The Effect of a Self-Made Vitality Intervention on Loneliness in Young Adults During COVID-19

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Abstract

The background of this research is the current increase in loneliness and the decrease in subjective vitality among young adults during the COVID-19 pandemic. The objective was to find out if a self-made intervention, aimed at increasing subjective vitality, also has an effect on loneliness and ideally decreases it. The intervention contains physical morning exercises and mental evening exercises. It assumes that the combination of both exercises is beneficial for subjective vitality, and more specifically for a decrease in stress. As stress is also a factor contributing to loneliness, the intervention is meant to also aid in decreasing loneliness. Therefore, this is a pilot study in which the mediating effect of subjective vitality on the relationship between exercise and loneliness was investigated.

A quasi-experimental design was applied, with 51 participants (mean age = 21, range: 18-24; 82.4% female, 17.6% male) taking part in the 7-day-intervention. Furthermore, they filled out a pre- and a post-test questionnaire including the Subjective Vitality Scale and the ULS-6. Data were analysed by gathering descriptive and inferential statistics, including a mediation analysis.

The analyses showed an increase in subjective vitality, a direct effect of exercise frequency on subjective vitality, and of subjective vitality on loneliness. No direct effect of exercise frequency on loneliness was found, and loneliness did not change.

It was concluded that subjective vitality was the predictor of loneliness, instead of the mediator. As the frequency of exercise was measured and not the general participation, no causal inferences could be drawn from the exercises themselves. Therefore, the increase of subjective vitality could have additional causes, and the current improvement of the COVID-19 situation might be involved. Thus, it would be beneficial to replicate the study with a control group in order to find out if participating in the intervention in general causes effects.

Key words: subjective vitality, loneliness, exercising, COVID-19

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Introduction

The current times of COVID-19 and the lockdown have taken a toll on especially younger people's health, both mentally and physically, since the majority of them usually spends a lot of time with friends and/or attends a sports club for example (Beam & Kim, 2020). These new and unusual circumstances, including multiple restrictions, imply for instance that people are not allowed to meet in person anymore, or that they cannot work out the way they usually do, for instance by doing a team-sport, or going to the gym. This means for many people that they might experience an increase in their perceived loneliness and a decrease in their amount of exercising. Generally, this leads to a decline in subjective vitality, which combines mental and physical health, and is a trend that has become visible recently (Groarke et al., 2020). Thus, the COVID-19 situation has brought about serious health issues, which is a problem that could possibly be tackled by means of an intervention. The intervention that was developed for this study focusses specifically on subjective vitality, which will be explained further in the following.

Definition subjective vitality

To give a more thorough explanation of subjective vitality, it is the positive feeling of energy, intrinsic motivation, and well-being, associated with both psychological and physical health. More specifically, a person's vitality is determined on the one hand by their mental well-being, which is influenced by different factors like the environment, the stress level, and the available amount of emotional support. On the other hand, their physical health is as important regarding subjective vitality, and it is determined by one's amount of physical activity, as well as any existing medical conditions that might impair a person's life (Ryan & Frederick, 1997). Furthermore, it is important to note that an individual's mental and physical health influence each other mutually and are in turn also mutually dependent to some extent (Kubzansky, Boehm, & Segerstrom, 2015). An example is the fact that people who engage in a high amount of exercising often also have a better mental health state than people who work

out less. Vice versa, people who have a more positive mental health state, including mindfulness and acceptance, tend to have a higher exercise maintenance than people with a lack thereof (Ulmer, Stetson, & Salmon, 2010). Further, this implies that it is important to not only engage in exercises beneficial for the body, but also for the mind, meaning relaxation or mindfulness exercises for example (Kaul et al., 2010; Midland, 2021; Wu & Buchanan, 2018). This interdependence of mental and physical health can be explained on the basis of the biopsychosocial model by George Engel (1981). It argues that someone's health is determined by genetics, mental health and behaviour, as well as the environment. More precisely, these factors do not influence someone's health each in isolation, but by being interrelated (Engel, 1981). In sum, subjective vitality combines the concepts of one's psychological and physical health, which are intertwined, and therefore describe the general composition of people's well-being.

Current increase in loneliness

One important aspect of subjective vitality on the side of mental health is loneliness. Groarke et al. (2020) found that the overall level of loneliness has increased detrimentally since the onset of the pandemic. Arslan (2020) mentions for instance the increase in loneliness that young adults experience during home-schooling, due to not feeling as connected to others anymore, which then makes their psychological adjustment to new situations like these even more difficult. Overall, vulnerable people's feelings of loneliness have increased, which is a fact that cannot be set aside. Such vulnerable people are especially younger individuals (Beam & Kim, 2020; Luchetti et al., 2020), who should be prioritised when designing supportive interventions (Groarke et al., 2020). Another factor contributing to loneliness is the stress that young adults oftentimes experience due to the large amounts of work in their studies or apprenticeship for example (Satici, 2020). Such stress increases their loneliness since it decreases their subjective vitality. Wu and Buchanan (2018) found that mindfulness exercises or meditation can effectively decrease such stress. Nonetheless, in addition to the stress

aspect, the social aspect of loneliness can obviously not be ignored, as it is of high importance to have people to talk to when trying to combat loneliness (Cacioppo & Hawkley, 2009). Overall, loneliness is one of the main issues causing mental health problems recently, especially with young adults being one of the most vulnerable groups to a decrease in subjective vitality, and thus an increase in loneliness.

Importance of physical activity

Another important aspect of subjective vitality on the side of physical health is exercising. A Belgian study (Constandt et al., 2020) states that a reduction in exercising during the lockdown can lead to serious negative implications for both the mental and physical health of the population, with people's subjective vitality decreasing significantly with their lack of exercising. Further support for the importance of physical activity is the physical activity intervention of Mavilidi et al. (2020) for senior school students, which significantly increased their subjective vitality. Additionally, Biddle and Ekkekakis (2005), but also Mikkelsen et al. (2017), found evidence that a physically active lifestyle also positively contributes to mental health in general, as it decreases stress for example. Because stress is a factor contributing to loneliness (Satici, 2020), this serves as support for the idea that loneliness could most likely also be affected by physical exercises, next to the earlier mentioned mindfulness exercises. Thus, it can be said that a physically active lifestyle might most likely also aid in decreasing loneliness, while increasing subjective vitality. In order to stop the problematic trend of declining physical activity and thus subjective vitality, preventive measures and intervention programs, like online exercise support, could be applied to encourage people to continue, or start, exercising (Constandt et al., 2020). If such measures and programs made people exercise regularly, their subjective vitality would become high or stay on a higher level, which highlights the importance of physical activity with regards to people's well-being.

The mediating role of subjective vitality

Subjective vitality oftentimes mediates the relationships between other variables. For instance, the earlier mentioned relationship between loneliness in young adults and their psychological adjustment to new and unusual circumstances is mediated by their subjective vitality (Arslan, 2020). This means that the loneliness of these individuals affects their subjective vitality, and additionally their subjective vitality affects their psychological adjustment. Therefore, they might feel lonely, which lowers their subjective vitality, and this then also impairs their psychological adjustment. There have also been other research examples of subjective vitality being a mediator. To elaborate, Akın and Akın (2015) found out that subjective vitality mediates the relationship between friendship quality and subjective happiness. Moreover, Uysal et al. (2014) found that subjective vitality partially mediates the relationship between life satisfaction and subjective happiness. Based on all the above-mentioned information, the current research explored the possibility of subjective vitality mediating the relationship between exercises and loneliness. More precisely, the influence of exercises on both loneliness and subjective vitality was substantiated in the previous paragraph with the example of stress, and the influence of subjective vitality on loneliness was explained by loneliness being connected to subjective vitality. These lines of reasoning substantiate the function of subjective vitality as the mediating variable, or working mechanism, in this research as well.

The self-made intervention

With the goal of possibly increasing subjective vitality, employing it as the mediator, and ideally decreasing loneliness in young adults, an intervention was developed of a short video including physical exercises, and a short audio including mental relaxation exercises. Short-time exercises meant to increase subjective vitality have proven to be effective in past studies like the one of Mavilidi et al. (2020), which serves as support for the current intervention's length (see Method section). Physical exercises were included because physical

activity is beneficial for both aspects of subjective vitality, namely physical health (Ryan & Frederick, 1997), but also mental health (Biddle & Ekkekakis, 2005; Mikkelsen et al., 2017). Since this is a pilot study, the chosen exercise regimen has not been tested before and is composed of exercises that the researchers deemed effective from their own experience. In addition to that, as mentioned earlier, it is also important to engage in relaxation exercises and apply breathing techniques or meditation for example. This can be especially helpful during stressful times, based on the assumption that breathing exercises decrease stress levels, improve concentration, and even decrease sleep need (Kaul et al., 2010; Midland, 2021; Wu & Buchanan, 2018). Thus, the inclusion of mental exercises was done mainly in order to reduce stress, which is a major factor contributing to loneliness and low subjective vitality (Satici, 2020). Therefore, the intervention that was developed for this study includes not only physical but also mental exercises, which are both further described in the Method section and can be found in Appendix C.

Research aim

Based on the information above, the relationship between the variable loneliness and the frequency of exercise one engages in (both mentally and physically) is mediated by the variable subjective vitality. This relationship is displayed in figure 1.

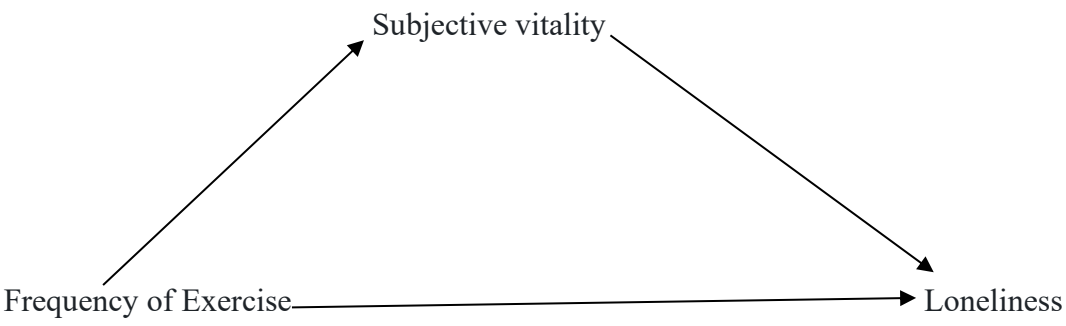

Figure 1. *Relationships between subjective vitality, loneliness, and frequency of exercise*

With regards to the importance of physical and mental health for young people during the pandemic, a clear research aim can be formulated, which will be explained in the following. The aim of this research is to find out if there is an effect of a self-made vitality intervention on loneliness in young adults, placed within the context of COVID-19. It was decided to focus on subjective vitality mediating the relationship of exercises and loneliness, because subjective vitality describes the composition of people's general well-being and has been found to take on the role of the mediator several times before. The intervention contains both physical and mental exercises in order to target exactly this concept. Loneliness was chosen as an important aspect because of its connection to subjective vitality and the aforementioned increase due to COVID-19. Young adults were chosen since they have been named as being most vulnerable to loneliness. The research question based on the abovementioned information is:

"What is the effect of an intervention meant to increase subjective vitality on loneliness in young adults during the coronavirus pandemic?"

The hypotheses resulting from the research question are:

"Regularly (twice a day) taking part in the 7-day-intervention increases subjective vitality from pre- to post-test."

"Regularly (twice a day) taking part in the 7-day-intervention decreases loneliness from pre- to post-test."

"Subjective vitality mediates the relationship between exercise and loneliness."

Method

Design

A quasi-experimental design was employed. A control group was not established because this is a pilot study. There was one independent variable (exercise), which was computed into a count variable because the frequency of the participants' exercising was measured. Furthermore, loneliness was the dependent variable and subjective vitality was the

mediating variable, and both were computed as continuous variables. Since this research is a co-production with Leon Dannenberg (2021), there were more variables than used in this specific study, which were “Spiritual Wellbeing” and “Physical Self-Efficacy”.

Participants

The sample included 51 adults aged between 18 and 24. An age of 18-25 was the only inclusion criterion in this study. Most of the participants were women (82.4%). All other participants were identified as male (17.6%). The mean age of participants was 21 (range: 18-24). Furthermore, most of the participants were students (94.1%), while every other participant was employed (5.9%). Moreover, the majority of participants reported living in a shared household (39.2%). Everyone else stated that they lived with their parents (33.3%), alone (13.7%), or with their partner (13.7%). Further, most participants stated that neither they or a close one had been infected with COVID-19 (66.7%), but there were some cases were participants reported that they had been infected with COVID-19 (3.9%) or where a close one had been infected with COVID-19 in the past (29.4%).

Ethical approval (file number 210392) was obtained from the dedicated committee at the UT before recruitment began. During recruitment, participants were selected based on the opportunity-sampling method. This was enabled through the SONA-systems survey network of the University of Twente (UT). In addition to this, the researchers asked individuals from their social surroundings. However, the researchers were also aware that this sampling method might have introduced bias into the study. Nevertheless, this method was chosen as participants were easily found because they would get 0.5 credits after completion of the study. These credits are necessary for students at the UT to complete their degree. The recruitment text of the study was as follows:

“Have you been feeling down lately and do you want to feel more energized? Then this study might be for you! We would like to invite you to participate in our 7-day intervention, which is meant to enhance your subjective vitality. There will be two

questionnaires that you will have to fill out, one before and one after the intervention. The intervention itself comprises morning and evening exercises at 5 minutes each."

Materials

The questionnaire consisted of four different scales and was administered via the platform Qualtrics. It had to be filled in either via computer, mobile phone, or other devices able to establish an internet connection. The scales measuring physical self-efficacy and spiritual well-being were used for parallel research and were therefore irrelevant for this research (Dannenberg, 2021). Two scales were used in this study to measure loneliness and subjective vitality, since the mediating effect of subjective vitality on the relationship between loneliness and exercises is of interest here.

The short-form UCLA Loneliness Scale (ULS-6; Appendix A) (Nazzal, Cruz, & Neto, 2018; Neto, 1992), consisting of 6 items, was used to measure the participants' loneliness. For this, a 4-point Likert scale was used, ranging from 1 (*never*) to 4 (*often*). One example of the 6 items is: *"I lack companionship."* The item *"I feel part of a group of friends."* is reverse scored. The Cronbach's alpha of the ULS-6 was .77 (Nazzal, Cruz, & Neto, 2018), whereas the current result for the pre-test was .61 and for the post-test .69, indicating that the reliability was not as high and only just acceptable.

To measure subjective vitality, the Subjective Vitality Scale (Appendix B) by Ryan and Frederick (1997) was used. This scale originally measures subjective vitality with 7 items on a 6-point Likert scale, ranging from 1 (*not at all true*) to 6 (*very true*). However, one item was excluded as it proved to be unreliable because of its negative wording (Ryan & Frederick, 1997). Hence, only 6 items were included in the final version of the questionnaire. One example of the 6 items is: *"I feel alive and vital."* The Cronbach's alpha of the Subjective Vitality Scale was .84 (Ryan & Frederick, 1997), which is similar to the current results of .89 for the pre-test and .84 for the post-test, indicating a high reliability.

Procedure

The whole intervention started with an introductory email from the researchers after completion of the first questionnaire via Qualtrics (see Appendix A and B for the questionnaires). With this email, participants were provided with all the materials necessary to complete the intervention. The materials were provided in the form of a video (physical exercise) and audio clip (mental exercise) on YouTube (see Appendix C for the materials), ensuring fast and easy access for the participants. In the email, it was stated that participants are free to choose between doing the physical exercises they were provided with or to do other physical exercises that were more to their liking and more appropriate for their fitness level. It should be noted that the participants were asked in the pre-test to write down if they left out any exercises during the intervention. After seven days, when they filled out the post-test, they were asked to indicate whether they did the exercises or not. They also needed to state whether they used the provided material or different exercises, with the tick of a box.

Intervention

If the participants chose to follow the provided material, they had to do a 5-minute workout that varies in intensity depending on the individual fitness level of the participant. This was ensured by showing them different variations for the same exercise in the video. At first, participants needed to stretch themselves in different ways for one minute. Subsequently, they were asked to do as many push-ups as possible for one minute. Afterward, they had to plank for one minute, followed by one minute of squats. Lastly, they had to stretch themselves again for one minute in the end. During the video, a voiceover explained to them how to complete each activity in different variations successfully. Participants were told to complete these exercises shortly after waking up to feel awake and alert as early as possible in their day. If the participants chose to do other exercises, it was expected of them to do that particular exercise for at least 5 minutes with a subjectively increased heart rate, meaning that

they did not need to measure their heart rate during the exercise, but rather have a feeling of being physically active.

For the mental exercise, participants were expected to listen to the audio clip at least once to get an understanding about what is expected from them. The whole premise of this exercise was to ensure that participants experience 5 consecutive minutes of deep relaxation with an inward focus. First, they could breathe in through their nose for 4 seconds, hold their breath for another 7 seconds and then breathe out for 8 seconds through their mouths. Another option for the participants was to focus on their bodily sensations (focus on parts of their body) for 5 minutes if they wanted to do so. If they felt comfortable doing that activity, they were also allowed to do the exercise themselves without the audio. Participants were also explicitly told to do these exercises right before going to bed to feel more rested and to have a potentially enhanced sleep.

To conclude, these specific physical and mental tasks were chosen because they tackle the physical and mental aspect of subjective vitality and they are fairly easy to adjust to the individual levels of fitness and/or personal preferences. In general, 5 minutes were seen as a sufficient duration for both exercises because on the one hand, the tasks are fairly easy and limited time-wise, which counteracts a high drop-out rate (De Feo, 2013) and on the other hand, they are also effective if they are done regularly (Stamford, 1998).

Data analysis

For the data analysis, SPSS version 26 was used. Before starting with the analysis, some data had to be removed because participants did not give their consent or did not finish the questionnaire. Further, the scoring of the second item of the ULS-6 had to be reversed for the analyses. Next, Cronbach's alpha was computed to estimate the scales' reliability. If a survey consists of less than ten items the minimum acceptable alpha score is > 0.5, which is necessary to prove the test's reliability (Pallant, 2013). The aim of this research was to find out if loneliness (DV) decreased after employing a vitality intervention consisting of physical

and mental exercises (IV), which was designed to enhance subjective vitality (mediating variable). For the independent variable exercise, the frequency of the participants' exercising, and thus their regular adherence to both the physical and mental exercise program, was counted daily over the time span of seven days and was then summed up into a count variable. The times that the participants only did the morning or the evening exercises in a day were also summed up for comparison. Further, the percentages of the participants' exercising behaviour were computed to illustrate the findings. In order to find out about a possible increase in subjective vitality and decrease in loneliness, a within-subjects approach was applied, and descriptive statistics were gathered for the dependent and mediating variables for both the pre- and post-test. Furthermore, the means of the variables from pre- to post-test were compared with a paired samples t-test, and their effect sizes (Cohen's *d*) were calculated with a within-subjects calculator (Effect Size Calculator, n.d.) to show the practical significance of the results. To investigate the hypothesis that subjective vitality mediates the relationship of the independent and the dependent variable a between-subjects approach was chosen, and a mediation analysis was conducted for the post-test results, on the basis of the macro of Hayes (PROCESS macro for SPSS and SAS, n.d.). Finally, Pearson's *r* was calculated based on a within-subjects approach again, to find out about possible significant correlations between variables.

Results

Regarding the independent variable exercise, the sum of all times that the 51 participants did the exercises regularly is 229, which equals 64.15% of the seven days. The times that they only did the morning exercises in a day sum up to 46, which is 12.89%. Lastly, the times that they only did the evening exercises in a day sum up to 82, which makes up 22.97% of the time.

With regards to the descriptive data, the means of the total scores of the pre- and post-test are being shown in table 1. The statistical comparison by means of a paired samples t-test

follows. Regarding subjective vitality, a statistically significant difference between means was found from after the intervention (M = 4.20, SD = 0.67) compared to before the intervention (M = 3.79, SD = 0.94) [t (50) = -2.53, p = .014], indicating an increase in the level of subjective vitality. For subjective vitality a Cohen's d of 0.36 was calculated, indicating a small effect size. For the variable loneliness no statistically significant difference between means was found from the pre-test (M = 5.57, SD = 0.51) to the post-test (M = 1.49, SD = 0.37) [t (50) = 1.59, p = .119], indicating that the level of loneliness did not change. For loneliness, a Cohen's d of 0.23 was calculated, which also indicates a small effect size.

Table 1.

Descriptive Data

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Subjective Vitality Pre-Test	51	1.50	6.00	3.79	.94
Subjective Vitality Post-Test	51	2.33	6.00	4.20	.67
Loneliness Pre-Test	51	4.67	6.50	5.57	.51
Loneliness Post-Test	51	4.50	6.67	5.42	.53
Valid N (listwise)	51				

The results of the mediation analysis with subjective vitality as the mediator are displayed in figure 2. The path (direct effect) from exercises to subjective vitality was positive and statistically significant (b = .13, $s.e.$ = .05, p = .011), indicating that the intervention had an influence on the participants' subjective vitality. Next, the direct effect of subjective

vitality on loneliness was negative and statistically significant (b = -.35, *s.e.* = .11, p = .003), indicating that participants with higher subjective vitality might be more likely to have a lower level of loneliness. Lastly, the direct path from exercises to loneliness was positive and statistically non-significant (b = .00, *s.e.* = .04, p = .959), indicating that the frequency of exercise did not have an influence on the level of loneliness.

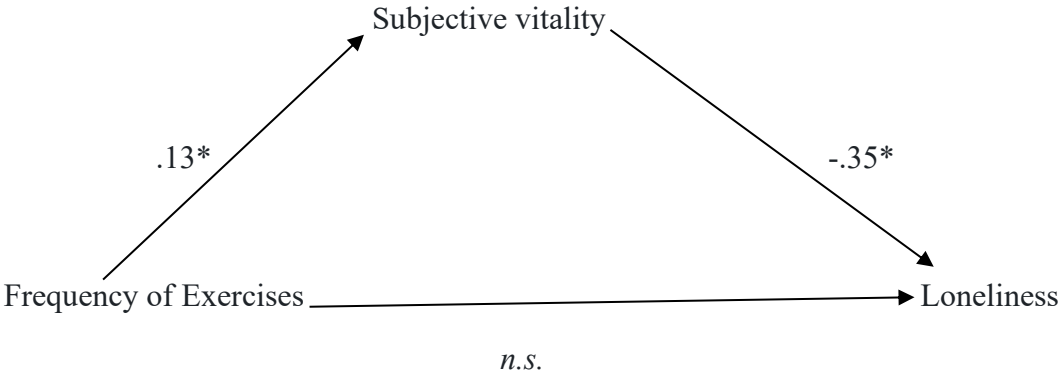

Figure 2. *PROCESS Analysis for Post-Test *= p < 0.05*

With regards to Pearson's *r,* a statistically significant negative correlation was found in the pre-test between subjective vitality and loneliness, $r(49)$ = -.39, p = .005. Furthermore, in the post-test another statistically significant negative correlation was found between subjective vitality and loneliness, $r(49)$ = -.44, p = .001.

To summarize, the participants' level of subjective vitality increased, while the level of loneliness did not change from pre- to post-test. A mediation analysis yielded the result of a significant predictive relationship from exercises to subjective vitality, as well as from subjective vitality to loneliness in the expected direction. The direct effect of exercise on loneliness was non-significant. A correlation analysis showed that there were statistically significant correlations between subjective vitality and loneliness in both the pre- and post-test, and the calculation of Cohen's *d* showed small effect sizes for both subjective vitality and loneliness.

Discussion

Key Findings

The aim of this research was to find out what kind of effect a self-made intervention meant to increase subjective vitality has on loneliness in young adults during the COVID-19 pandemic. According to the results, the participants did the exercises regularly during more than half of the time of the intervention. Further, the level of loneliness did not increase from pre- to post-test, but subjective vitality increased. It should be noted that the effect sizes for both these variables from pre- to post-test were small, which indicates that the practical significance of the results is also small. Moreover, the PROCESS analysis showed a direct effect from exercises on subjective vitality, and from subjective vitality on loneliness. This suggests that the frequency of exercise had an influence on the increase of subjective vitality, and that increased subjective vitality indicated lower loneliness in the participants. Significant correlations between subjective vitality and loneliness before as well as after the intervention was applied indicate that the intervention did not have an effect on the relationship between the two variables. Out of the three hypotheses, one can be accepted with certainty, namely that regularly taking part in the intervention increases subjective vitality from pre- to post-test. The second hypothesis that regularly taking part in the intervention decreases loneliness must be rejected, as there was no change in the level of loneliness to be found. The third hypothesis that subjective vitality mediates the relationship between exercise and loneliness must be rejected as well, since there was no direct effect of the frequency of exercise on loneliness.

Interpretation

Firstly, it can be said that the participants took part quite regularly in the intervention, and the increase in subjective vitality can certainly in part be attributed to the exercise frequency, because of the significant direct effect that was found. This is also supported by the numerous sources stating that exercises have a positive influence on subjective vitality (Biddle & Ekkekakis, 2005; Mavilidi et al., 2020; Ryan & Frederick, 1997). The small effect

size within the subjects' level of subjective vitality from pre- to post-test should not be ignored, but is has to be said that a large effect size would have been more surprising, considering the implementation of a completely new intervention. Even though the effect size is small, the increase cannot be overlooked. It should be noted that there could have also been other factors influencing subjective vitality in addition to the intervention, for instance the participants' personal circumstances with a positive event occurring, like a good grade or a birthday for instance. Furthermore, the current decrease of COVID-19 cases and measures might make people feel livelier and more hopeful again. This can be based on the biopsychosocial model (Engel, 1981), since COVID-19 can be seen as an environmental factor that influences the psychological and physical aspects of the participants. It is important to state that the absence of a control group does not allow to say with certainty that the intervention itself influenced subjective vitality, since the independent variable exercise in this case focusses on the frequency of exercise and is therefore entirely different of the general participation in the intervention. This means that there is a lack of information about if the participation would have an effect on the participants' subjective vitality and loneliness because no baseline level of both those variables is available to compare with the experimental group, and therefore no real causal inferences can be drawn here.

Regarding loneliness, the initially stated relationship between exercises and the stress aspect of loneliness did not occur in this research because loneliness did not decrease (Mikkelsen et al., 2017; Satici, 2020). Nevertheless, the social element to loneliness cannot be disregarded and might play a more important role than the stress aspect, which would then portray an alternative explanation as to why there was no change to be detected (Cacioppo & Hawkley, 2009). Thus, it could most likely be the case that the exercises are simply not suitable to effectively decrease loneliness since no direct effect was found here. Further proof for this is the fact that the correlation between subjective vitality and loneliness was present in both pre- and post-test, which means that the frequency of exercise did not influence the

relationship between subjective vitality and loneliness. With regards to this relationship, the results indicate that high subjective vitality in the participants equals lower loneliness levels. This finding is in line with the assumption that loneliness and subjective vitality are connected since loneliness is of high importance with regards to mental health, which is a part of subjective vitality (Ryan & Frederick, 1997). This is why subjective vitality cannot be high, while loneliness is also high and vice versa.

When considering the initially assumed mediating effect of subjective vitality, the variable can rather be seen as the predictor for decreased loneliness instead of the mediator here because of the missing direct effect of exercise frequency on loneliness. This predictor role can be partly explained by earlier mentioned findings. To elaborate, Satici (2020) found that stress contributes to loneliness, which can be combined with the fact that subjective vitality is influenced by stress (Ryan & Frederick, 1997). Since higher subjective vitality indicates decreased stress, or at least higher stress resistance (Ryan & Frederick, 1997), it can be concluded that participants with higher subjective vitality experience less stress and might thus feel less lonely compared to participants with lower subjective vitality. This then supports the predictor role, which can also be based on the interdependence of mental and physical health (Kubzansky, Boehm, & Segerstrom, 2015) and more specifically the biopsychosocial model (Engel, 1981), since they show how easily the psychological and bodily functions are influenced by each other and also environmental factors. However, the papers of Arslan (2020), Akın and Akın (2015), and Uysal et al. (2014) discussing subjective vitality as a mediator do unfortunately not support the current results, as the previous assumptions do not hold. This could possibly be attributed to the fact that the assumed mediating effect does simply not exist in this relationship between the frequency of exercises and loneliness.

Implications

Considering the implications of this study, one main aspect stands out. While the previously discussed research focusses mainly on subjective vitality as a mediator, these findings demonstrate that subjective vitality works in several ways, namely also as a predictor variable. Therefore, regarding the practical relevance of this research, this finding highlights the possibility of 'using' subjective vitality to influence and ideally decrease loneliness. It also shows that the social aspect should not be disregarded when wanting to decrease loneliness (Cacioppo & Hawkley, 2009). Moreover, the findings may be useful for researchers looking into the direction of subjective vitality and/or loneliness especially in young adults. Questions that arise could for example deal with factors that are important for a decrease in loneliness, like the social element, or factors that are important for both a low level of loneliness and a high level of subjective vitality. Next to this, different organizations could consider this study for tailoring future vitality or loneliness interventions, or also exercise programs more precisely to the needs of young adults, in order to possibly improve the well-being of a large group of people further during this current time of uncertainty. Thus, they could even consider using the self-made exercise regimen. Finally, on the individual level, this paper might bring clarity to the reader with regards to one's own vitality and view on the importance of regular exercise because it has hopefully become clear that regular exercise is important to support and maintain one's overall health, both physically and mentally. It could also be that a participant liked the exercises and continues to do them, or at least incorporates some of them into their daily life, for instance the breathing exercise before going to sleep.

Strengths

Considering the strengths of this study, the main strength is the self-made intervention. Since this was a pilot study and this specific composition of exercises was still new, it was unclear if the intervention would yield any outstanding results at all. Therefore, it is even more satisfactory that the participants' subjective vitality increased. This shows that the

design was, at least to some extent, effective and that the combination of physical and relaxation exercises was a suitable choice. The substantiation of the intervention is solid, since the physical exercises are based on several sources stating that physical activity is beneficial for the overall well-being and health (Biddle & Ekkekakis, 2005; Mavilidi et al, 2020; Mikkelsen et al., 2017), and the relaxing breathing exercises are also based on multiple sources supporting that mindful breathing is useful for relaxation, concentration, and energy (Kaul et al., 2010; Midland, 2021; Wu & Buchanan, 2018). Another positive aspect is that the data proved to be reliable and is relatively easy to analyse.

Limitations and suggestions for future research

With regards to the limitations, the most important one is probably the absence of a control group due to this research being a pilot study for the intervention. This made it impossible for 'cause and effect'-insights to arise, as including a control group could show if the general participation in the intervention would influence subjective vitality and loneliness. A baseline level of subjective vitality would have been established with which the experimental group could have been compared. Furthermore, the research in general would have been improved and also validated (Moser, 2019). Thus, one of the main suggestions for future research is the inclusion of a control group.

Another limitation could possibly be the time frame of one week for the intervention since this might have been relatively short. A time frame of one month could have yielded different results since the level of loneliness might take longer to change than subjective vitality, especially since the social aspect mentioned by Cacioppo and Hawkley (2009) was not considered in this study, which has a considerable influence on the level of loneliness. This can be seen as another limitation, namely the lack of the social aspect of loneliness. Future research could focus on this aspect in combination with the stress aspect that Satici (2020) mentioned and could possibly develop a new effective intervention aimed at decreasing loneliness.

Another point are the aforementioned life circumstances that differ from individual to individual. Those might additionally influence subjective vitality or feelings of loneliness, for instance if someone currently suffers from an illness or injury, or has recently had a fight with a close one. This might be solved by asking the participants in the post-test questionnaire to indicate if anything serious or emotionally straining happened during the time span of the intervention.

Next, the generalizability of the findings is not that high, since most participants were students from Germany, which is not very representative for many people. For future research, collecting a sample from a more diverse background, including different professions for example, would make the results more generalizable. Another suggestion would be to also widen the age range, or to choose a completely different age range to investigate the effects of this intervention and to be able to investigate how the results differ between age groups, since the living circumstances are most often very different between young and old adults (Franssen et al., 2020). Franssen et al. (2020) also suggest that every age group would need a specifically tailored approach to achieve a decrease in loneliness, which further supports this suggestion.

As a final aspect, the trust in participants could be an issue because participants could lie and say they did the exercises, even though they did not. A solution to this could be ensuring the participants in the study information that it is okay if they do not do exercises, but that it is important for them to stay truthful and state this in the post-test. In addition to this, the exercise data could be collected in a different way, for instance by means of a heart rate monitor, as this would almost guarantee that participants do not “cheat” on the study. It should be noted that this would entail a higher cost and is not as easy to implement, since the heart rate monitors must be given to the participants somehow, and the participants must additionally be instructed in how to use them.

Conclusion

The implemented intervention, meant to target subjective vitality and indirectly target loneliness in young adults during the current global pandemic, yielded the expected results to a certain extent. The first of the three hypotheses was accepted, namely that subjective vitality increased from pre- to post-test through regularly taking part in the intervention. It should be noted that the exercise frequency influenced subjective vitality, but it is unclear if the general participation also would have, as no control group was established. Additionally, there was also a direct effect of subjective vitality on loneliness, indicating that a high level of subjective vitality implied a lower level of loneliness, even though there was no overall change in loneliness to be found. Subjective vitality thus became a predictor instead of a mediator since the intervention did not influence loneliness, which means the second and third hypotheses must be rejected. This predictive relationship is a valuable insight because it highlights the fact that subjective vitality is very multi-faceted and it also supports the view that mental, physical and environmental aspects do not influence someone's well-being separately, but rather as a whole. The implications this entails address especially other researchers interested in the variables and their relations, and furthermore organizations developing interventions to increase subjective vitality, decrease loneliness, and therefore support people during this difficult current time. The social aspect contributing to loneliness also came up in the discussion of such new interventions, since the current study only considered the stress aspect of loneliness. This is one of the elements that future studies could address, but the main recommendation for future research was to replicate the study with the inclusion of a control group. Finally, it can be said that the study showed that regular adherence to the self-made intervention influenced participants' subjective vitality, but it did not influence their loneliness. Somewhat unexpected but useful results are provided, that will hopefully emphasize the importance of physical and mental exercising for everyone's health,

and also encourage people to exercise regularly if possible, even if it is only the breathing exercise before sleep.

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Appendix A

ULS-6

UNIVERSITY OF TWENTE.

Please read the following statements carefully and try to answer them as honestly as possible.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I lack companionship.	○	○	○	○	○
I feel part of a group of friends.	○	○	○	○	○
I feel left out.	○	○	○	○	○
I feel isolated from others.	○	○	○	○	○
I am unhappy being so withdrawn.	○	○	○	○	○
People are around me but not with me.	○	○	○	○	○

Appendix B

Subjective Vitality Scale

UNIVERSITY OF TWENTE.

Please read the following statements carefully and try to answer them as honestly as possible.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I feel alive and vital.	○	○	○	○	○
Sometimes I am so alive I just want to burst.	○	○	○	○	○
I have energy and spirit.	○	○	○	○	○
I look forward to each new day.	○	○	○	○	○
I nearly always feel awake and alert.	○	○	○	○	○
I feel energized.	○	○	○	○	○

Appendix C

Intervention Materials

https://www.youtube.com/playlist?list=PL8HiMAGXUpyErBXpUeMs_mNeGA5H-v1ou