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Institute of Sport Sciences and Physiotherapy, Faculty of Medicine, University of Tartu, Tartu, Estonia

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CONTENTS

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Paper I, II, III and IV. Henri Tilga had primary responsibility for leading the design of the studies, coordinating and implementing data collection, performing statistical analyses, and drafting the manuscripts.

1. INTRODUCTION

An important issue in educational settings, including the context of physical education (PE), is how teachers' behaviour is related to the students' adaptive outcomes (Van den Berghe et al., 2014). One of the essential outcomes in educational settings among adolescents' is health-related quality of life (HRQoL; Bisegger et al., 2005; Koka, 2014; Standage & Gillison, 2007) as it encompasses a wide set of health concerns such as physical, social, emotional, and academic functioning (Varni et al., 2003). HRQoL is described as "a person's subjective evaluations of the influences of their current health status, health care, and health promoting activities on their ability to achieve and maintain a level of overall functioning that allows them to pursue valued life goals and that is reflected in their general well-being" (Shumaker & Naughton, 1995, p. 7). HRQoL has an adaptive function in educational contexts and has been shown to be related to students' academic performance in school (Durlak et al., 2011). Despite this, research has demonstrated a sharp decline in HRQoL among school children after the age of 12 years (Bisegger et al., 2005). It is, therefore, important to provide formative evidence on the determinants of HRQoL to inform teaching practices that may enhance HRQoL in school students.

Based on self-determination theory (SDT; Deci & Ryan, 1985), students' perception of autonomy-supportive behaviour from their PE teachers' is vital as it enhances their experiences of psychological needs, motivation, and adaptive outcomes (Assor et al., 2002; Cheon et al., 2012; Vansteenkiste, Simons, Lens, Soenens, & Matos, 2005). Previous research investigating the autonomy-supportive behaviour from the PE teacher has adopted unidimensional measures such as the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996) modified for PE, and the Perceived Autonomy Support Scale for Exercise Settings (PASSES; Hagger et al., 2007). It is proposed by Stefanou and colleagues (2004) that autonomy-supportive behaviour can be described by three different dimensions such as cognitive, organisational and procedural. The rationale for investigating the students' perceptions of autonomy-supportive behaviours from their PE teacher regarding these three dimensions is to provide a deeper understanding of the associations between those perceptions of teachers' behaviours, students' psychological needs and adaptive outcomes such as HRQoL.

Based on SDT, students' can perceive their PE teacher exhibiting autonomy-supportive and controlling behaviours (Ryan & Deci, 2017). Previous research has demonstrated that the association between students' perception of teachers' autonomy-supportive behaviour (by using a unidimensional scale) on students' HRQoL in PE is mediated by motivational processes in PE (Koka, 2014; Standage & Gillison, 2007; Standage et al., 2012). However, the mechanism by which students' perception of teachers' controlling behaviour relates to students' HRQoL has not been previously examined and needs further

investigation. Another an intriguing possibility is that the students' perceptions of controlling- and autonomy-supportive behaviours from the PE teacher may interact in determining students' adaptive outcomes such as HRQoL. Specifically, one may argue that students' perceptions of autonomy-supportive behaviours from their PE teachers may buffer, or moderate, the indirect effect between students' perceptions of controlling behaviours from PE teachers on students' HRQoL via need frustration. This knowledge can have implications for the designing of intervention programs aimed at promoting adaptive outcomes in PE.

A meta-analysis conducted by Su and Reeve (2011) across different domains demonstrated that interventions for teachers are effective in promoting an autonomy-supportive behaviour. While autonomy-supportive behaviour has been typically taught as a multidimensional construct involving several different categories of teaching behaviour in previous intervention programs for PE teachers, students' perceptions of their teachers' autonomy-supportive behaviour has been typically measured as a unidimensional construct (Su & Reeve, 2011). Measuring students' perceptions in multidimensional fashion can provide useful information for improving the quality of PE teacher training programs. In addition, while previous studies have embraced a face-to-face approach to training teachers to become more autonomy-supportive toward their students (Su & Reeve, 2011), web-based training has the advantages of being cost-effective, convenient, and easily accessible while also affording attendees anonymity (Murray, 2012).

The main objective of the present study was to investigate the effects of the multidimensional autonomy-supportive behaviour and multidimensional controlling behaviour from PE teacher on students' psychological need satisfaction and frustration and on students' HRQoL. Firstly, an instrument was developed and validated to assess the students' perceptions of the teachers' autonomy-supportive behaviour by the multi-dimensional scale (Multi-Dimensional Perceived Autonomy Support Scale for Physical Education; MD-PASS-PE). Secondly, two SDT-based motivational models were proposed in which students' perceptions of their PE teachers' behaviours on students' HRQoL via psychological needs were estimated. The first structural equation model was proposed to measure the relationships from students' perceived autonomy supportive and controlling behaviour to HRQoL through need satisfaction and need frustration. The second conditional process model was proposed to demonstrate moderation of autonomy support on indirect effect between controlling behaviour and HRQoL through need frustration. Finally, a Web-Based Autonomy-Supportive Intervention Program (WB-ASIP) for PE teachers was developed to test the efficacy of a web-based intervention for enhancing PE teachers' autonomy-supportive behaviour and minimising their controlling behaviour from within a multidimensional outcome assessment.

2. REVIEW OF LITERATURE

2.1. Theoretical framework

SDT (Deci & Ryan, 1985) serves as the theoretical framework for the current work. The current work focuses on one of the most prominent sub-theories of SDT that is basic psychological needs theory (BPNT; Deci & Ryan, 2000). The advantage of focusing on BPNT is that it proposes the mechanism of how social factors influence motivation, and thus, adaptive outcomes such as HRQoL.

SDT has been extensively used to investigate various cognitive, affective, and behavioural outcomes in the context of school PE (Ntoumanis & Standage, 2009). The degree to which individuals' basic psychological needs are fulfilled possesses the central role in this theory. SDT proposes that individuals strive to satisfy three basic psychological needs for autonomy, competence, and relatedness (Deci, Ryan, 1985; 2000). The need for autonomy reflects an individual's need to perceive opportunities for choice and self-actualisation. The need for competence reflects an individual's need to experience adequate capacity to carry out their actions. Finally, the need for relatedness indicates the desire to feel involved and to have a sense of belongingness with others. The extent by which these needs are satisfied determines the type of motivation, direction, and persistence of an individual's behaviour (Vallerand, 1997). For example, when individuals' needs are satisfied, then their behaviour is likely self-determined. Vallerand (1997) proposed a motivational sequence model: Social factors → Psychological Needs → Motivation → Outcomes. This model describes that motivation is shaped by a number of social factors such as teacher's behaviour and learning environment. The impact of these social factors on individuals' motivation is exerted through the satisfaction of the basic psychological needs (i.e., need for autonomy, competence, and relatedness). Finally, the type of motivation determines the specific cognitive, affective, and behavioural consequences.

2.2. Autonomy supportive vs. controlling PE teachers' behaviour

2.2.1. Previous measures of perceived autonomy support in a PE context

Autonomy support indicates a situation where an individual in a position of authority (e.g., a teacher) adopts the others' (e.g., students) perspective, recognises the others' feelings, and provides to him or her with appropriate information and opportunities for choice, while minimising the use of pressures and demands (Black & Deci, 2000).

Numerous studies have been conducted using different measures such as the LCQ (Williams & Deci, 1996) to assess perceived autonomy support in various fields including health (Williams et al., 1999), learning (Black & Deci, 2000), work (Baard et al., 2004), and exercise and sport (Hagger et al., 2003, 2005, 2007; Ntoumanis, 2005; Standage et al., 2005). Previous research using the unidimensional scale of LCQ (Williams & Deci, 1996) modified for PE context to assess the perceived autonomy support from the teacher, found that it was related to students' need satisfaction, which also predicted self-determined motivation (Ntoumanis, 2005), and intrinsic motivation and adaptive PE-related outcomes (Standage et al., 2005). The results of the several studies in which unidimensional scale such as LCQ was used to measure perceived autonomy support from teachers also indicated that perceived autonomy support in an educational context influenced motivation in PE and in a leisure-time context (Hagger et al., 2003, 2005). Later, Hagger et al. (2007) developed and validated the unidimensional scale PASSES. The PASSES included three versions to measure perceived autonomy support from teachers, parents and peers (each consists of 12 items). Although the positive role of autonomy supportive behaviour and need satisfaction on various affective and behavioural outcomes are well documented (Hagger et al., 2003, 2005, 2007, 2009; Standage & Gillison, 2007), there is a lack of knowledge how autonomy supportive teachers' behaviour measured by multiple dimensions are related via need satisfaction with various adaptive behavioural and affective outcomes. So far there is only one scale known that has been developed and validated to assess the adolescents' perception of the autonomy supportive behaviour by multiple dimensions (i.e., an "interest in athlete's input" and "praise for autonomous behaviour"), but this scale was developed to assess autonomy supportive behaviour in a coach-athlete context (Conroy & Coatsworth, 2007). According to the findings of Stefanou et al. (2004), it is relevant to find out if students perceive distinctive aspects or dimensions of teachers' autonomy supportive behaviour to acquire a deeper understanding of how autonomy supportive behaviour may affect students' perceptions to further promote their motivation.

2.2.2. The rationale for distinctive dimensions of the autonomy-supportive behaviour

Stefanou et al. (2004), based on previous classroom context studies of several authors (Logan et al., 1995; Reeve et al., 1999; Turner et al., 2002) in which SDT was used, suggested that autonomy supportive behaviour could be characterised by three dimensions: organisational, cognitive, and procedural. According to Stefanou et al. (2004) organisational autonomy support promotes student ownership of environment and can contain teacher behaviours that offer students opportunities for choice over environmental actions (e.g., choose evaluation procedure, choose equipment and exercise place, participating in creating and implementing a lesson structure). Procedural autonomy support

facilitates student ownership of form and involves teacher behaviours such as offering students different choices to present ideas (e.g., choose the way the competence will be demonstrated, providing rationales, explaining a lesson structure, display the work in an individual manner). Cognitive autonomy support promotes student ownership of the learning and can contain teacher behaviours such as asking students to explain or argue for their thoughts, asking students to generate their own solutions, or asking students to evaluate their own and others' solutions or ideas (e.g., discuss multiple approaches and strategies, receive informational feedback, debate ideas freely, ask questions, re-evaluate errors, have ample time for decision making). The distinction of autonomy supportive behaviour into three dimensions in line with the concept of Stefanou et al. (2004) was one of the bases of developing the pool of items in the present study.

2.2.3. Perceived PE teachers' controlling behaviour

Consistent with SDT, teachers may also exhibit controlling behaviours in school lessons. Controlling behaviour can be characterised as pressuring strategies used by the teacher to ensure students conform, thereby putting aside students' opinion (Reeve, 2009). Research on teachers' controlling behaviour has used a unidimensional (e.g. Assor et al., 2005; Reeve & Halusic, 2009; Soenens et al., 2012) and a multidimensional approach (Bartholomew et al., 2010; Hein et al., 2015). For instance, a conceptual model of controlling behaviours is proposed by Bartholomew et al. (2010) that comprises four controlling strategies (e.g. controlling use of praise and extrinsic rewards, negative conditional regard, intimidation, and excessive controlling behaviour). In educational contexts, teachers can use controlling behaviours like praise and extrinsic rewards to pressure students to participate in desired behaviours. For example, a PE teacher may promise to praise or reward the students to keep them focused on tasks during the lesson. Similarly, a teacher may order or shout at his or her students to intimidate them into doing certain behaviours. A teacher's use of the threat of punishment to encourage students to keep them in line during lessons is an example of intimidating behaviour. Negative conditional regard refers to the withdrawal of attention, affection, and support from the teacher when specified behaviours by their students are not exhibited. For instance, a teacher can influence students in behaving in a desired way by making them feel guilty (e.g. by saying 'you make me sad'). Finally, teachers excessive controlling behaviour refers to behaviours that can be described as obtrusive monitoring toward their students. For example, a teacher can control students' behaviour by attempting to interfere in aspects of the students' lives that are not related to their schooling. In line with Bartholomew et al. (2010), a conceptual model of teachers' controlling behaviour from the teacher comprising these four controlling strategies is adopted in the current study.

2.3. Autonomy-supportive behaviour and controlling behaviour in relation to basic psychological needs and PE-related outcomes

2.3.1. The mediation role of basic psychological needs

One of the most recognised sub-theories of SDT is a basic psychological needs theory (BPNT; Ryan & Deci, 2017). Based on BPNT, the individuals' psychological needs for autonomy, competence, and relatedness can be satisfied or frustrated (Ryan & Deci, 2017). Importantly, experiences of psychological need satisfaction and need frustration have differential antecedents and outcomes (Vansteenkiste & Ryan, 2013). Autonomy-supportive behaviour has been found to be related to students' need satisfaction in the context of PE (Taylor et al., 2010). For example, satisfying students' psychological needs is displayed in students' experiences that their actions are self-determined (i.e., autonomy need satisfaction), that they are competent in interactions with the environment and have different opportunities to express capability (i.e., competence need satisfaction), and in feeling that they get along to class members (i.e., relatedness need satisfaction). Further, when people report that their needs are satisfied, they most likely experience activities as autonomous and tend to display adaptive outcomes such as optimal functioning and well-being (Mouratidis et al., 2011), and higher intrinsic motivation (Ntoumanis, 2001; Standage et al., 2003; Xiang et al., 2017; Kalajas-Tilga et al., 2019).

Based on SDT, teachers may also exhibit controlling behaviours in school lessons. Such behaviours are likely to undermine autonomous motivation and lead to maladaptive outcomes such as anxiety (Assor et al., 2005), depersonalisation (Soenens et al., 2012), oppositional defiance (Haerens et al., 2015), and anger and bullying (Hein et al., 2015). The mechanism for these associations is through students' perceptions of psychological need frustration and controlled motivation. It is important to highlight that teachers might exhibit both controlling and autonomy-supportive behaviours within a single lesson (Amoura et al., 2015). In a study by Haerens et al. (2015), it was found that students' perceptions of their teachers' behaviour as autonomy-supportive and controlling were related to adaptive and maladaptive motivational outcomes through separate pathways. In particularly, associations between of students' perception autonomy-supportive behaviour from their teacher was indirectly related to adaptive motivational outcomes (i.e., autonomous motivation) in PE via need satisfaction, whereas students' perception controlling behaviour from their teacher was indirectly related to maladaptive motivational outcomes (i.e., controlled motivation and amotivation) in PE via need frustration. However, there is a lack of knowledge about the relationship between students' perceptions of their PE teachers' interpersonal behaviour (i.e., autonomy-supportive and controlling behaviours) and students' HRQoL. Therefore, in the present study, the structural equation model is proposed to explain the mechanism by which the students' perception of autonomy-supportive and controlling behaviours

from their PE teacher is related to students' HRQoL via psychological need satisfaction and need frustration.

2.3.2. Autonomy-supportive behaviour as a moderator

Students' perception of their PE teachers' autonomy-supportive behaviour is important because it facilitates students' HRQoL through motivational processes in the context of PE (Koka, 2014; Standage & Gillison, 2007; Standage et al., 2012). Although teachers at school may exhibit autonomy supportive behaviours, they may fail to do so consistently and resort to controlling behaviours when under stress or pressure, or when they lack time (Pelletier et al., 2002; Reeve, 2009; Stebbings et al., 2012). For instance, teachers tend to be under time pressure on a regular basis and may perceive the need to maximise discipline to manage their classes and view controlling behaviours as an easy means to do so. One may argue that this approach might be at the expense of students' well-being and adaptive outcomes. As a result, students may be attuned to teachers' controlling behaviours and may experience need frustration and, in turn, maladaptive outcomes. One intriguing possibility is that the teachers controlling- and autonomy-supportive behaviours that are perceived by the students', may interact in determining students' adaptive outcomes such as HRQoL. For instance, a recent study by Haerens et al. (2017) found that teachers perceived as high on autonomy support and low on use of controlling behaviours are likely to benefit most in terms of students' motivation and well-being. Furthermore, results showed teachers perceived to use controlling behaviours leads to maladaptive outcomes (e.g. higher need frustration perceived by students) even when the teacher is also perceived using autonomy-supportive behaviours. Based on that, the effect of perceived controlling behaviours exhibited by teachers on adaptive outcomes such as HRQoL through need frustration can be conceptualised as a mediation relationship in which the perceived controlling behaviours-HRQoL relation is mediated by need frustration. It is this effect that might be moderated by the students' perception of teachers' autonomy-supportive behaviours. In the current study, it is expected that when students perceive their teachers more autonomy-supportive, then the undermining effect of the perceived controlling behaviours of teachers on HRQoL through need frustration will be weaker. Based on the premise that controlling behaviours tend to undermine adaptive outcomes because they induce need frustration, it may be that perceived autonomy-supportive behaviours may buffer, or moderate, the detrimental effects of need frustration on these adaptive outcomes such as HRQoL. Therefore, in the present study, a conditional process model is tested in which the negative indirect effect of students' perceptions of controlling behaviours of their PE teachers on students' HRQoL through psychological need frustration is moderated by students' perceptions of the autonomy support provided by their teachers.

2.4. Interventions designed to promote an autonomy-supportive teaching style in PE

SDT-based research has widely addressed the question of whether socialising agents can learn to adopt an autonomy-supportive style (e.g., Su & Reeve, 2011), indicating that available interventions are effective in promoting an autonomy-supportive approach. Also, several interventions have been set up for the domain of PE (e.g., Chatzisarantis & Hagger, 2009; Leenknecht et al., 2017; Lonsdale et al., 2013; McLachlan & Hagger, 2010; Tessier et al., 2008, 2010; Ulstad et al., 2018). In most of these interventions, teachers were invited to participate in a training program to implement autonomy-supportive teaching, whose effectiveness was assessed by their students' experiences. Generally, it was found that teachers are capable to learn how to be more autonomy supportive, and their students displayed significant gains in different adaptive outcomes. For instance, Chatzisarantis and Hagger (2009) assessed the effectiveness of an intervention with 10 PE teachers on autonomy-supportive teaching over a 5-week time. The students in the experimental group reported their teachers to be more autonomy-supportive, greater self-determined motivation, and greater self-reported leisure-time physical activity behaviour at follow-up compared with students in the control group. However, as recognised by the authors, this study did not take into consideration experiences relating to the need satisfaction. A study by Lonsdale et al. (2013) investigated the effects of an intervention program for PE teachers to implement autonomy-supportive teaching style. The students in the experimental group reported their teachers to be more autonomy supportive and greater autonomy satisfaction, but not on competence satisfaction, and relatedness satisfaction at follow-up compared with students in the control group. According to Su and Reeve (2011), less effective interventions focused more on content (what autonomy support is) than on skill (how to be autonomy supportive), lacked opportunity for teachers to express their concerns and share ideas, and contained too much reading materials and less electronic media to deliver the intervention.

Although in previous intervention programs autonomy support has been usually taught to PE teachers as a multidimensional construct involving several different categories of teaching behaviour, students' perceptions of their teachers' autonomy-supportive behaviour have been typically assessed as a unidimensional construct (Su & Reeve, 2011). To the best of my knowledge, the current study is the first study to adopt a multidimensional outcomes assessment approach by measuring students' perceptions of their PE teachers' autonomy-supportive and controlling behaviour. This approach should provide useful information for improving the quality of PE teacher training programs. Also, while previous studies have adopted a face-to-face approach to training teachers to become more autonomy-supportive (Su & Reeve, 2011), web-based training has the advantages of being cost-effective, convenient, and easily accessible while also affording attendees anonymity (Murray, 2012). Accordingly, the

present study was designed to develop and test the efficacy of a web-based intervention for enhancing PE teachers' autonomy-supportive behaviour and minimising their controlling behaviour from within a multidimensional outcome assessment.

OBJECTIVES OF THE STUDY

The overall objective of this study was to examine the relationships between students' perceptions of autonomy-supportive and controlling behaviours from their PE teacher, students' psychological needs and students' HRQoL.
The aims of the present study were:

1. To develop and confirm the initial validity and reliability of the MD-PASS-PE.
2. To test the independence of the pathways by which students' perceptions of their teachers' autonomy-supportive and controlling behaviour in PE affect their HRQoL.
3. To test a conditional process model in which the negative indirect effect of students' perceptions of controlling behaviours of their PE teachers on HRQoL through psychological need frustration is moderated by students' perceptions of the autonomy support from by their teachers (see Figure 1).
4. To examine the effects of a web-based intervention for PE teachers on students' perceptions of their teachers' multidimensional autonomy-supportive and controlling behaviours, students' psychological need satisfaction and need frustration, and students' intrinsic motivation.

In this study, it was hypothesised (H1) that MD-PASS-PE is valid and reliable to measure students' perception of teachers' cognitive, organisational, and procedural autonomy support in PE. It was also hypothesised (H2) that the developed multi-dimensional scale would predict the significantly larger amount of variance in students' psychological need satisfaction for autonomy, competence and relatedness compared with existing unidimensional scale.

Based on the developed scale, it was predicted that students' perception of their teachers' autonomy-supportive behaviour in PE would be indirectly related to their HRQoL through psychological need satisfaction (H3), whereas controlling behaviour through psychological need frustration (H4). Further, it was predicted (H5) that the indirect effect between students' perception of controlling behaviour from their teacher on HRQoL via need frustration would be moderated by autonomy support. Specifically, it was expected that students who perceive that their teachers offered higher levels of autonomy support would show weaker indirect effects of perceived controlling behaviour on HRQoL through need frustration.

Finally, it was hypothesised that, at one-month follow-up, students in the experimental group, compared to students in the control group, would perceive teachers as higher in organisational, procedural, and cognitive autonomy support (H6) and lower in negative conditional regard, intimidation, and controlling use of praise and extrinsic rewards (H7); and students would report higher perceived need satisfaction for autonomy, competence, and relatedness (H8), lower perceived need frustration for autonomy, competence, and relatedness (H9), and higher intrinsic motivation (H10).

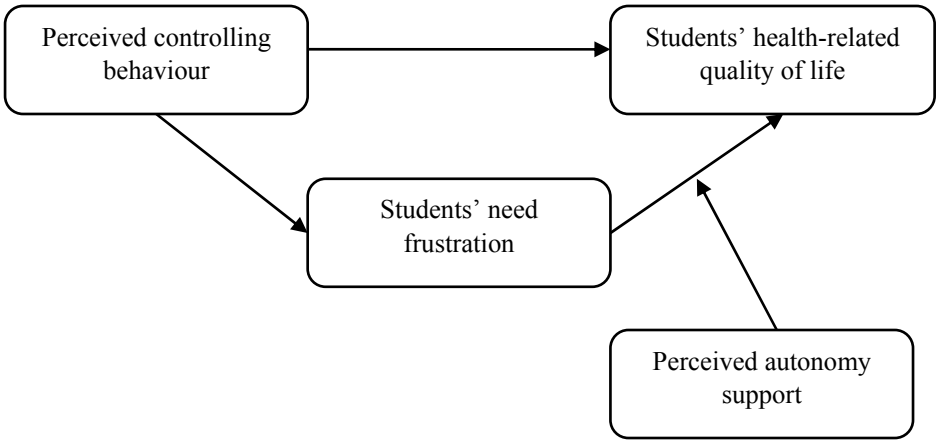

Figure 1. The hypothesised conditional process model in which the negative indirect effect of students' perceptions of controlling behaviours of their physical education teachers on health-related quality of life through psychological need frustration is moderated by students' perceptions of the autonomy support from by their teachers.

4. METHODS

4.1. Participants and research design

The sample of the current research was recruited from different schools in Estonia. Students in Estonia attend 45 minutes long compulsory PE lessons twice per week as part of the school curriculum. All the questionnaires were administered online and designed so that participants were required to complete all the items.

In Paper I, three studies were conducted to develop and validate a new scale. In study 1, the sample of 62 students (30 boys and 32 girls) aged between 12 to 15 years old in one school from a city located in southeast Estonia were identified as eligible and were invited to the study. All these students agreed to participate in study 1. In study 2, the sample of 2541 students were identified as eligible and were invited to the study. Out of these participants, the final sample of study 2 was 1152 secondary school students (528 boys and 624 girls) from 6 to 8 grade (M_{age} = 13.00; SD = .86; range = 12–15) from randomly selected schools in Estonia. In study 3, the sample of 556 students were identified as eligible and were invited to the study. Out of these participants, the sample of 262 secondary school students (114 boys and 148 girls) aged between 12 to 15 years old (M_{age} = 14.00; SD = .99) agreed to participate in this study. All three studies in Paper I adopted cross-sectional design to develop and initially validate a multi-dimensional instrument to assess students' perceptions of their teachers' autonomy-supportive behaviour.

In Paper II, the sample of 3741 school students were identified as eligible and were invited to the study. Out of these participants, the sample of 1042 school students (453 boys and 589 girls) aged between 12 to 15 years (M_{age} = 13.00; SD = .86) agreed to participate in this study. The study in Paper II adopted a cross-sectional design. The school students completed self-report measures of perceived teachers' autonomy support, perceived teachers' controlling behaviour, students' need frustration, and HRQoL.

In Paper III, the sample of 3741 school students were identified as eligible and were invited to the study. Out of these participants, the sample of 1031 school students (448 boys and 583 girls) aged between 12 to 15 years (M_{age} = 13.39; SD = 1.02) agreed to participate in this study. The study in Paper III adopted a cross-sectional design. The school students completed self-report measures of perceived teachers' autonomy support, perceived teachers' controlling behaviour, students' need satisfaction and need frustration, and HRQoL.

In Paper IV, the sample of 74 experienced PE teachers were identified as eligible and were invited to the study. In total, 28 PE teachers (8 men and 20 women) aged between 28 to 66 years (M_{age} = 44.1; SD = 11.4) agreed to participate in this study. Next, the sample of 487 students of these teachers were identified as eligible and were invited to the study. In total, 321 students

(146 boys and 175 girls) aged between 11 to 15 years (M_{age} = 13.7; SD = 1.2) agreed to participate in this study. All the participants were invited from 25 different secondary schools throughout Estonia. The study in Paper IV adopted a randomised controlled research design. All student-participants completed two questionnaires about their perceptions of their teachers' multidimensional autonomy-supportive and controlling behaviour and their perceptions of their own psychological need satisfaction and frustration for autonomy, competence and relatedness, and intrinsic motivation at baseline and one-month follow-up. All teacher-participants received the WB-ASIP for a period of four weeks. For a detailed description of the WB-ASIP please see Paper IV.

4.2. Measures

4.2.1. Teachers' autonomy-supportive behaviour

In Paper I, a series of three studies were carried out to develop and confirm the initial validity and reliability of the MD-PASS-PE. In Paper III and IV, students' perception of teachers' cognitive, organisational, and procedural autonomy support was measured using the MD-PASS-PE (Paper I). Students were presented with a common stem: "My PE teacher...", followed by the items tapping the three subscales: organisational autonomy support (e.g., "… allows me to choose exercise place"), procedural autonomy support (e.g., "… explains the effect of exercises"), and cognitive autonomy support (e.g., "… understands my needs"). Each subscale comprised five items with responses provided on seven-point scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

In Paper I and II, students' perception of teachers' unidimensional autonomy-supportive behaviour was measured using the LCQ (Reeve & Halusic, 2009), which comprised six items (e.g. 'I feel that my teacher provides me with choices and options'). Responses were provided on seven-point scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The LCQ was used in order to estimate whether three subscales of the MD-PASS-PE enables to account for a larger amount of variances from the need satisfaction variables compared to the unidimensional autonomy support scale (Paper I).

4.2.2. Teachers' controlling behaviour

In Paper II, III and IV, an adapted version (Hein et al., 2015) of the multidimensional controlling coach behaviours scale (CCBS; Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2010) was used to measure the students' perception of the PE teachers' controlling behaviour. Students were presented with a common stem: "My PE teacher...", followed by the items tapping the three CCBS subscales: negative conditional regard (e.g., "... pays me less attention if I have displeased him/her"), intimidation (e.g., "... uses the threat of punishment to keep me in line during lesson"), and the controlling use of grades (e.g., "...

promises to give me a good grade if I do well"). Each subscale comprised three items with responses provided on seven-point scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Previous studies have supported the factorial validity of the adapted version of the CCBS as well as the acceptable reliability of the scales (Hein et al., 2015, 2018).

4.2.3. Students' psychological need satisfaction and need frustration

In Paper I, II, III and IV, students' perceptions of their psychological needs in PE were assessed by the basic psychological need satisfaction and need frustration scale (BPNSNF; Chen et al., 2015) adapted and validated for PE (Haerens et al., 2015). Each subscale comprised four items and was presented with a common stem ("During the PE lesson…") followed by the set of items: need satisfaction for autonomy (e.g., " …I felt that the exercises reflect what I really want"), competence (e.g., "…I felt capable at what I did"), and relatedness (e.g., "…I felt that the class members I care about also cared about me"), and need frustration for autonomy (e.g., "…I felt pressured to do too many exercises"), competence (e.g., "…I felt insecure about my abilities"), and relatedness (e.g., "…I felt excluded from the group I want to belong to"). Participants' responses were provided on seven-point scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Previous studies have supported the factorial validity of the adapted version of the BPNSNF as well as the acceptable reliability of the scales (Haerens et al., 2015).

4.2.4. Students' HRQoL

In Paper II and III, students' HRQoL was measured using an adapted, validated version (Viira & Koka, 2011) of the 23-item pediatric quality of life inventory 4.0 generic core scales (PedsQL^{TM} 4.0; Varni et al., 2003). The PedsQL^{TM} 4.0 comprises five dimensions: physical health (eight items, e.g., "I have low energy"), social functioning (five items, e.g., "I have trouble getting along with other kids"), emotional functioning (five items, e.g., "I feel angry"), school-related functioning (three items, e.g., "I forget things"), and days missed from school due to illness (two items, e.g., "I miss school because of not feeling well"). Students were asked to indicate how much of a problem has this been during the past month. Responses were provided on five-point scales ranging from 0 (*strongly disagree*) to 4 (*strongly agree*). Prior to data analysis, items were reverse-scored and linearly transformed to a 0 to 100 scale (0 = 100, 1 = 75, 2 = 50, 3 = 25, and 4 = 0). Previous studies have supported the factorial validity of PedsQL^{TM} 4.0 as well as the reliability of the total score of HRQoL (e.g., Koka, 2014; Standage et al., 2012).

4.2.5. Students' intrinsic motivation

In Paper IV, students' intrinsic motivation in PE was measured by a four-item subscale of the Perceived Locus of Causality (PLOC) scale revised by Goudas et al. (1994). An example item included, "I do PE because I enjoy PE". Previous studies have shown the intrinsic motivation subscale of the PE-adapted PLOC to demonstrate high internal reliability (e.g., Pihu et al., 2008; Viira & Koka, 2012).

4.3. Research procedure

In all cases, the permission to conduct the study was elicited from the principal of each school, students, and parents. The questionnaires were administered online and information regarding the survey as well as a URL for the survey location was provided by the students' PE teachers. In all cases, the URL directed participants to an introductory page that outlined the aim of the research and provided general instructions on how to complete the questionnaires. Consent to conduct the study was issued by the local university ethical committee (252/T-7). In Paper I, II, III and IV, all the questionnaires were administered online and designed so that participants were required to complete all the items.

4.4. Statistical procedures

The IBM SPSS and AMOS statistical packages were used to analyse the data. As the online survey required participants to respond to all items, there was no missing data.

4.4.1. Preliminary analysis

Descriptive statistics (means and standard deviations) for all the measures were calculated. Regarding normal univariate distribution, the values for asymmetry and kurtosis between –2 to +2 were considered acceptable (George & Mallery, 2006). Pearson correlation analysis was used to examine associations between study variables (Paper I, II, III and IV).

The preliminary analysis also included the chi-square tests and independent samples t-tests to examine baseline differences between study groups and differences between those who remained in the study and those who were lost to follow-up. The effect size of mean differences was presented as a Hedges' g and interpreted as follows: 0.20 = small; 0.50 = moderate; 0.80 = large (Paper IV).

4.4.2. Main analysis

Composite reliability coefficients (Raykov, 1997; Paper I) and Cronbach's α coefficients were used to indicate internal reliability of the scales (Paper II, III and IV).

The content validity of a designed pool of items was estimated based on the Content Validity Index (CVI; Lynn, 1986). CVI was calculated for each item based on ratings provided by the experts that informed decisions about whether to revise, eliminate, or retain the items. The CVI was calculated by dividing the number of experts who gave a rating of 3, 4, or 5 (i.e., rated the item as moderately relevant, relevant, or highly relevant) by 5, i.e., the number of experts on the panel. According to Lynn (1986), when expert panels consist of five or more reviewers, then CVIs of approximately .80 is acceptable. The items displayed CVIs ranging from .80 to 1.00 were retained (Paper I).

Exploratory factor analysis (EFA) was used to identify underlying dimensions of autonomy-supportive teacher behaviour. A principal axis factoring method with a direct oblimin rotation was used since it was expected that underlying dimensions of the scales remain interrelated. In order to interpret the extracted factors, all items with factor loadings of < .30 and items with cross-loadings were deleted (Kline, 1994). An item analysis was conducted to assess the homogeneity of the items each factor includes (DeVellis, 1991). To evaluate the internal reliability of each factor, according to Kidder and Judd (1986), the following criteria were used. First, an interitem correlation between r = .20 and r = .70, and second, a minimum corrected item-total correlation of r = .30 were considered as accepted values (Paper I).

Confirmatory factor analysis (CFA) with maximum likelihood procedure was used to test the adequacy of the study measures in representing their related hypothesises constructs using latent variables indicated by the questionnaire items (Paper I, II and III), and to verify the measurement model (Paper II and III).

Structural equation modelling (SEM) was used to test the direct and indirect paths from autonomy support through need satisfaction to HRQoL, and from controlling behaviour through need frustration to HRQoL. Parameter estimates and bias-corrected bootstrapped confidence intervals were calculated for each of the proposed pathways consistent with recommendations (Cerin & MacKinnon, 2008; Hayes & Scharkow, 2013; Paper III).

The adequacy of the CFAs and SEM was evaluated using multiple goodness-of-fit indices (Hu & Bentler, 1995): the Chi-square statistic (χ^2), the comparative fit index (CFI), the Bentler–Bonett normed fit index (NFI), the Bentler–Bonett non-normed fit index (NNFI), and the root mean square error of approximation (RMSEA). An acceptable fit between the hypothesised model and the data was indicated by values ≥. 90 for the CFI, NFI, and NNFI and value ≤. 08 for the RMSEA (Paper II and III).

The discriminant validity was supported if the difference between unity and values of correlations of the MD-PASS-PE subscales did exceed 1.96 multiplied

by the standard error of the correlation (Bagozzi & Kimmel, 1995). To additionally support the discriminant validity of the three-factor structure, the single-factor model was also performed. Discriminant validity is supported if the three-factor CFA model is superior in fit to the single-factor model (Paper I).

The incremental validity was supported if the three subscales of the MD-PASS-PE accounts for a larger amount of variances from psychological need satisfaction variables compared to the unidimensional autonomy support scale such as LCQ adapted for PE (Paper I).

SPSS PROCESS macro (Hayes, 2013) was used to test a simple mediation model and a moderated mediation model. To test a simple mediation model, need frustration as the putative mediator was regressed on controlling behaviour and the dependent variable, HRQoL, was regressed on the independent variable controlling behaviour and need frustration. To test a moderated mediation model, need frustration was regressed on controlling behaviour and HRQoL was regressed on controlling behaviour, need frustration, autonomy support, and the interaction term computed from the mean-centred scores of the need frustration and autonomy support variables (Paper II).

A series of analyses of covariance (ANCOVA) was used to examine the effectiveness of the WB-ASIP. Specifically, variables of students' perceptions of teachers' autonomy-supportive and controlling behaviours, students' perception of need satisfaction and need frustration, and students' perception of intrinsic motivation at follow-up were used as dependent variables, whereas study group (experimental vs. control group) was used as the independent variable. In each of the ANCOVA analysis, the respective baseline variable was included as a covariate. Partial eta squared (η_p^2) was used as a measure of the effect size for ANCOVA (Paper IV).

5. RESULTS

5.1. Validity and reliability of the Multi-Dimensional Perceived Autonomy Support Scale for Physical Education (Paper I)

In Paper I, a series of three studies were carried out to develop and confirm the initial validity and reliability of the MD-PASS-PE. In study 1, out of 49 initial pool items, two were removed (i.e., "My PE teacher allows me to debate my ideas freely," and "My PE teacher listens to me more than she or he talks") as they were not relevant or hard to follow for students. There were seven problematic items that were too difficult for students to understand and as a result, these items were reworded. The following pool of items (i.e., 47 items) was examined by academic experts, who provided ratings and suggestions if items needed the revision. Ten items out of 47 were excluded as they displayed CVIs lower than .80. The remaining items demonstrated CVIs ranging from .80 to 1.00 and were thus retained. However, nine items with CVIs of .80 or higher were revised based on the suggestions from the experts. Study 1 ended up with the pool of 37 items that were considered to be subjected to test factorial validity and to be applicable to the PE context by 6th- to 8th-grade students.

In study 2, an EFA was conducted on the first half of a sample (n = 576) to identify underlying dimensions of autonomy-supportive teacher behaviour. Stefanou et al. (2004) three-dimensional framework of autonomy-supportive behaviour was the basis to decide the number of factors to be extracted. Assuming that underlying dimensions of autonomy-supportive behaviour remain interrelated, a principal axis factoring method was used. Three factors emerged from the initial EFA by examining the pattern matrix (accounting for 62.46% of the item variance). Factor 1 consisted of 16 items that reflected teachers' use of cognitive autonomy support. Factor 2 consisted of 11 items that reflected teachers' use of procedural autonomy support. Factor 3 consisted of seven items that reflected teachers' use of organisational autonomy support. An initial EFA provided the model with 34 items in total. Based on Kidder and Judd (1986) suggestions the criteria for interitem correlation between r = .20 and r = .70, and a minimum corrected item-total correlation of r = .30 were considered as accepted values. Based on that, two items of organisational, three items of procedural and eight items of cognitive autonomy support were considered as inappropriate and were deleted. As a result, 21-items (i.e., cognitive autonomy support with eight items, organisational autonomy support with five items, and procedural autonomy support with eight items) remained for the following analyses. Descriptive statistics, factor loadings and correlations, and internal consistency estimates are displayed in Table 1 (see in Paper I). Next, a CFA was conducted on the second half of the sample (n = 576) to confirm the three-factor structure that was extracted in the EFA. Three items (two from procedural and one from cognitive autonomy support subscale) with

high multiple standardised residuals > |2.00| were removed. As a result, the 15-item three-factor model remained that displayed an excellent fit to the data: χ^2 = 170.88, df = 87, p < .001; CFI = .98; NNFI = .98; RMSEA = .04. The standardised factor loadings, bootstrapped standard errors, factor correlations and internal consistency estimates for the final 15-item, 3-factor solution, are displayed in Table 3 (see in Paper I). The difference between unity and values of correlations of the MD-PASS-PE subscales did exceed 1.96 multiplied by the standard error of the correlation, supporting the discriminant validity (Bagozzi & Kimmel, 1995). The change in χ^2 was significant between a single factor model and three-factor model, $\Delta\chi^2$ = 296.932, Δdf = 3, p < .001, also indicating discriminant validity.

Table 1. Multiple regressions predicting need satisfaction by multi- and unidimensional scale.

Predictive dimensions	Predictor dimensions	*B*	*t*	R^2	*p*	ΔR^2
Autonomy need satisfaction	Unidimensional scale	.82	23.17	67.4%	.00	
	Multidimensional scale			67.8%		0.4%(ns)
	Cognitive subscale	.41	4.86		.00	
	Organisational subscale	.34	4.02		.00	
	Procedural subscale	.10	1.38		.17	
Competence need satisfaction	Unidimensional scale	.74	17.82	55.0%	.00	
	Multidimensional scale			59.2%		4.2%*
	Cognitive subscale	.56	5.89		.00	
	Organisational subscale	.12	1.25		.21	
	Procedural subscale	.11	1.35		.18	
Relatedness need satisfaction	Unidimensional scale	.63	13.05	39.6%	.00	
	Multidimensional scale			41.0%		1.4%(ns)
	Cognitive subscale	.25	2.16		.03	
	Organisational subscale	.14	1.18		.24	
	Procedural subscale	.29	2.86		.01	

Note. Unidimensional scale = Learning Climate Questionnaire; Multidimensional scale = Multidimensional Perceived Autonomy Support Scale for Physical Education setting (MD-PASS-PE); Cognitive subscale, Organisational subscale and Procedural subscale = Cognitive, organisational and procedural subscales of MD-PASS-PE; Autonomy need satisfaction, Competence need satisfaction and Relatedness need satisfaction = subscales of the Basic Psychological Need Scale-Revised.
* p < .05; ns = not significant.

In study 3, the retested factorial structure of the MD-PASS-PE demonstrated a good fit to the data: $\chi^2(87) = 239.47$, CFI = .96, NFI = .94, NNFI = .95, RMSEA = .08. The regression models indicated that variance of all three BPNS-R subscales (i.e., autonomy, competence, and relatedness need satisfaction subscales) was explained by the MD-PASS-PE in a greater extent compared to the unidimensional LCQ (see Table 1), but significantly greater only for competence need satisfaction. Therefore, the incremental validity of the MDPASS-PE was provided for competence need satisfaction from the BPNS-R scale.

5.2. The relationships from students' perceived autonomy-supportive and controlling behaviour to HRQoL through need satisfaction and need frustration (Paper II)

Descriptive statistics including non-latent correlations among averaged scales, and Cronbach's α reliability coefficients for all the scales of this study, are presented in Table 1 (see in Paper II) and correlations among latent study variables in Table 2 (see in Paper II).

An initial fit of the measurement model fell short of acceptable fit according to the multiple criteria adopted: $\chi^2 = 1046.99$, df = 109, $p < .001$; CFI = .89; NNFI = .86; RMSEA = .09. Analysis showed that items from the "social functioning" subscale of the PedsQL^{TM} 4.0 inventory, and items from the relatedness need satisfaction and relatedness need frustration subscales of the BPNSNF scale displayed high modification indices and high standardised residual covariances (> ±2), indicating considerable redundancy across items from the measures. It was therefore decided to omit the "social functioning" (e.g., "Other kids do not want to be my friend") subscale from the PedsQL^{TM} 4.0 inventory because items from this subscale overlap with those from the relatedness need frustration (e.g., "During the PE lesson I had the impression that the class members I spend time with disliked me") and relatedness need satisfaction (e.g., "During the PE lesson I felt close and connected to the class members who are important to me") subscales of the BPNSNF scale (Haerens et al., 2015). In addition, the "days missed from school due to illness" subscale from the PedsQL^{TM} 4.0 inventory exhibited sub-optimal internal consistency ($\alpha = .55$), so it was excluded from subsequent analyses. The "relatedness need frustration" and "relatedness need satisfaction" subscales were also allowed to covary based on the modification indices. As a result, the final measurement model of all five latent constructs and 15 indicators yielded good fit with the data ($\chi^2 = 547.87$, df = 79, $p < .001$; CFI = .94; NNFI = .92; RMSEA = .08; CI_{90} RMSEA = .07–.08).

Results of the structural model estimated in the full sample demonstrated good fit with the data ($\chi^2 = 547.87$, df = 79, $p < .001$; CFI = .94; NNFI = .92; RMSEA = .08; CI_{90} RMSEA = .07–.08). Factor loadings of the indicators across

all latent variables in the model ranged between .55 and .91. In this model (Figure 2), direct relationships between teaching behaviours and HRQoL were not significant. Relationships between teaching behaviours and the mediators (i.e., need satisfaction and need frustration), and between mediator and HRQoL are reported in Table 3 (see in Paper II) and are displayed in Figure 2. Table 3 (see in Paper II) also presents the point estimates as well as the bias-corrected bootstrapped 95% confidence intervals for the mediated effects. The relationship between perceived autonomy support and HRQoL was mediated only by need satisfaction ($\beta = .24$, $p < .001$) and not by need frustration ($\beta = .00$, $p = .91$). The relationship between perceived controlling behaviour and HRQoL, mediation occurred only through need frustration ($\beta = –.30$, $p < .001$) and not through need satisfaction ($\beta = .01$, $p = .31$). These component indirect effects resulted in significant total indirect effects of perceived autonomy support ($\beta = .24$, $p < .01$) and controlling behaviour ($\beta = –.29$, $p < .001$) on HRQoL. Also, a significant negative relationship between the latent constructs for need satisfaction and need frustration ($\beta = –.32$, $p < .001$), and between the latent constructs for perceived autonomy support and perceived controlling behaviour ($\beta = –.54$, $p < .001$) was found. The structural model accounted for 40% of the variance in HRQoL, and 66% and 30% of the variance in need satisfaction and need frustration, respectively.

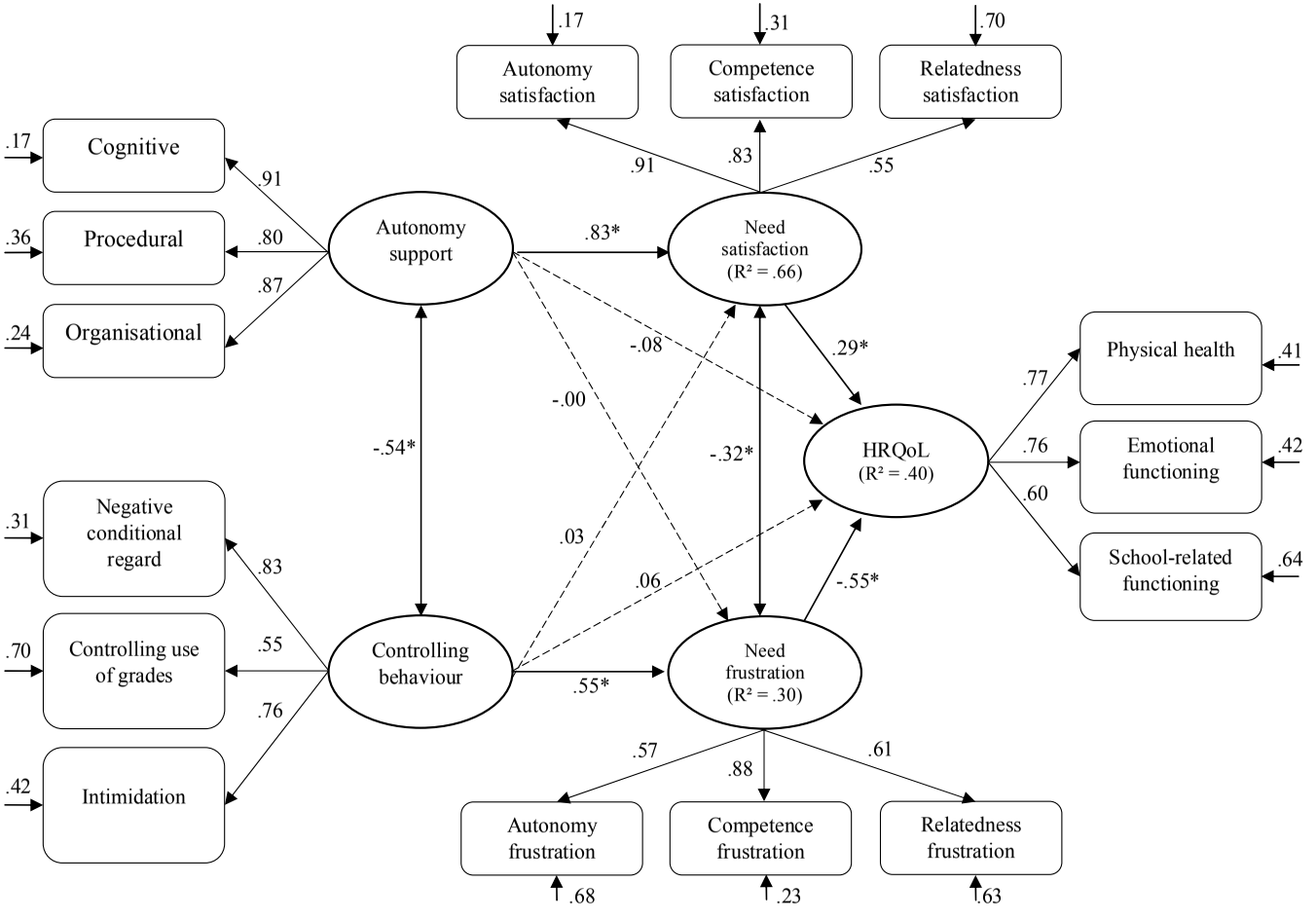

Figure 2. The structural equation model measuring the associations of perceived autonomy supportive and controlling behaviour with students' need satisfaction, need frustration, and HRQoL. *Note.* *$p < .001$; Broken lines represent not significant relations. HRQoL = Health-related quality of life.

5.3. The moderated mediation model of autonomy support on indirect effect between controlling behaviour and HRQoL through need frustration (Paper III)

Descriptive statistics, Cronbach's α coefficients, and intercorrelations for this study variables are presented in Table 1 (see in Paper III).

Firstly, a mediation model was computed in which the relationship between perceived controlling behaviour and HRQoL was mediated via need frustration (see Paper III, Table 2). It was found that perceived controlling behaviour from teachers had a significant, direct, and positive relationship on students' need frustration (b = .3981, p < .0001), and need frustration had a significant, direct, and negative relationship on students' HRQoL (b = –6.6658, p < .0001). As predicted, there was a statistically significant, negative indirect relationship from perceived teachers' controlling behaviour on students' HRQoL via students' need frustration (b = –2.6535, p < .0001, 95% bias-corrected confidence interval (95% CI) = –3.1329, –2.2293). When controlling for the mediator, the direct effect of perceived teachers' controlling behaviour on students' HRQoL changed from b = –2.6219 (p < .0001) to b = .0316 (p = .932).

Secondly, a moderated mediation analysis was computed to examine whether the indirect effect of perceived teachers' controlling behaviour on students' HRQoL via students' need frustration was moderated by perceived teachers' autonomy support (see Paper III, Table 3). In the mediation model, a statistically significant, direct, and negative effect of students' need frustration on their HRQoL (b = –8.3599, p < .001) was found. The interaction effect between perceived teachers' autonomy support and students need frustration to students' HRQoL was not found to be statistically significant (b = .5951). Specifically, the conditional indirect effect of perceived teachers' controlling behaviours on students' HRQoL mediated via students' need frustration at the mean value of students' perceived teachers' autonomy support and one standard deviation (SD) above and below the mean were computed. Significant indirect effects were found in all cases (see Paper III, Table 3). It was found that the confidence intervals of the indirect effect significantly overlapped with the effects of the other at each level of the moderator. As a result, it was concluded that the indirect effect was significant at all levels of the moderator with no support for the moderated mediation hypothesis. In addition, controlling for age and gender did not change these results.

Finally, using the Johnson-Neyman technique (Preacher, Rucker, & Hayes, 2007) to test the regional significance of the conditional indirect effect revealed that the indirect relationship between perceived teachers' controlling behaviour and students' HRQoL via students' need frustration was significant at all the values of perceived autonomy support (see Figure 3).

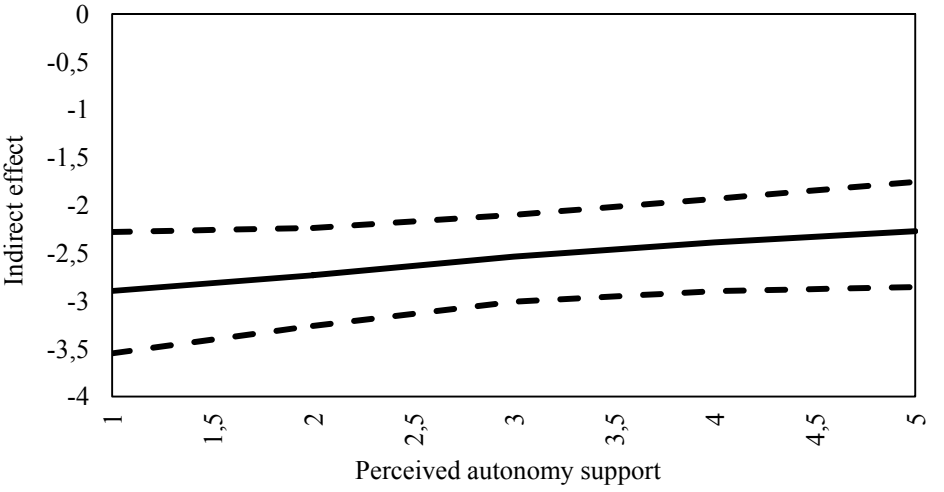

Figure 3. The conditional indirect effect of perceived teachers' controlling behaviour to students' HRQoL via need frustration at all values of perceived autonomy support.

Note. The conditional indirect effect is depicted by the trajectory of a solid plot, the upper and lower limits of the 95% CI are depicted by dashed plots.

5.4. The effects of the web-based autonomy-supportive intervention program (Paper IV)

Firstly, for preliminary analysis, baseline differences between study groups were examined (i.e., randomisation check; see Paper IV, Table 1). With regards to students' perceptions, results of the independent samples t-test revealed no significant differences in any of the study variables between the control and experimental group at baseline (ts = –1.39–1.68, ps > 0.095, gs < 0.19). Also, based on the chi-square test results there was no significant difference in the proportion of male and female students across the experimental and control groups ($\chi^2 = 3.24$, $p = 0.074$).

Secondly, the differences between those who remained in the study and those who were lost to follow-up were examined (i.e., attrition check; see Paper IV, Table 2). With regards to students' perceptions, results of the independent samples t-test revealed no significant baseline differences in any of the study variables (ts = –1.39–1.11, ps > 0.166, gs < 0.16) except the perception of students' intrinsic motivation. It was found that students who remained in the study reported significantly (t = 2.48, p = 0.014, g = 0.28) higher intrinsic motivation at baseline than those who were lost to follow-up. Based on the chi-square test results there was no significant difference in the proportion of boys and girls between the students who remained in the study and those who were lost to follow-up ($\chi^2 = 3.67$, $p = 0.068$).

Thirdly, for main analysis, a series of analyses of covariance (ANCOVA) was conducted to examine the effectiveness of the WB-ASIP. The results (see Table 2) indicate that students in the experimental group reported significantly higher perceptions of cognitive ($F(1,175) = 17.44$, $p < 0.000$, $\eta_p^2 = 0.09$), procedural ($F(1,175) = 11.45$, $p = 0.001$, $\eta_p^2 = 0.06$), and organisational ($F(1,175) = 6.34$, $p = 0.013$, $\eta_p^2 = 0.04$) autonomy support at follow-up compared to students in the control group. In addition, need satisfaction for autonomy ($F(1,175) = 10.21$, $p = 0.002$, $\eta_p^2 = 0.06$), competence ($F(1,175) = 5.77$, $p = 0.017$, $\eta_p^2 = 0.03$), and relatedness ($F(1,175) = 6.12$, $p = 0.014$, $\eta_p^2 = 0.03$) were perceived significantly higher by students in the experimental group at follow-up compared to students in the control group. Students in the experimental group reported significantly lower perception of intimidation ($F(1,175) = 17.32$, $p < 0.000$, $\eta_p^2 = 0.09$) and need frustration for autonomy ($F(1,175) = 6.64$, $p = 0.011$, $\eta_p^2 = 0.04$) at follow-up compared to students in the control group. No significant group effects were found on students' perceived teachers' controlling use of grades ($F(1,175) = 2.39$, $p = 0.124$, $\eta_p^2 = 0.01$), negative conditional regard ($F(1,175) = 1.33$, $p = 0.250$, $\eta_p^2 = 0.01$), students' competence ($F(1,175) = 0.00$, $p = 0.953$, $\eta_p^2 = 0.00$) and relatedness ($F(1,175) = 3.21$, $p = 0.075$, $\eta_p^2 = 0.02$) need frustration, and intrinsic motivation ($F(1,175) = 3.22$, $p = 0.075$, $\eta_p^2 = 0.02$) at follow-up.

Table 2. Differences between the experimental and control group students' perceptions of psychological variables at follow-up.

	Experimental group ($n = 72$)	Control group ($n = 118$)			
Variable	*M* (SD)	*M* (SD)	$F(1,175)$	p	η_p^2
Cognitive autonomy support	5.92 (1.27)	5.12 (1.25)	17.44	0.001	0.09
Procedural autonomy support	5.74 (1.34)	5.05 (1.33)	11.45	0.001	0.06
Organizational autonomy support	4.95 (1.29)	4.46 (1.28)	6.34	0.013	0.04
Negative conditional regard	2.92 (1.80)	3.23 (1.78)	1.33	0.250	0.01
Intimidation	1.25 (1.35)	2.11 (1.34)	17.32	0.000	0.09
Controlling use of grades	3.52 (1.70)	3.91 (1.68)	2.39	0.124	0.01
Autonomy need satisfaction	5.18 (1.48)	4.46 (1.47)	10.21	0.002	0.06
Competence need satisfaction	5.54 (1.56)	4.97 (1.55)	5.77	0.017	0.03
Relatedness need satisfaction	5.70 (1.30)	5.21 (1.29)	6.12	0.014	0.03
Autonomy need frustration	3.31 (1.27)	3.81 (1.26)	6.64	0.011	0.04
Competence need frustration	2.96 (1.71)	2.97 (1.70)	0.00	0.953	0.00
Relatedness need frustration	2.06 (1.57)	2.49 (1.56)	3.21	0.075	0.02
Intrinsic motivation	5.66 (1.74)	5.18 (1.73)	3.22	0.075	0.02

Note. η_p^2 = partial eta squared, a measure of the effect size for ANCOVA.**DISCUSSION**

6. DISCUSSION

6.1. Multi-Dimensional Perceived Autonomy Support Scale for Physical Education as a valid and reliable instrument

The analysis demonstrated that MD-PASS-PE is a valid and reliable questionnaire for measuring students' perceptions of their teachers' autonomy-supportive behaviour in a multi-dimensional fashion. After several satisfied criterions, the final 15-item three-factor CFA model displayed the solution with an excellent model fit, confirming the hypothesis H1. Previously, Hagger et al. (2007) developed a 12-item measure that also displayed a very good model fit. However, the latter scale enables to assess the perceived autonomy support, although from three different agents (i.e., teacher, parents, and peers), only in a unidimensional fashion. Also, in the present study, a higher-order model was tested in which the three first-order factors were represented by one second-order factor. Analysis revealed that a second-order model also provided goodness-of-fit indices similar to that of the first-order model. Marsh (1987) has pointed out that if the second-order model goodness-of-fit indices are similar to the first-order model, the former model should be favoured because it is more frugal. The second-order model would be useful in examining the effect of an overall perceived autonomy supportive teachers' behaviour on students' various affective and behavioural outcomes. Still, if there is an interest to examine whether specific aspects of the perceived teachers' autonomy supportive behaviour predict distinctive outcomes, it is suggested using the three-factor model. Also, a congeneric 15-item model was tested that produced only a moderate fit to the data, and that was statistically significantly worse than the first-order model, indicating that a perceived autonomy supportive teachers' behaviour should be measured by multiple dimensions. Thus, autonomy supportive teachers' behaviour is a multidimensional construct featured by a number of separate, but still related autonomy supportive strategies.

For testing the hypothesis H2, the incremental validity of the final MD-PASS-PE 15-item solution via multiple regression analysis, using another independent sample was assessed. Results revealed that the multidimensional scale explained a larger amount of variance of the observed predictive variables, but only for competence need satisfaction the amount of explained variance was significantly larger. This finding partially confirms the hypothesis H2. However, the multidimensional scale might provide a better understanding of how satisfaction of the needs is predicted by perceived autonomy supportive behaviour and it is expected that a similar trend exists also for other PE-related outcomes perceived by students. For example, teachers who use autonomy supportive strategies that can be characterised as organisational autonomy support (e.g., allows the student to choose exercise place; allows the student to do exercises using different methods) may further facilitate students' feelings of autonomy need satisfaction in PE lessons, which, in turn, may result in

increased autonomous motivation. Higher perception of students' feelings of relatedness and thereby enhanced autonomous motivation can be ensured when PE teachers use strategies such as guiding students in finding solutions or explaining the effect of exercises, both behavioural strategies that can be categorised as procedural autonomy support. Finally, enhanced feelings of all three needs for autonomy, competence, and relatedness of students simultaneously can be achieved by PE teachers offering autonomy supportive strategies that are cognitive in nature. For example, teachers conveying confidence in students' abilities most likely will result in students' increased perceptions of all psychological needs, and subsequent autonomous motivation. This is consistent with SDT arguing that social factors (e.g., autonomy support from the teacher) are related with the satisfaction of the students' basic needs, which, in turn, are related with various affective and behavioural outcomes (Deci & Ryan, 2000).

6.2. Unique pathways from perceived teachers' autonomy-supportive and controlling behaviour to students' HRQoL

The analysis of the proposed mediation model of psychological needs revealed that perceived teachers' autonomy-supportive behaviour and teachers' controlling behaviour is associated with students' HRQoL. Firstly, confirming the hypothesis H3, an indirect effect of perceived teachers' autonomy-supportive behaviour on students' HRQoL mediated by need satisfaction in PE was found. While previous studies have tested the indirect effect of perceived PE teachers' autonomy support on students' HRQoL (Koka, 2014; Standage & Gillison, 2007; Standage et al., 2012), the current study adds to the literature by providing the evidence that perceived teachers' multidimensional autonomy-supportive behaviour (i.e., organisational, procedural, and cognitive autonomy support) is related to students' HRQoL through need satisfaction. This finding is important because it adds some specific implications to practising PE teachers (e.g., providing autonomy support to students' regarding three dimensions of autonomy-supportive behaviour) that can be provided to facilitate the formation of adequate levels of HRQoL of their students.

Secondly, confirming the hypothesis H4, a significant indirect effect of the perceived controlling behaviour of the teacher to students' HRQoL mediated by need frustration was found. The current study adds to the literature by providing the evidence that perceived teachers' controlling behaviour was found to be negatively associated with students' HRQoL, and that this effect was mediated by psychological need frustration. Based on current findings, future studies might focus on examining the effects of potential interventions aimed at decreasing students' perceptions of teachers' controlling behaviour on HRQoL. For example, it is argued by De Meyer et al. (2014) that controlling behaviour could be perceived by students strongly despite the relatively infrequent use of

controlling behaviour by teachers. It is possible that even minimal exposure to controlling behaviour might impact students' need frustration and HRQoL. Therefore, one might argue that it is important not only to increase teachers' autonomy-supportive behaviour but also decrease teachers' controlling behaviours. This suggestion is also supported by the results of the current study indicating that PE teachers' behaviour with respect to increasing students' HRQoL does not involve only increasing autonomy-supportive strategies, but also decreasing controlling behaviour. Like perceived autonomy support, the perceived teachers' controlling behaviour in the present study was composed of different dimensions, adapted from coaching setting into PE by Hein et al. (2015). Accordingly, some specific suggestions can be provided to practising PE teachers on which behaviours should be avoided in their classes if the aim is not to deteriorate their students' perceptions of HRQoL. This finding might have some implication in designing intervention programs to improve teachers' interpersonal behaviour.

Thirdly, no significant negative relationships between perceived autonomy support and students' need frustration nor between perceived controlling behaviour and students' need satisfaction in PE was found. This result is inconsistent with previous findings showing relations between perceived teachers' behaviours and students' psychological needs in the context of PE (Haerens et al., 2015). More precisely, in a previous study by Haerens et al. (2015), a significant negative correlation was found between students' perceived teachers' autonomy support and students' need frustration, and also between students' perceived teachers' controlling behaviour and need satisfaction. The inconsistencies across studies may be attributed to differences in the ages of participants. Participants in Haerens et al.'s (2015) were more than two years older than participants in the current study. Older students may have more flexible views of motives for participating in PE and may have more differentiated views of their PE teachers. Nevertheless, taken together, both studies provide support for a notion that need satisfaction might be the unique pathway that mediates effects of the autonomy support from the teacher on PE related adaptive outcomes, and that teachers' controlling behaviour undermines students' HRQoL through a separate pathway. Finally, the proposed model accounted for substantive variance in HRQoL. The findings of the current study suggest that HRQoL in students is a function of a 'motivationally adaptive' pathway instigated autonomy support and experiences of need satisfaction (Deci & Ryan, 2000). In contrast, a controlling 'motivationally maladaptive' pathways also exist determined by perceived controlling behaviours from teachers (Vansteenkiste & Ryan, 2013) and experiences of need frustration (Bartholomew et al., 2011).

6.3. Perceived autonomy-support as a buffer to the detrimental effect of perceived controlling behaviour from the teachers

Results revealed that the indirect effect was significant at all levels of autonomy support leading to reject hypothesis H5. Therefore, it was concluded that perceived autonomy support does not buffer the undermining effect of controlling behaviour on students' HRQoL. This finding supports previous research that students can be highly sensitive to controlling behaviour, and its effects can be highly influential even in cases where teachers using controlling behaviours sparingly (De Meyer et al., 2014). It is also consistent with a previous study, which found that perceiving one's instructor as high on control is detrimental even when the instructor is perceived to be autonomy-supportive (Haerens et al., 2017). Much of the research on interventions based on SDT advocate promoting autonomy support (Su & Reeve, 2011), suggesting that teachers should adopt behaviours that foster student autonomy including PE teachers providing students with choices and options. Although there is often a stipulation in autonomy-support interventions that controlling behaviours should be minimised, there is often little emphasis placed on this aspect (Su & Reeve, 2011). The current findings suggest that this lack of emphasis is misplaced given that if students perceive their teachers to use controlling behaviours, it will have a detrimental effect on adaptive outcomes like HRQoL in educational contexts regardless of whether they also perceive their teachers adopt autonomy supportive behaviours. In other words, autonomy support displayed by teachers will not be effective in countering the detrimental effects of their perceived controlling behaviours on adaptive outcomes on students' HRQoL. The current findings imply that minimising controlling behaviours is just as important as enhancing autonomy-supportive behaviours.

6.4. The effects of the web-based autonomy-supportive intervention program

Results of this study revealed that the WB-ASIP was partially effective. After the intervention, students in the experimental group reported that their teachers dedicated more resources to organisational (e.g., accepts different solutions in learning of exercises), procedural (e.g., explains the effect of exercises), and cognitive (e.g., allowing students to express their opinion) support. In line with Su and Reeve (2011) meta-analysis and confirming the hypothesis H6, the current finding affirms that autonomy-supportive intervention programs are effective, as established by students' perceptions of teachers' autonomy-supportive behaviour. Partially in line with hypothesis H7, students in the experimental group reported that their teachers dedicate less resources to intimating behaviour (e.g., teacher shouts less at students in front of others to make them

comply). However, the current intervention failed to decrease students' perceptions of their teachers' negative conditional regard and controlling use of grades. The reason for this might be that the baseline levels of students' perceptions of these negative behaviours were relatively low, giving little room for teacher improvement at follow-up. Confirming the hypothesis H8, it was found that after the intervention, students' felt more that their needs for autonomy, competence and relatedness are satisfied, which is partially in line with the Lonsdale et al. (2013). The possible reason for this might be that experimental group teachers were provided with detailed information on how to be more autonomy supportive from within the multidimensional approach. On the other hand, only autonomy need frustration was reported to be significantly lower at follow-up compared with control group students, which is mostly not in line with hypothesis H9. The reason for this might be that the current intervention exclusively focused on increasing PE teachers autonomy-supportive behaviour which is mainly related to the content of autonomy need frustration. Finally, rejecting the hypothesis H10, no significant group effects were found for students' perceptions of their intrinsic motivation. Since students in the study were volunteers and those who remained in the study reported higher intrinsic motivation than those lost to attrition, the current study participant sample may have been unusually high in intrinsic motivation at baseline with little room for gains in this regard. Another possible reason for this might be that changes in students' perception of intrinsic motivation towards PE may take more time to apply.

6.5. Practical recommendations

Based on the current research results, some practical recommendations for PE teachers can be given. Considering the importance of all three autonomy-supportive behaviour dimensions, some specific implications for practising PE teachers to promote students' HRQoL are suggested. Firstly, it is recommended for PE teachers to adopt organisational autonomy-supportive behaviour (e.g., to allow students to choose their sports equipment and to accept students' solutions in learning exercises). That form of autonomy-supportive behaviour was found to be related to students' feelings of autonomy need satisfaction in the context of PE (Paper I) and may further enhance students' HRQoL. Secondly, PE teachers are encouraged to exhibit cognitive autonomy-supportive behaviour (e.g., allowing students to express their own opinions and providing responses to students when they express their opinion). That form of autonomy-supportive behaviour may facilitate students' competence need satisfaction in the context of PE (Paper I) and students' HRQoL. Thirdly, teachers should use procedural autonomy-supportive behaviour (e.g., to explain the effect of exercise on health and guide students toward finding solutions to problems without directly revealing the answer), which is associated with students' feelings of relatedness satisfaction and may result in enhanced HRQoL.

On the other hand, some specific suggestions can be given to practising PE teachers to avoid certain behaviours in their classes so as not to decrease their students' HRQoL. PE teachers would do well if they avoid behaviours such as being less supportive of their students when they do not perform well (i.e., negative conditional regard); shouting at students in front of others to make them comply (i.e., intimidating behaviour); and promising to give students a good grade only if they behave well (i.e., controlling use of grades). Aforementioned behaviours have found to be related to students' basic psychological need thwarting (Hein et al., 2015), which may undermine HRQoL.

Drawn from the above, PE teachers should be aware that their students' perceptions of the autonomy-supportive and controlling behaviours that are perceived in the PE lessons could have a positive and negative relationship, respectively, to their students' HRQoL. It should be noted that the mechanism behind the effects of teachers' autonomy-supportive and controlling behaviour in the context of PE on students' HRQoL is through the students' perceived psychological need satisfaction and frustration, respectively. This knowledge is important for PE teachers because if they use autonomy-supportive behaviours in lessons, their students are likely to experience higher HRQoL. The reason behind this is that autonomy-supportive behaviours are likely to satisfy students' psychological needs in PE lessons. On the other hand, if PE teachers use controlling behaviours, their students are likely to experience lower HRQoL. The reason behind this is that controlling behaviours frustrate students' psychological needs in PE lessons.

6.6. Limitations of the study

There are several limitations of the current research that should be acknowledged. First, in all studies participants were employed from a relatively narrow age-group (i.e., students 11 to 15 years old). Future research should aim to determine whether the examined relationships are evident with more diverse age groups. Second, the participants in all studies were from only one cultural group. For instance, current results may not be so pronounced in collectivistic cultures in which controlling teaching styles are representative of culturally-normative classroom practices (Reeve et al., 2014). Examining the equivalence of tested models across different cultural groups would provide further evidence for its validity and reliability. Third, for validating the MD-PASS-PE and testing the two proposed models in the current study, only a cross-sectional data was collected. A cross-sectional data is not informative of the causal relations between these constructs. In future, longitudinal studies are warranted to determine whether the examined processes are evident across time and to test reciprocal effects within model constructs. Fourth, it is important to highlight that any inferences on the direction of effects are based on theory rather than data. This is evident for all the studies relying on correlational data and is a caveat may be resolved by further tests of model hypotheses using designs,

which model change such as experimental or panel designs (Hagger & Chatzisarantis, 2016). Fifth, between-group change comparisons were made only on a one month follow up data. Future research should determine if these between-group change effects are persistent over a longer time of period such as one or two years. Sixth, future studies should address other factors such as motivation and theory of planned behaviour to test the applicability of the trans-contextual model in predicting students' HRQoL. Seventh, future studies should address perceived autonomy-supportive behaviour from other salient agents such as peers and parents in predicting students' HRQoL. Eight, all studies collected self-reported data that has potential to introduce common method variance and may inflate associations among constructs (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Future studies should consider behavioural observations to provide converging evidence for the proposed relationships. Ninth, there was an imbalanced sample of 20 female and eight male teachers in the intervention study because more female teachers volunteered. Because of that current results might better describe female teachers' behaviours and may be less generalisable to male teachers. Tenth, low response rate of invited participants in all studies is also a limitation. Specifically, the current study did not take into account the potential influence of the participants who declined the invitation to the study. The reason for low response rate of invited participants might be that an online questionnaire was employed in all studies. Finally, all studies were conducted only in a PE context. The future research would do well to test the MD-PASS-PE and two models proposed in the current study in other settings, such as sports and classrooms, to support their psychometric properties and generalisability.

7. CONCLUSIONS

1. Psychometric parameters of the developed MD-PASS-PE indicated that it is a valid and reliable questionnaire to measure students' perceptions of the cognitive, organisational and procedural dimensions of teachers' autonomy-supportive behaviour in the context of PE.
2. MD-PASS-PE explained a significantly larger amount of variance for competence need satisfaction compared to unidimensional Learning Climate Questionnaire.
3. Students' perceptions of their PE teachers' autonomy-supportive and controlling behaviours are indirectly related to students' HRQoL through need satisfaction and need frustration, respectively.
4. Perceived autonomy support does not buffer the undermining indirect effect of controlling behaviour via need frustration on students' HRQoL.
5. At one-month follow-up, the WB-ASIP led to a significant increase in the experimental group students' perceptions of PE teachers' cognitive, organisational and procedural autonomy-supportive behaviours, and students' need satisfaction for autonomy, competence and relatedness, compared with control group students.
6. At one-month follow-up, the WB-ASIP led to a significant decrease in experimental group students' perceptions of PE teachers' intimidation, and students' autonomy need frustration, compared with control group students.

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SUMMARY IN ESTONIAN

Õpilaste tajutud kehalise kasvatuse õpetaja autonoomsust toetava ja kontrolliva käitumise tajumise mõju õpilaste psühholoogilistele vajadustele ja tervisealasele elukvaliteedile

Uuringud on näidanud õpilaste tervisealases elukvaliteedis langustendentsi (Bisegger et al., 2005; Meade & Dowswell, 2016). Õpilaste tervisealane elukvaliteet on oluline kuna see hõlmab selliseid aspekte nagu kehaline, sotsiaalne, emotsionaalne ja akadeemiline suutlikkus (Varni et al., 2003). Koolikeskkond, sealhulgas õpetaja käitumine, võib omada õpilaste tervisealasele elukvaliteedile olulist mõju. Tuginedes enesemääratlemise teooriale (Deci & Ryan, 1985), võib õpetaja käitumist üldises plaanis jagada õpilasi kontrollivaks ja neile autonoomsuse toetust pakkuvaks, mis mõlemad võivad mõjutada õpilaste tervisealast elukvaliteeti. Kui varasemates uuringutes on leitud, et kehalise kasvatuse õpetaja tajutud autonoomsuse toetus on positiivselt seotud õpilaste motivatsiooniga ja tervisealase elukvaliteediga (Standage & Gillison, 2007; Standage et al., 2012), siis senini pole uuritud õpetaja kognitiivse, protseduurilise ja organisatsioonilise autonoomsuse toetust mõju õpilaste tervisealasele elukvaliteedile. Samuti puuduvad uuringud teemal kuidas on tajutud kehalise kasvatuse õpetaja kontrolliv käitumine seotud õpilaste tervisealase elukvaliteediga ning milline on tajutud kehalise kasvatuse õpetaja kontrolliva käitumise ja autonoomsuse toetuse koosmõju õpilaste psühholoogilistele vajadustele ja tervisealasele elukvaliteedile. Antud töös käsitletakse õpilaste tajutud õpetajapoolse autonoomsuse toetuse ja kontrolliva käitumise mõju õpilaste psühholoogilistele vajadustele ja tervisealasele elukvaliteedile tuginedes enesemääratlemise teooriale (Deci & Ryan, 1985).

Käesolev doktoritöö koosneb neljast uuringust. Esimeses uuringus töötati välja ja valideeriti õpilaste tajutud kehalise kasvatuse õpetaja autonoomsuse toetust hindav mitmedimensionaalne küsimustik, mis hindab tajutud kognitiivset, protseduurilist ja organisatsioonilist autonoomsuse toetust. Uuring viidi läbi üle Eesti 1476 õpilase seas vanuses 12 kuni 15 eluaastat. Uuringu tulemused näitasid, et mitmedimensionaalne autonoomsuse toetuse küsimustik on valiidne ja usaldusväärne ning prognoosib võrreldes ühedimensionaalse küsimustikuga oluliselt suuremas ulatuses õpilaste kompetentsuse vajadust.

Teises uuringus hinnati õpilaste tajutud kehalise kasvatuse õpetaja autonoomsuse toetuse ja kontrolliva käitumise spetsiifilist mõju läbi õpilaste psühholoogiliste vajaduste rahuldamise ja frustratsiooni õpilaste tervisealasele elukvaliteedile. Uuringus osales 1031 õpilast vanuses 12 kuni 15 eluaastat. Tulemustest selgus, et kehalise kasvatuse õpetaja autonoomsuse toetuse tajumine omab õpilaste tervisealasele elukvaliteedile positiivset mõju ainult läbi psühholoogiliste vajaduste rahuldamise. Lisaks näitasid tulemused, et kehalise kasvatuse õpetaja kontrolliva käitumise tajumisel on negatiivne mõju õpilaste tervisealasele elukvaliteedile ainult läbi õpilaste vajaduste frustratsiooni.

Kolmanda uuringu eesmärk oli välja selgitada, kas õpilaste tajutud kehalise kasvatuse õpetaja autonoomsuse toetus vähendab õpetaja kontrolliva käitumise tajumise negatiivset mõju õpilaste tervisealasele elukvaliteedile. Uuringus osales 1042 õpilast vanuses 12 kuni 15 eluaastat. Tulemustest selgus, et tajutud kehalise kasvatuse õpetaja kontrolliva käitumise ja õpilaste tervisealase elukvaliteedi vaheline kaudne negatiivne seos, vahendatuna läbi psühholoogiliste vajaduste frustratsiooni, ei erine oluliselt õpilastel, kes tajuvad õpetajapoolset autonoomsuse toetust kas madalalt, keskmiselt või kõrgelt. Selle tulemuse põhjal võib öelda, et õpetajapoolse autonoomsuse toetuse tajumine ei vähenda kontrolliva käitumise negatiivset mõju õpilaste tervisealasele elukvaliteedile.

Esimese kolme uuringu tulemused olid aluseks neljanda uuringu veebipõhise sekkumisprogrammi koostamisel. Neljanädalase sekkumisprogrammi eesmärgiks oli suurendada kehalise kasvatuse õpetaja autonoomsust toetava käitumise erinevate dimensioonide kasutamist, samas vähendada kontrolliva käitumise erinevate dimensioonide kasutamist õpetamisel. Uuringus osales 28 õpetajat vanuses 28 kuni 66 eluaastat ja nende 321 õpilast vanuses 11 kuni 15 eluaastat. Tulemustest selgus, et sekkumisprogramm oli efektiivne suurendamaks õpilaste tajutud õpetajapoolset kognitiivset, protseduurilist ja organisatsioonilist autonoomsuse toetust, samuti õpilaste autonoomsuse, kompetentsuse ja seotuse vajaduse tajumist. Samuti oli sekkumine efektiivne vähendamaks õpilaste tajutud õpetajapoolset hirmutamist ja autonoomsuse vajaduse frustratsiooni. Leitud tulemuste põhjal võib järeldada, et sekkumisprogramm oli osaliselt efektiivne, kuna muutusi ei ilmnenud õpetaja negatiivses tingimuslikus hoolimises, hinnetega kontrollimises, õpilaste kompetentsuse ja seotuse vajaduse frustratsioonis ning õpilaste sisemises motivatsioonis.

Käesoleva uuringu tulemused näitasid, et kehalise kasvatuse õpetajatel on oluline pakkuda õpilastele kognitiivset, protseduurilist ja organisatsioonilist autonoomsuse toetust ja samuti on tähtis vähendada õpilaste suhtes kontrollivat käitumist.

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Peamised uurimisvaldkonnad

Õpetajate mitmedimensionaalne autonoomsuse toetust pakkuv käitumine, õpilaste psühholoogilised vajadused ja motivatsioon kehalise kasvatuse kontekstis.

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