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Predicting students' basic psychological needs, motivation, and well-being in online physical education: a semester-term longitudinal study

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ABSTRACT

Background and Purpose: Emerging the covid-19 has raised new barriers to students' motivation and well-being. Students may not be autonomously motivated toward healthy behaviours due to the limitation and restriction in movement. Grounded in self-determination theory, in this study, we aimed to examine how students' perceptions of teachers' interpersonal behaviours (need support, need indifference, and need thwart) predict students' basic psychological need satisfaction and need frustration, motivational regulations toward physical education, and well-being over an online physical education (PE) semester during the pandemic.

Method: A sample of college students participated in this semester-term longitudinal study. Data collected at the beginning (T1, N = 557, $M_{age} = 21.20$, SD = 1.56) and the end of the semester (T2, N = 262, $M_{age} = 21.01$, SD = 1.53) in the first online college PE programmes during the pandemic.

Results: The results showed that teachers' need-supportive teaching style at T1 positively predicted students' positive affect at T2 through the mediating roles of need satisfaction and autonomous regulation at T2. Neither teachers' need-thwarting nor need-indifferent behaviours at T1 predicted students' outcomes at T2. Need satisfaction positively predicted autonomous and controlled regulations, negatively predicted amotivation, and directly predicted well-being. Need frustration positively predicted controlled regulation and amotivation as well as directly positively predicted negative affect.

Conclusion: Findings emphasized the important role of teachers' need-supportive teaching style on students' well-being and their experience of need satisfaction and autonomous regulation in online PE programmes and during challenging times. Practical implications and future research directions are discussed.

ARTICLE HISTORY

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KEYWORDS

Self-determination theory; basic psychological needs; motivation; pandemic; physical education

Introduction

In December 2019, due to the spread of the novel coronavirus, educational activities faced many restrictions and problems. In many places, to limit the spread of the virus, students

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needed to change their lifestyle, such as isolating themselves or working from home, restricting sports and recreational activities, and using online programmes. With the closure of universities, teachers also faced an unprecedented challenge in relationships with their students (Gobbi et al., 2020), and implementing online education disrupted teachers' interpersonal teaching styles, such as face-to-face and body-based teaching styles. In this situation neither teachers nor students might regulate their behaviours effectively to cope with stressors and experience well-being (Behzadnia et al., 2022). Importantly, students' healthy lifestyles unpredictably changed due to restrictions on movement (Behzadnia & FatahModares, 2023; Jeong & So, 2020), which also cost their well-being (Brooks et al., 2020). Therefore, an important challenge arose regarding how students can stay motivated to be physically active and experience well-being in online education and during restrictions. In this study, through a self-determination theory (SDT; Ryan & Deci, 2017, 2020) approach, we aimed to examine how teachers' interpersonal behaviours would relate to students' basic psychological needs, motivational regulations, and wellbeing over an online semester in college Physical Education (PE) lessons during the pandemic.

Self-determination theory

Need satisfaction and need frustration

SDT (Deci & Ryan, 1985; Ryan & Deci, 2017, 2020) is a macro-theory of human motivation, health, and wellness. According to SDT, all human beings have three basic psychological needs, the satisfaction of them facilitates individuals' growth, development, integration, and well-being, regardless of their age, gender, socioeconomic status, and situation. These are the need for autonomy (a sense of willingness, being self-regulated, and acting based on personal endorsements), competence (feeling effective in achieving outcomes and interacting with the environment, and experiencing growth), and relatedness (having a sense of close relationship with others and experiencing belonging to a group). Research in the area of PE and healthy behaviours showed that the satisfaction of these basic psychological needs results in intrinsically motivated toward activities, greater healthy behaviours, intention to continue the activities, and well-being. In contrast, when basic needs are not satisfied or they are frustrated, it results in amotivation, disengagement, poorer performance, and ill-being (Behzadnia et al., 2018; Leo et al., 2022; Ntoumanis et al., 2021; Vasconcellos et al., 2020).

Teachers' interpersonal behaviours

The distinction between need satisfaction and need frustration is important as they can result in different outcomes (Vansteenkiste & Ryan, 2013). Based on SDT, the social context of teachers' interpersonal behaviours are among the most important determinants of students' need satisfaction versus need frustration (Ryan & Deci, 2020). When students feel that teachers' interpersonal behaviours are supportive of their basic needs, they experience greater need satisfaction and positive outcomes. Teachers' autonomy support refers to supporting students' choices and decision-making and providing them with options. To support students' competence, teachers encourage students to participate in the activities and improve their skills, and provide positive and informational feedback. To support students' relatedness, teachers show interest in students' activities, create a

warm environment, and make a close relationship with them. In contrast to teachers' need-supportive behaviours is teachers' need-thwarting behaviours. When teachers limit students' choices and options, pressure them to behave in certain ways, and use conditional rewards, students feel autonomy thwarting; when teachers use critical and normative feedback, students feel competence thwarting; and when teachers remain cold with students and show no interest in students' activities and their feelings, students' feel relatedness thwarting (Behzadnia, 2021; Bhavsar et al., 2019; Leo et al., 2020; Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013).

In addition to need-supportive and need-thwarting behaviours, when social contexts adopt need-indifferent behaviours, it results in negative outcomes (Bhavsar et al., 2019). Need-indifferent behaviours conceptually differ from need-thwarting behaviours. Need-indifferent behaviours are demonstrated, when teachers are unresponsive toward students' perspectives and interests (autonomy indifference), when teachers are negligence toward providing feedback and are disorganized in class activities (competence indifference), and when teachers pay no attention to students' activities or show inattentiveness toward the quality of teacher-student relationships (relatedness indifference) (Bhavsar et al., 2019; Quested et al., 2018). Examining need-indifferent behaviours would be important in online education as teachers stay far from students and may not pay attention to students' wellness and health, so students might feel that their teachers behave indifferently toward them. Research also in the area of sport has shown that need-indifferent behaviours were related to individuals' experience of need frustration and ill-being outcomes (Bhavsar et al., 2019).

Motivational regulations

Within SDT, teachers' interpersonal teaching styles and students' experience of need satisfaction and need frustration affect their outcomes through the regulatory styles of motivation (Ryan & Deci, 2017, 2020). Based on SDT, motivational regulations define in a spectrum ranging from autonomous regulation to controlled regulation and amotivation. Intrinsic motivation, on the autonomous end, refers to doing activities out of personal interest and enjoyment. Identified regulation is also autonomous motivation, which refers to doing activities because of valuing them. Introjected regulation, on the controlled end, refers to doing activities because of internal pressures such as ego involvement. External regulation is the highest form of controlled regulation that refers to doing activities because of external pressures such as rewards and expectations by others. In contrast to both autonomous and controlled regulations is amotivation, which refers to the lack of any motivation which one may believe that either the activities are not worth doing or not able to handle it. Research before the pandemic has shown that autonomous regulation was related to higher performance, intention to continue the activities, and greater well-being in PE programmes (Standage et al., 2005). In contrast, controlled motivation and amotivation were related to poorer performance, dropout intention, and ill-being (Behzadnia et al., 2018; Ntoumanis, 2005).

Well-being in PE programmes

PE programmes have been considered as an important activity to enhance students' wellbeing in either school or college, however, students' well-being has been challenged

during the pandemic (Brooks et al., 2020). While physical activity behaviours relate to the experience of greater well-being, increases in sedentary behaviours during the lockdown and guarantine would diminish individuals' well-being (P. Chen et al., 2020). Based on SDT, the experience of greater well-being would be a function of need satisfaction and autonomous regulation, whereas, the experience of ill-being is related to need frustration, controlled motivation, and amotivation (Ryan & Deci, 2017). Research before the pandemic has also shown that when social context supports students' basic needs, they experience higher need satisfaction and autonomous motivation toward healthy behaviours, as well as resulted in students' greater well-being in PE programmes (Behzadnia, 2021; Behzadnia et al., 2022; Standage et al., 2005). In contrast, teachers needthwarting behaviours (or controlling behaviours) related to higher need frustration, controlled motivation, and amotivation, as well as higher ill-being (Behzadnia et al., 2018; Ntoumanis, 2005; Standage et al., 2005). In the current study, we also explored how teachers' need-indifferent behaviours would relate to students' well-being, as well as experience of psychological needs and motivational regulations in online PE programmes.

Present study

The main goal of the present study was to examine the relation between teachers' needsupportive, need-thwarting, and need-indifferent teaching styles with students' need satisfaction and need frustration, motivations, and well-being in online college PE programmes during the pandemic. Based on SDT (Ryan & Deci, 2017), teachers' need-supportive behaviours positively relate to students' need satisfaction, autonomous motivation, and well-being, whereas, need-thwarting behaviours relate to students' need frustration, controlled motivation, amotivation, and ill-being (Howard et al., 2021). Experimental research before the pandemic has shown that teachers' interpersonal teaching styles are among the important predictors of changes in students' outcomes, for example, teachers' need-supportive teaching style positively increased students' need satisfaction and autonomous motivation over time (Cheon et al., 2012). Different social contexts have been found to change the SDT variables over time, and they can vary over time depending on the situation (Krijgsman et al., 2019). However, emerging the coronavirus has also challenged these situations. That is, research has shown that students' perceptions of teachers' interpersonal behaviours remain unchanged, but students' autonomous and controlled motivation toward healthy behaviours decreased over a semester in online school PE programmes (Behzadnia et al., 2022). Moreover, teachers' interpersonal behaviours neither positively nor negatively predicted students' motivational regulations (Behzadnia et al., 2022). Changes in lifestyle affect the experience of need satisfaction and need frustration, as well as motives and well-being during the pandemic (Behzadnia & FatahModares, 2020, 2023). Thus, before testing the main hypotheses, we aimed to explore whether variables remain stable or change over time.

Based on the SDT (Ryan & Deci, 2017), through a prospective semester-term longitudinal study, we aimed to examine how students' perceptions of teachers' interpersonal styles at the beginning of the semester (T1) predict students' basic psychological needs, motivations, and well-being at the end of the semester (T2) in online PE programmes. We expected that teachers' need-supportive teaching style at T1 positively predict students' need satisfaction, autonomous motivation, and well-being at T2, whereas, teachers' need-thwarting and need-indifferent teaching styles at T1 positively predict students' need frustration, controlled motivation, amotivation, and ill-being at T2. We next aimed to examine the indirect effects of teachers' need-supportive, need-thwarting, and need-indifferent teaching styles at T1 on students' well-being outcomes at T2 through the mediating roles of need satisfaction and need frustration, and motivational regulations at T2. We expected that teachers' need-supportive teaching style at T1 positively relate to students' well-being at T2 through need satisfaction and autonomous motivation at T2, whereas, teachers' need-thwarting and need-indifferent teaching styles at T1 positively relate to students' ill-being at T2 through need frustration, controlled motivation, amotivation at T2. We also aimed to explore some cross-paths, for example, the path from teachers' need-indifferent behaviours at T1 toward students' need satisfaction and well-being outcomes at T2.

Method

Participants and procedures

Five hundred and fifty-seven students ($M_{age} = 21.20$, SD = 1.56), age ranged from 18 to 31, including 460 females and 97 males, enrolled in online PE lessons participated at the beginning of the semester (T1) during the pandemic in Spring semester of 2020 in a local university in the north-western of Iran. PE is a mandatory course in educational systems in university studies during face-to-face lessons in Iran, similar to that of high school educational systems in North America. Because of the coronavirus pandemic, all educational lessons were held through online programmes.

Among those students who completed the questionnaires at T1 (three weeks after the beginning of the semester, N = 557), 262 (47%) of them ($M_{age} = 21.01$, SD = 1.53), age ranged from 18 to 31, including 231 females and 31 males, completed the questionnaires at the end of the semester (T2, after 13 weeks from T1). Participation in the current study was voluntary. Although attending the online lessons was not mandatory due to the students' limitation, only those students who attended 12 lessons out of 16 lessons were asked to fill out the questionnaires at T2 (n = 262) so that they were able to adequately evaluate their teachers' interpersonal behaviours (and report their basic needs, motives, and well-being) during the online PE lessons. Nine PE teachers (7 females, 2 males) age ranged from 27 to 43 years ($M_{age} = 31.82$, SD = 5.06), teaching experience ranged from 2 to 16 years ($M_{age} = 5.36$, SD = 4.25), and with teaching degrees of master (n = 7) and PhD (n = 2) in PE who taught in 18 classes (each teacher taught two classes: 9 teachers and 18 classrooms) participated in this study.

The results of Univariate analyses showed that dropout students did not differ from remaining students at T2 in all measures, except for dropout students who reported higher perceptions of teachers' need-thwarting behaviours at T1 than remaining students, F(1, 555) = 7.47, p = .006, $\eta^2 = .01$. All questionnaires created in Google Docs and were provided for students through WhatsApp mobile application. Students were explained the general goal of the study at each time point – that is, the research team aimed to investigate students' psychological status in general. The university

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review board has approved the study protocol. Consent forms were provided for all participants, and we ensured students that their responses will keep confidential and had no influence on their course grades. All questionnaires were administrated in Persian.

Online PE programmes

The main lessons in online PE included discussion about the followings (20 mins): (1) the importance of physical activity for health and well-being, especially among university students and during the pandemic, (2) the main factors of physical activity, and how to enhance them, (3) showing skilled models as examples to learn how to do correctly physical activities, (4) how to do physical activity at home (learn how to make gym equipment, for example creating dumbbells with bottles), and (5) the social, physical, and psychological benefits of physical activities. Moreover, each session included 90 mins that started with the above discussion-based lessons, continued by warming up activities (either instructor do by him/herself in online lessons, or used video of physical activity; 15 mins), then followed by the main body of session (e.g., physical fitness activities like push-up and stretching training, 40 mins), and finally the session ended by cool-down activities (e.g., relaxation, 15 mins).

This syllabus was generally used in face-to-face PE programmes in Iran, but teachers and students needed to follow them virtually during the pandemic. Moreover, according to the PE department, teachers provided live PE lessons once a week, and they asked students to do physical activities one more time (on another day during the week, they were free to do it, whenever they have availability: offline) until the end of the semester. During the live lessons, teachers interacted with students and asked them to turn on their microphone (and sometimes turn on their camera) to talk with them and asked about activities. Online lessons most of the time were live so that enabled the teachers-students interaction. It this way students had opportunities to talk with teacher and classmates and discuss about the activities. Students also could show, for example, how they do exercises and received feedback in their performances. Moreover, students can share their activities either with teacher or with their classmates in live lessons. During offline lessons, teachers send PE files (word or pdf documents related to the topics, for example, the importance of healthy behaviours as well as video of physical activities) and students could send their feedback and report their activities through WhatsApp or Adobe Connect applications.

Measures

Teachers' interpersonal behaviours: Students' perceptions of their teachers' interpersonal behaviours were assessed through the Tripartite Measure of Interpersonal Behaviors (TMIB; Bhavsar et al., 2019). The TMIB assesses three types of behaviour, need support, need thwart, and need indifference. Need-supportive behaviours included items to measure autonomy support (3 items, e.g., "Explains the reasons when he/she asks me to do something"), competence support (2 items, e.g., "Recognizes my efforts and accomplishments"), and relatedness support (3 items, e.g., "Takes interest in my welfare"). Need-thwarting behaviours included items to measure autonomy thwarting (3 items, e.g., e.g., "Completence autonomy thwarting (3 items, e.g., e.g., e.g., "Completence autonomy thwarting (3 items, e.g., e.g., e.g., e.g., "Completence autonomy thwarting (3 items, e.g., e.g., e.g., e.g., e.g., "Completence autonomy thwarting (3 items, e.g., e.g., e.g., e.g., e.g., e.g., "Completence autonomy thwarting (3 items, e.g., e.g., e.g., e.g., e.g., e.g., e.g., e.g., "Completence autonomy thwarting (3 items, e.g., e.g., e.g., e.g., "Completence autonomy thwarting (3 items, e.g., e.

"Dismisses my opinion"), competence thwarting (3 items, e.g., "Makes it clear that I have little to contribute"), and relatedness thwarting (2 items, e.g., "Deliberately ignores me"). Need-indifferent behaviours included items to measure autonomy indifferent (2 items, e.g., "Sets activities that lack variety"), competence indifferent (2 items, e.g., "Can be disorganized"), and relatedness indifferent (2 items, e.g., "Is indifferent to how I feel"). The stem of the TMIB was modified slightly to the online PE contexts, "My PE teacher in online lessons ... ". The items were rated using a 7-point scale (1 = not at all true, 7 = very true).

In this study, the TMIB was firstly translated from English to Persian by a psychologist expert in SDT and fluent in English, and then two researchers fluent in English translated the scale from Persian to English. Non-equivalences and dis-agreement between psychologists and researchers in English were discussed through a Skype meeting. To examine the construct of the TMIB, we used the Confirmatory Factor Analysis (CFA) with the T1 data. The CFA tested the proposed three-factor model for need support, need thwart, and need indifferent, but fit indices were not satisfactory, $\chi^2 = (206) 1124.38$; p < .001; RMSEA = .09; RMSEA 90% CI = .09 to .10; CFI = .90, SRMR = .07. The problem found in one item in relatedness need thwarting ("Makes it clear that he/she doesn't like me") that loaded poorly (standardized regression weighted = .23, p < .001). After removing that item, data yielded a satisfactory fit, $\chi^2 = (186) 992.10$; p < .001; RMSEA = .08; RMSEA 90% CI = .91, SRMR = .06. All items loaded above .47, p < .001.

Students' basic psychological needs: Students' experiences of their basic psychological needs were assessed through the short 12-version (Behzadnia et al., 2018) of the Basic Psychological Need Satisfaction and Need Frustration Scale (BPNSNFS; B. Chen et al., 2015). The BPNSNFS assesses the satisfaction and frustration of basic needs and each need with two items. Need satisfaction included items to measure autonomy satisfaction (e.g., "I felt that the exercises reflect what I really want"), competence satisfaction (e.g., "I felt confident that I could do the exercises well"), and relatedness satisfaction (e.g., "I experienced a warm feeling with the class members I spend time with"). Need frustration included items to measure autonomy frustration (e.g., "I felt disappointed with many of my performances"), and relatedness frustration (e.g., "I felt excluded from the group I want to belong to"). The stem for BPNSNFS was, "During online PE lessons ... ". The items were rated using a 7-point scale (1 = not at all true for me, 7 = very true for me).

The BPNSNFS has been translated and validated in previous research by Behzadnia et al. (2018). In the current study, the results of CFA with the two-factor model of need satisfaction and need frustration also yielded a good fit with the T1 data, $\chi^2 = (49)$ 155.93; p < .001; RMSEA = .06; RMSEA 90% CI = .05 to .07; CFI = .97, SRMR = .05. All item loadings were above .52, p < .001.

PE motivation: Students' motivational regulations toward PE activities were assessed through the adapted PE version (Goudas et al., 1994; Ntoumanis, 2002) of the Self-Regulation Questionnaire (Ryan & Connell, 1989). The scale assesses five types of regulatory styles, intrinsic motivation (four items, e.g., "Because PE is exciting"), identified regulation (four items, e.g., "Because I can learn skills which I could use in other areas of my life"), introjected regulation (four items, e.g., "Because I would feel bad about myself if I didn't"), external regulation (four items, e.g., "Because that's what I am supposed to do"), and amotivation (four items, e.g., "But I really feel I'm wasting my time in PE").

The stem for this scale was, "I participate in online PE lessons ... ". The items were rated using a 7-point scale (1 = strongly disagree, 7 = strongly agree). In this study, we classified items tapping intrinsic and identified regulations as a measure of autonomous regulation, and items tapping introjected and external regulations as a measure of controlled regulation. Thus, we used three styles of regulation: autonomous regulation, controlled regulation, and amotivation.

This scale has been translated and validated in previous research (Behzadnia & Ryan, 2018). In the current study, we also tested the CFA with the three-factor model of motivational regulations with the T1 data. The model was not initially satisfactory, $\chi^2 = (167)$ 1346.73; p < .001; RMSEA = .11; RMSEA 90% CI = .11 to .12; CFI = .85, SRMR = .12. Based on the modification indices, two items ("So that the teacher won't yell at me" and "Because that's the rule") that loaded poorly on their corresponding scale (controlled regulation) were removed. Modification indices also recommended allowing covariance between four items: items "Because PE is exciting" with "Because PE is fun" (r = .63, autonomous regulation items), and items "Because I want the teacher to think I'm a good" with "Because I want the other students to think I'm skillful" (r = .39, controlled regulation items). In the revised model, data yielded a good fit, $\chi^2 = (130)$ 571.46; p < .001; RMSEA = .08; RMSEA 90% CI = .07 to .09; CFI = .94, SRMR = .05. All item loadings were above .41, p < .001.

Well-Being: Students' well-being and ill-being were assessed with four Positive Affect items (e.g., "joyful" and "happy") and five Negative Affect (e.g., "worried/anxious" and "depressed") items (PANAS; Diener & Emmons, 1984). The stem for this scale was, "Please indicate how much you experienced the following states during online PE lessons ... ". The items were rated using a 7-point scale (1 = *strongly disagree*, 7 = *strongly agree*). This scale previously had been translated into Persian and reported acceptable internal reliability in the college PE domain (Behzadnia et al., 2018).

Plan of analyses

Before starting to work with data we found two outliers (the initial sample was N = 559). After removing them, the values of skewness (ranged from 2.60 to -1.73) and kurtosis (ranged from 6.82 to -.73) showed that data are normally distributed. Based on Kline's (2015) recommendation, values less than 3 and 8 for skewness and kurtosis, respectively, are not considered a non-normal data distribution. To compute the internal consistency of the questionnaires, Cronbach's alpha was used (see Table 1). To handle missing values, we used full information likelihood estimation in the main analyses. Moreover, the results of Little's (1988) MCAR test to compare students who participated at T1 with students who dropped out from T2 (retention rate = 47%) showed that the attrition rate was random at T2 (χ^2 (10) = 12.72, p = .24).

To estimate the variances at the class level, a multilevel model with 18 different teachers (557 students were nested within 18 classes) were tested. The results showed that all interclass correlations (ICC) were smaller than 0.08 (except for need thwarting at T2, ICC = .11) and non-significant, therefore, data were analysed through a one-level analysis.

Before the main analyses, we utilized a two-wave autoregressive cross-lagged longitudinal research design. That is, we tested whether variables at T2 would predict by their corresponding variables at T1 (e.g., the predictive association between teacher

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Time 1																				
1	Need support	.95																			
2	Need thwart	38	.81																		
3	Need indifferent	53	.67	.88																	
4	Need satisfaction	.48	19	23	.90																
5	Need frustration	22	.28	.25	48	.85															
6	Autonomous motivation	.53	14	24	.51	28	.96														
7	Controlled motivation	.28	.01	13	.26	05	.39	.83													
8	Amotivation	30	.26	.29	31	.38	55	11	.86												
9	Positive affect	.43	11	23	.53	31	.53	.28	35	.97											
10	Negative affect	33	.30	.32	39	.43	31	07	.35	51	.89										
	Time 2	_									_										
11	Need support	.63	42	<u>50</u>	.31	<u>25</u>	.38	.26	28	.30	29	.96									
12	Need thwart	26	.51	.38	<u>13</u>	.13	<u>18</u>	<u>14</u>	.20	02	. <u>18</u>	32	.88								
13	Need indifferent	43	.56	.55	17	.25	20	12	.19	14	.30	65	.67	.89							
14	Need satisfaction	.51	34	35	.55	29	.39	.33	22	.37	38	.63	23	43	.89						
15	Need frustration	18	.22	.19	31	.47	22	10	.20	11	.21	32	.38	.39	43	.85					
16	Autonomous motivation	.40	27	33	.37	26	.51	.33	40	.37	23	.62	22	43	.60	31	.97				
17	Controlled motivation	.28	10	19	.20	.03	.27	.58	06	.23	07	.30	01	10	.30	.01	.31	.84			
18	Amotivation	36	.30	.33	23	.24	40	17	.51	26	.30	43	.32	.44	37	.36	58	05	.90		
19	Positive affect	.41	26	35	.39	29	.40	.24	34	.47	38	.62	16	42	.63	31	.69	.29	40	.96	
20	Negative affect	27	.27	.31	29	.26	25	11	.27	19	.43	44	.27	.45	48	.54	40	09	.39	52	.89
21	Age	.06	.01	05	03	.05	.01	06	05	.06	03	.01	.01	.01	.05	03	09	.02	.02	.07	05
22	Socioeconomic status	. <u>09</u>	04	02	. <u>16</u>	<u>12</u>	.08	.07	<u>10</u>	.08	<u>10</u>	.08	05	01	.09	07	.09	03	11	.07	<u>16</u>

Table 1. Descriptive statistics, and interrelations between study variables at Time 1 (N = 557) and Time 2 (N = 262).

Notes: Bold values are significant. Values equal or above .09 are significant at p < .05, values above .15 are significant at p < .01, and values above .20 are significant at p < .001. Italic values are Cronbach's alpha.

need support at T1 and teacher need support at T2). We also used paired sample *t*-test to examine changes from T1 to T2. To examine the main hypotheses, in a full model we tested the relation between teachers' need-supportive, need-thwarting, and need-indifferent behaviours at T1 with students' need satisfaction and need frustration, motivational regulations, and well-being outcomes at T2, while controlling for T1 need satisfaction and need frustration, motivational need frustration, motivational regulations, and well-being outcomes at T2, while controlling for T1 need satisfaction and need frustration, motivational regulations, and well-being outcomes on their corresponding variables. We used the T2 scores as dependent variables and incorporate the T1 scores as control variables. To do this, the model was tested using a bias-corrected bootstrapping method (bootstrap sample = 5000) and 95% of confidence intervals (CI) (Hayes, 2013), in Mplus (Muthén & Muthén, 2010).

In addition, to assess confirmatory factor analysis (CFA) of the questionnaires and the main model fits, we used the following fit indices: The Comparative Fit Index (CFI), the Root Mean Squared Error of Approximation (RMSEA), and the Standardized Root Mean Squared Residual (SRMR). The cut-off values between .95 to .90 for CFI, between .06 to .10 for RMSEA, and between .08 to .10 for SRMR are considered a good fit and acceptable fit, respectively (Hu & Bentler, 1999; Kline, 2015).

Results

Preliminary analyses

Table 1 presents reliability estimates and bivariate correlation among the study variables. Preliminary analyses showed that age was not correlated with the study variables. Socioe-conomic status was correlated with some of the study variables. To examine mean differences between gender and sport background on the study variables, we conducted two MANOVAs. The omnibus test for mean gender differences was significant (Wilks' Lambda = .96, *F* (10, 546) = 2.40, *p* = 009, η_p^2 = .04). Compared to female students, male students reported higher perceived need support, (*F* (1, 555) = 6.52, M = .35, *p* = 011, η_p^2 = .012) and lower negative affect (*F* (1, 555) = 4.81, M = .32, *p* = 029, η_p^2 = .01). The omnibus test for mean sport background was also significant (Wilks' Lambda = .96, *F* (10, 546) = 2.33, *p* = 011, η_p^2 = .04). Compared to students who had no sport background, students with a sport background reported higher perceived need support, (*F* (1, 555) = 7.72, M = .29, *p* = 006, η_p^2 = .014), autonomous motivation (*F* (1, 555) = 11.38, M = .41, *p* = 001, η_p^2 = .02), and lower amotivation (*F* (1, 555) = 13.33, M = .43, *p* < 001, η_p^2 = .023). Thus, in the analyses, we controlled for students' socioeconomic status (SES), gender, and sport background.

Table 2 presents descriptive statistics of the variables employed in the study across both time points. The results of the autoregressive cross-lagged analysis showed that all variables at T2 were predicted by their corresponding variable at T1 (p < .001). The results of paired *t*-test showed that teacher need support, need satisfaction, autonomous motivation, and positive affect increased from T1 to T2, and amotivation decreased from T1 to T2. The remaining variables were stable from T1 to T2.

Primary analyses

To test the main hypotheses, through a path analysis we tested whether students' perceptions of teachers' interpersonal teaching styles at T1 relate to students' need satisfaction

	Tim (N=	ne 1 557)	Tim (<i>N</i> =		
	М	SD	М	SD	<i>t</i> -test
Need support	5.88	1.22	6.19	1.10	-4.119***
Need thwart	1.67	0.79	1.64	0.93	-1.333
Need indifferent	1.46	0.79	1.40	0.76	.284
Need satisfaction	5.18	1.34	5.62	1.16	-5.450***
Need frustration	2.57	1.21	2.33	1.16	1.844
Autonomous regulation	5.66	1.40	5.98	1.27	-3.053**
Controlled regulation	4.17	1.41	4.16	1.40	.840
Amotivation	2.17	1.36	1.89	1.20	2.835**
Positive affect	4.62	1.78	5.43	1.46	-7.355***
Negative affect	2.15	1.33	1.88	1.17	1.928

Tak	ole	2.	Differ	rences	between	Time	1 and	Time 2	variables.
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** p < .01, *** p < .001.

and need frustration, motivational regulations, and well-being at T2. The results of path analysis initially showed that data yielded a satisfactory fit, $\chi^2 = (61)$ 183.34; p = .048; RMSEA = .06; RMSEA 90% CI = .05 to .07; CFI = .89, SRMR = .04. To improve the model fit, modification indices suggested to add direct relations from need satisfaction toward positive affect, and from need frustration toward negative affect. After adding these paths, the final model yielded a well fit to data, $\chi^2 = (59)$ 107.47; p = .95; RMSEA = .038; RMSEA 90% CI = .027 to .05; CFI = .96, SRMR = .03. As expected, teacher need support at T1 positively predicted students' need satisfaction at T2, Unexpectedly, however, neither teacher needthwarting nor teacher need-indifferent teaching styles at T1 predicted need frustration and need satisfaction at T2. Interestingly, need satisfaction positively highly predicted autonomous motivation and moderately positively predicted controlled motivation, and negatively predicted amotivation, as well as directly positively predicted positive affect. Need frustration only positively predicted controlled motivation and amotivation, as well as directly predicted negative affect. In addition, autonomous motivation positively predicted positive affect, but neither controlled motivation nor amotivation predicted positive and negative affects (Figure 1).

In the main analysis, grounded in SDT, we controlled for the covariances between teachers' interpersonal teaching styles, between need satisfaction and need frustration, between motivations, and between positive affect and negative affect. We also controlled for the association between covariates (socioeconomic status, gender, and sport background) with all variables.

The results of indirect relations showed that teacher need support at T1 indirectly positively related to positive affect at T2 through need satisfaction and autonomous motivation at T2 (β = .05, p = .014, 95%CI = .02, .08). Teacher need support at T1 also indirectly only through need satisfaction at T2 related to positive affect at T2 (β = .06, p= .011, 95%CI = .03, .10). Need satisfaction and need frustration, and motivational regulations at T2, unexpectedly, did not mediate the relations between teachers' need thwarting and need indifferent teaching styles at T1 with students' outcomes at T2.

Discussion

In addition to helping students to be active and follow their educational programmes, a critical role of education is to support students' wellness (Ryan & Deci, 2017), especially in

background

satisfaction



Figure 1. The path model assessing the relations from teachers' interpersonal behaviours at T1 to students' well-being at T2 via students' basic psychological needs and motivational regulations at T2. The effects of T1 mediators and outcomes on their corresponding values at T2 are controlled. Values are standardized regression weights. Paths from the covariates and control variables and the correlation between variables are not shown due to model complexity. SES = socioeconomic status. Note: ***p <.001. ** *p* < .01, * *p* < .05.

regulation

Amotivation

affect

affect

regulation

online educational programmes and during difficult situations. In this study, we took an SDT approach to examine whether teachers' interpersonal teaching styles relate to students' well-being via students' experience of psychological needs and motivational regulations in online college PE programmes and during the covid-19 pandemic. Generally, the results showed that teachers' need-supportive teaching style at the beginning of the semester (T1) positively predicted students' well-being at the end of the semester (T2) through the mediating roles of students' need satisfaction and autonomous motivation at T2. Teachers' need-thwarting and need-indifferent teaching styles at T1 did not predict students' ill-being at T2. These findings suggest that teachers' need-supportive teaching style is important for students' well-being in online college PE programmes.

Consistent with SDT (Ryan & Deci, 2017), we found that teachers' need-supportive teaching style would help students to experience greater well-being in online PE education. Social contexts would contribute positively to changes in individuals' experience of greater well-being over time (Behzadnia et al., 2020). Besides, students can experience greater well-being as a function of their need satisfaction and autonomous motivation over time – that is, teachers' need-supportive teaching style play a key role in students' need satisfaction, autonomous motivation, and well-being during challenging times. In other words, when teachers support students' choice, encourage them to make decisions, provides valuable feedback, and show interests in spending time with students during online lessons, students experience higher need satisfaction, autonomously motivated toward activities, and experience greater well-being.

Unexpectedly, teachers' need-thwarting and need-indifferent teaching styles were neither directly related to students' ill-being, nor through the mediating role of students' need frustration and controlled motivation and amotivation. Neither of these teaching styles was related to students' psychological needs. One possible explanation might be related to students' access to computers or the internet. After emerging the covid-19, the university administrators informed all students that attending online lessons is not mandatory as some students did not have access to computers or smartphones to attend the lessons. So, this process might perceive by students that there is no pressure to attend, and those who attended lessons perceived their teachers' behaviour as more need-supportive than need-thwarting and even need-indifferent. The effects of social contexts on individuals' behaviours either positively or negatively have been challenged during the pandemic. Previous research also showed that social contexts might not affect individuals' goal-directed behaviours during the pandemic as much as before the pandemic (Behzadnia et al., 2022; Behzadnia & FatahModares, 2023; Bradshaw et al., 2021; Collaboration, 2022). That is, PE teachers, like other people, might affect by the stressful situation of the covid-19 outbreak, and they may feel deprived of their basic needs and experience lower well-being (Behzadnia & FatahModares, 2023; Brooks et al., 2020) – thus, this situation might cause the non-significant relation of teachers' behaviours and students' outcomes. In other words, teachers' limitations in connecting and doing daily works and exposure to stressors during the covid-19 outbreak might affect their interpersonal behaviours to not pay attention to students' psychological needs and motivational behaviours. Future experimental research designs would add to the current findings by showing how teachers' need-thwarting and need-indifferent teaching styles relate to students' psychological needs and their outcomes in online PE programmes.

It is also important to note that in the model we controlled for the associations between need support with need-thwarting and need-indifferent teaching styles. Neither teachers need thwarting nor need indifferent teaching styles predicted students' psychological needs, motivation, and well-being outcomes, whereas need supportive teaching style predicted psychological needs and well-being. Consistent with past cross-sectional research (Behzadnia et al., 2018), these results support the SDT's notion (Ryan & Deci, 2017, 2020) that teachers' need-supportive teaching style is in fact, a high quality teaching approach that strongly predicts positive outcomes in online PE programmes and during difficult situations of the covid-19 pandemic. This is important because it implies the fact that supportive environments result in students' positive outcomes even during the lockdowns and restrictions on movements.

Interestingly, we found that need satisfaction positively predicted both autonomous and controlled motivation, and negatively predicted amotivation, as well as positively predicted well-being. This is an important finding that emphasizes students' experience of need satisfaction helps them to autonomously engage in activities and experienced greater well-being in online lessons as well as decreased their amotivation. The results also showed that, unexpectedly, need satisfaction positively predicted controlled motivation. Nevertheless, students' controlled regulation significantly decreased from T1 to T2, and that decrease might affect the positive relation with need satisfaction. State differently, need satisfaction was positively related to a decrease in controlled regulation over time. Previous research also showed similar findings that need satisfaction positively related to controlled motivation in college PE programmes in cross-sectional research (Behzadnia et al., 2018). It might be that the stressors around students during the pandemic affected their external motivation, and they externally motivated toward physical activities to enhance their physical health and immune system function to not infect with the covid-19 or to not lose their score in PE – that is, need satisfaction might relate to their

internalization of controlled regulations. During the pandemic, many health organizations recommended a physically active lifestyle to have a better immune system function and to not highly suffer from the coronavirus if they are infected (external motivators). However, these need further research to more specifically examine the relations between need satisfaction and controlled regulations over time. This research, based on our knowledge, is among the first that examined the relationship between psychological needs and motivations in a semester-term longitudinal research design among college PE programmes during difficult situations of the covid-19 outbreak.

We also found that need frustration positively predicted controlled regulation and amotivation, as well as directly predicted negative affect. Like previous research among school PE students in cross-sectional research design (Haerens et al., 2015), in this semester-term longitudinal study we found that when students experienced need frustration, they did not see the importance of PE (amotivation) and attended the online lessons based on external and internal pressures (controlled regulations) over time. Moreover, when students experience need frustration, they also feel a higher negative affect. Generally, consistent with SDT (Ryan & Deci, 2017), experiencing need frustration contributes to the low quality of motivations (controlled regulation and amotivation) and ill-being over time.

The results also showed that only autonomous regulation positively predicted positive affect, but surprisingly, neither controlled regulation nor amotivation predicted wellbeing outcomes over time. It is important to note that, in the path analysis we controlled for the association between autonomous regulation with controlled regulation and amotivation. That is, in supporting the SDT notion, we found that autonomous regulation is a higher quality of motivation that results in experiencing greater well-being over time.

Finally, we found that students' perceptions of teachers' need-supportive teaching style, the experience of need satisfaction, autonomous motivation and positive affect increased from T1 to T2, as well as controlled regulation and amotivation decreased from T1 to T2. Interestingly, this result in some ways confirm our previous findings (mediational model) – that is, when students felt that their teachers support their basic needs, students' need satisfaction, autonomous motivation, and positive affect increased, and their controlled regulation and amotivation decreased. It might also be the freedom that provided for students to attend the lessons was perceived by them as a need-supportive approach. Moreover, this situation might relate to teachers' approach toward teaching in online systems. Teachers experienced online educational systems for the first time and this may affect their interpersonal behaviours toward students in online programmes - that is, to help and facilitate lessons for students, they tried to behave in a supportive way, though they may not know what does a need-supportive teaching style means. However, these need further research, perhaps in longer-term longitudinal studies or experimental research designs to figure out how teachers' interpersonal teaching styles would shape students' outcomes in online programmes and during challenging times.

Practical implications, limitations, and future research

One of the limitations of the current study was the unequal number of males and females, which need to consider in future research. The next limitation was related to collecting

data in a geographical place, in Iran, and it would be helpful to see further online PE findings among other countries, such as Australia or European and American countries. PE lessons are mandatory in university studies in Iran, and students have to pass two PE courses to graduate. Recent research before the pandemic has also shown that college face-to-face PE programmes resulted in a variety of positive outcomes (e.g., Behzadnia et al., 2018) similar to what has been found in school PE programmes around the globe (Vasconcellos et al., 2020). Enhancing students' motivation toward healthy behaviours and pursuing a healthy lifestyle is one of the most important aims of college PE programmes in Iran. In this study, we found that students can benefit from online programmes and it helps them to find activities interesting and they wholeheartedly engage in activities.

One other limitation was that we collected data at the first online course during the outbreak which might affect our findings. When people are exposed to stressors for a long time, it might reduce the effects of stressors that they felt at the first time. Thus, it would be interesting to see how social contexts and students' basic needs shape students' motivational regulations and well-being outcomes after the pandemic. Moreover, future research may test the specific variables in the path model (e.g., between autonomy need satisfaction and competence need frustration). We could not test such analysis due to the relatively small sample size at T2.

Besides the limitations, the current study has important implications for teachers and health professionals either in Iran or in other countries. The results showed that teachers' need-supportive teaching style related to students' greater well-being through the mediating role of need satisfaction and autonomous regulation. In contrast, neither needthwarting nor need-indifferent teaching style did not relate to students' outcomes. This is an important result that reveals such teaching styles would not relate to students' psychological needs, motivational regulations, and well-being outcomes, whereas, teachers' need-supportive teaching style was a promising teaching approach that contribute to students' well-being in online PE lessons and during challenging times. To increase students' well-being and autonomous motivation toward activities during challenging times, teachers can apply need-supportive behaviours by showing interest in students' choices, showing patience in students' activities and efforts, and supporting their abilities and effectiveness in doing things. At the same time, teachers would minimize thwarting behaviours by not using demanding language and negative feedback, teacher-center approaches, and do not behave coldly and superficially toward students. They can also reduce indifferent behaviours to reduce students' negative outcomes (Bhavsar et al., 2019), although these needs further research in experimental research designs.

The PE programmes before the pandemic aimed to promote students' physical, social, psychological, and healthy lifestyle through physical activities and conceptual programmes (Wuest & Bucher, 1999), but teachers and students needed to follow them virtually during the pandemic. Future research can investigate how students response to alternative programmes, virtual PE. That is, it would be interesting to know, for example, how students' motivations differ from face-to-face to online PE programmes as well as how their responses would be different with alternative contents. In addition, in this study, we adjusted T2 scores for T1 scores in testing the main hypotheses to see changes in scores over time (Dalecki & Willits, 1991). We only tested the relations

between teachers' behaviours at T1 with students' psychological needs, motives, and well-being at T2, but it would be also interesting to see how changes in psychological needs related to changes in motivational regulation and well-being outcomes over time (e.g., Kalajas-Tilga et al., 2022a, 2022b; Polet et al., 2020). Future research by analysing data through different change scores or residualized change score approaches would add to the current findings by examining how teachers' interpersonal behaviours relate to changes in students' basic needs, motives, and outcomes in online PE programmes over time.

Conclusion

Restrictions in activities cost healthy behaviours and in turn well-being (Arora & Grey, 2020; P. Chen et al., 2020), and this affects motivational quality toward activities (Behzadnia & FatahModares, 2020). In this study, we found that teachers' need support positively predicted students' well-being through students' need satisfaction and autonomous regulation over time. In contrast, teachers' need-thwarting and need-indifferent teaching styles did not predict students' psychological needs, motivations and well-being outcomes in online college PE lessons and during the pandemic.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

Data for this study is available from the corresponding author on request.

Ethical statement

The University of Tabriz Ethical Review Board approved the study.

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