the psychological domain. This study suggests that increased physical activity may be associated with reduced school stress among adolescents, with self-efficacy potentially acting as a mediator. While it was already known that exercise reduces stress (Paluska & Schwenk, 2000), this study specifically shows that it can have a small effect on school-related stress. Furthermore, this study extends existing theories on stress reduction and self-efficacy. It provides evidence for the self-efficacy hypothesis, which predicted that accomplishing a challenging task, like completing

an exercise session, induces a sense of mastery and improves mood (Mikkelsen et al., 2017). Therefore, physical activity can not only reduce stress but also enhance psychological resilience and coping strategies.

Besides the implications for science, the findings highlight the significance of incorporating regular physical activity into school curricula and emphasize the need for community and public health programs to promote physical activity among adolescents as a preventive measure against stress. Moreover, sports offer a significant solution for enhancing mental health by alleviating stress. Given the existing stigma around mental health, adolescents experiencing stress may hesitate to seek professional help. Participating in sports, however, provides an easy way to reduce the need for help, without needing to seek help from professionals like psychologists.

### **Strengths and Limitations**

A strength of this study is the sample size. 5637 students were included in this research. This ensures that the results of the linear regression are more accurate and therefore the conclusions are also more reliable. Additionally, a diverse, nationwide sample was used. For example, the students come from different educational levels, which enhances the generalizability of the results to the entire population.

A limitation of this study is that mediation analysis is not commonly used for cross-sectional research. It is typical to employ this analytical approach for longitudinal research, as the temporal sequence of events provides greater insight into the causal relationships between variables. Another limitation of this research is the way physical activity was measured in the participants. In contrast to the other variables, the scale of physical activity was determined based on only 2 questions: “How many days out of the last seven days were you engaged in at least 60 minutes of physical activity per day?” and “How often do you approximately engage in a sport or play in your free time (outside of school hours) to the point where you become

out of breath or start sweating?” Although these are two important and meaningful questions, their use resulted in a low Cronbach's alpha and may not have provided a comprehensive representation of an individual's overall physical activity. This could also be a possible explanation for the small effect of physical activity on school stress.

### **Recommendations**

There are four recommendations for future research. Firstly, future research should utilize longitudinal studies. Longitudinal studies could also help in understanding the long-term effects of physical activity on stress and academic outcomes.

Secondly, future research can incorporate moderators that influence how each individual experiences the relationship between physical activity and school stress. Social support, for instance, is an important moderator that can affect how effective exercise is in reducing school stress. The positive effects of exercise on school stress may be strengthened or weakened by the level of social support a student receives. Physical activity can offer social interaction, and participating in exercise groups may provide social support, which can enhance self-esteem and life satisfaction (Fox, 1999). Additionally, social support is recognized for its buffering effect against stressful environments (Cohen & McKay, 2020), such as educational settings. However, physical activity and exercise are often pursued individually. Do these two distinct groups experience stress reduction differently? By examining moderating factors, a deeper understanding can be gained of the conditions under which exercise is most beneficial for reducing school stress.

Thirdly, self-efficacy consists of multiple domains. Such domains can include any activity where individuals may differ in both their actual success rates and their perceptions of their success. For example, the domain might be related to a mathematics course, tasks requiring physical strength, adhering to a diet, eye-hand coordination, memory tasks, or even maintaining successful relationships. General self-efficacy measurements violate the basic



assumption of the multidimensionality of self-efficacy. Measurements of self-efficacy without context have limited predictive value. Therefore, measuring self-efficacy must be aligned with the domain of interest (Paunonen & Hong, 2010). However, physical activity and education are two distinct domains, but they may still influence each other. This provides an opportunity for further exploration.

Fourthly, future research should explore alternative methods to measure physical activity. The theoretical framework emphasized the distinction between physical activity and exercise (Caspersen et al., 1985), yet both were considered in this study and combined into a single variable. However, it is important to consider that these forms of activity may have distinct effects. For example, structured exercise routines like jogging or weightlifting may impact self-efficacy differently compared to less structured activities such as walking or gardening. Physical activities that offer performance feedback, comparative feedback with others, and the opportunity to observe others successfully performing tasks tend to produce the highest levels of self-efficacy (Williams & French, 2011). Understanding these nuances is crucial for comprehensively exploring how various types of physical activity influence outcomes such as stress levels among adolescents. Exploring alternative measurement approaches may potentially strengthen the identified relationships.

There are also recommendations for policy. To begin with, sports should be well integrated into schools, not only to promote physical health but also to improve mental well-being by reducing school stress. Although physical education is a compulsory subject in secondary education in the Netherlands, a greater focus on physical activity combined with skill-building exercises aimed at improving self-efficacy could be particularly effective. Additionally, integrating mental health education into the school curriculum can be beneficial. Children in the Netherlands are increasingly less involved in sports outside of school (RIVM, 2023b). Therefore, it is important to motivate young people to participate in sports. Educating

students on how physical activity can improve self-efficacy and reduce stress will encourage them to engage in regular exercise and will improve their mental health. This is an area where schools and educators can take proactive measures.

In conclusion, this study highlights the important relationship between physical activity, self-efficacy, and school-related stress in adolescents, underscoring the potential of physical activity as a stepping stone to stress relief. One possible explanation for this small but significant effect is that physical activity shifts attention away from stressors, providing a time-out period. This study also found that physical activity's impact on school stress is mediated by self-efficacy. Physical activity can boost self-efficacy, influencing whether tasks are viewed as stressful or as challenges. When tasks are seen as challenges, individuals are more persistent, reducing stress. Therefore, promoting physical activity in educational settings offers a promising way to reduce school stress and enhance self-efficacy. Addressing both physical and psychological aspects of student well-being, schools can create a more supportive and productive environment.

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## **Appendix A: Reflection on Interdisciplinarity**

Different scientific disciplines contribute to understanding the effect of physical activity on school stress with self-efficacy as a mediator. Various insights provide a deep understanding of the complex interactions between the three variables and also lead to better development of potential interventions to reduce stress and improve mental health.

For this research, various scientific disciplines have been employed to gain a comprehensive understanding of the effect of physical activity on school stress with self-efficacy as a mediator. To begin with, physiology and health sciences have been utilized. There is already considerable knowledge about the physiological consequences of physical activity. For instance, physical activity improves cardiovascular health and stimulates the release of endorphins, which can act as stress reducers. Insights from psychology have also been applied. This research investigates self-efficacy as an explanatory factor between physical activity and stress reduction. Self-efficacy encompasses multiple cognitive processes that may explain the reduction of stress. Additionally, educational sciences play a crucial role. The contribution of school environments and learning demands to stress has been examined. This discipline also contributes to potential solutions by integrating sports activities into the school curriculum in a manner that may reduce stress among students. Lastly, a sociological perspective has been proposed for future research in the discussion section. Social interactions during physical exercises contribute to a supportive environment that may reduce stress.

The use of insights and perspectives from stakeholders outside academia significantly contributes to understanding the effect of physical activity on school stress with self-efficacy as a mediator. Stakeholders such as teachers, school administrators, parents, and policymakers provide valuable insights into the practical realities of school environments and the challenges students face. Also, when stakeholders recognize the relevance and applicability of research

outcomes to their own experiences and contexts, it enhances the credibility and utility of the research.

Looking at the results and conclusions from the thesis, several stakeholder perspectives emerge as particularly important in crossing boundaries between science and practice. Teachers and educators play a crucial role in implementing physical activity interventions and supporting students' self-efficacy and stress management skills within the school context. Parents are key determinants of students' engagement in physical activity and their overall well-being. For example, they have an influence on the ability to participate in sports after school. Healthcare professionals provide valuable insights into students' physical and mental health needs and policymakers have the authority to shape school policies and can support physical activity initiatives and mental health services in schools.

If an interdisciplinary approach is not possible, a monodisciplinary approach remains legitimate for this research, as it yields specialized knowledge. Focusing on a single discipline could lead to a nuanced understanding of the effect of physical activity on school stress with self-efficacy as a mediator. In this case, the focus would be on a psychological approach to fully comprehend the cognitive processes of self-efficacy.

Using multiple research methods to investigate the effect of physical activity on school stress with self-efficacy as a mediator significantly enhances the reliability and validity of the findings. This study employed desk research, linear regression, and mediation analysis, offering a comprehensive approach to understanding both direct and indirect effects. Desk research provides essential background and context, helping to build a theoretical framework and formulate hypotheses based on previous studies. Linear regression quantifies the strength and direction of the relationship between physical activity and school stress, showing if increased physical activity correlates with decreased school stress. Mediation analysis delves into the mechanisms underlying this relationship, explaining why and how physical activity

impacts school stress. Future research could incorporate qualitative methods to complement the quantitative data, resulting in a more complete understanding of the topic. This mixed-methods approach would reveal patterns, trends, and relationships while also uncovering the meanings, motivations, and experiences behind the data.

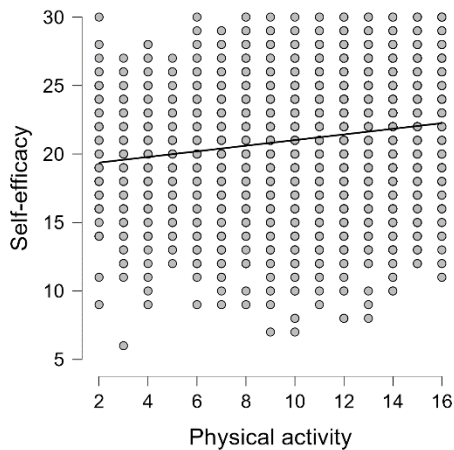
Using multiple analytical levels, such as a systems perspective, to investigate the effect of physical activity on school stress with self-efficacy as a mediator enhances understanding in several ways. It allows researchers to examine the problem from various perspectives, including individual behaviours and broader systemic influences like school policies and peer interactions. This approach captures the complexity and interactions of contributing factors. Analyzing multiple levels also enables comprehensive exploration of both proximal and distal influences. For example, researchers can see how individual factors like self-efficacy beliefs are shaped by broader contextual factors like school climate and community resources. This helps to create interventions and develop strategies addressing different levels of influence.



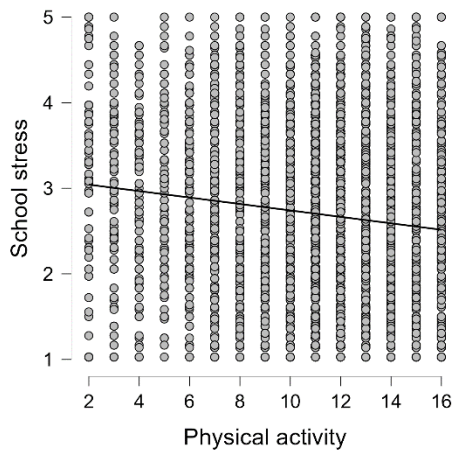
## Appendix B: Assumption checks

### Linearity

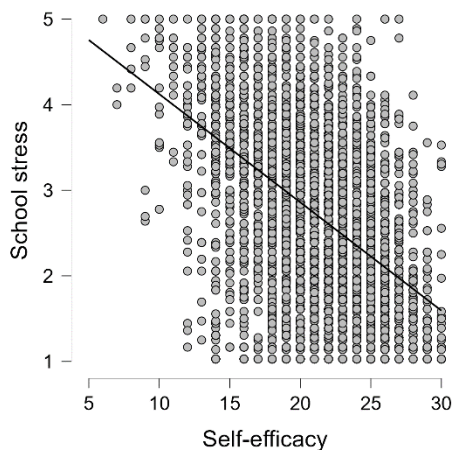
*Physical activity vs. Self-efficacy*



*Physical activity vs. School stress*

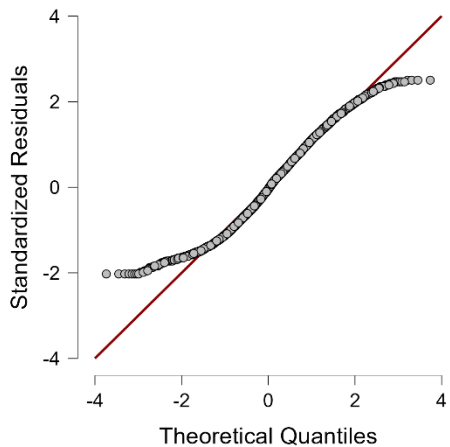


*Self-efficacy vs. School stress*

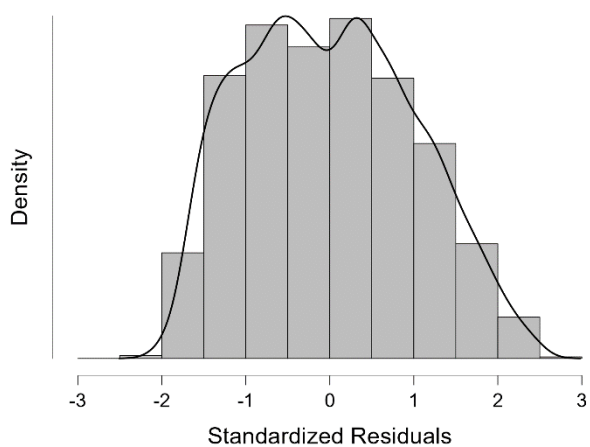


### Normality of residuals

*Q-Q Plot Standardized Residuals*

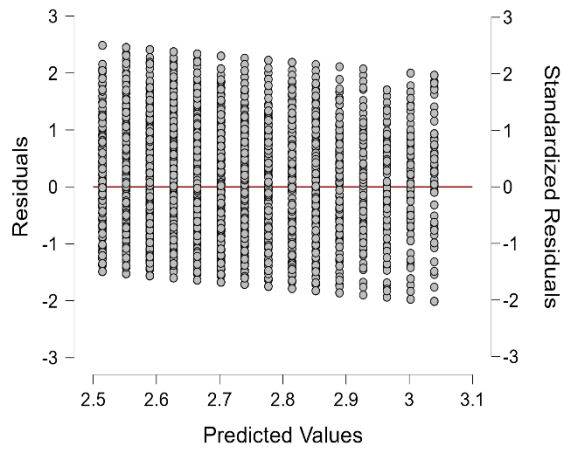


*Standardized Residuals Histogram*



## Homoscedasticity

*Residuals vs. Predicted*



### Appendix C: Scales

#### Self-efficacy Scale (6 items, $\alpha = .728$ )

Question	Response options
How often do you find a solution to a problem if you really try?	1=never, 2=almost never, 3=sometimes, 4=usually, 5=always.
How often do you manage to do what you planned to do?"	1=never, 2=almost never, 3=sometimes, 4=usually, 5=always.
How often did you feel you had no influence on important things? (Past month)	1 = Very often 2 = Fairly often 3 = Sometimes 4 = Almost never 5 = Never
How often did you feel confident about your ability to handle personal problems? (Past month)	1=never, 2=almost never, 3=sometimes, 4=fairly often, 5=very often.
"How often did you feel that things were going your way? (Past month)	1=never, 2=almost never, 3=sometimes, 4=fairly often, 5=very often.
"How often did you feel that problems were becoming so overwhelming that you could not handle them anymore? (Past month)	1 = Very often 2 = Fairly often 3 = Sometimes 4 = Almost never 5 = Never

#### School stress Scale (9 items, $\alpha = .911$ )

Question	Response options
Do you feel pressured by the schoolwork you have to do?	1=not at all, 2=a little, 3=quite a lot, 4=a lot
<b>How much stress did you have in the past six months due to the situations below?</b>	
Having to learn something at school that you don't understand	1 = No stress or not occurred, 2 = A little stress, 3 = Average stress, 4 = Quite a lot of stress, 5 = A lot of stress
Teachers who expect too much of you	Idem
Parents who expect too much of you	Idem
Keeping track of everything you have to do for school	Idem

Having to make decisions about future work or education for later	Idem
Putting yourself under pressure to achieve your future goals	Idem
Not having enough free time -	Idem
Having too much homework	Idem

**Physical activity Scale (2 items,  $\alpha = .681$ )**

<b>Question</b>	<b>Response options</b>
How many days out of the last seven days were you engaged in at least 60 minutes of physical activity per day?	1 = 0 days, 2 = 1 day, 3 = 2 days, 4 = 3 days, 5 = 4 days, 6 = 5 days, 7 = 6 days, 8 = 7 days
How often do you approximately engage in a sport or play in your free time (outside of school hours) to the point where you become out of breath or start sweating?	1 = never, 2 = less than once a month, 3 = once a month, 4 = once a week, 5 = twice a week, 6 = three times a week, 7 = 4 to 6 times per week, 8 = every day