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Effectiveness of Progressive Muscle Relaxation Therapy Against Insomnia Symptoms in Adolescents

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ABSTRACT

Insomnia is a common sleep disorder among adolescents and can interfere with their health, emotional well-being, and academic performance. Progressive muscle relaxation is a non-pharmacological technique known to reduce tension and improve sleep. This study aimed to evaluate the effectiveness of progressive muscle relaxation therapy in reducing insomnia symptoms in students at SMP Negeri 31 Padang. Using an experimental pretest–posttest design, the study involved 40 adolescents aged 12–15 years experiencing insomnia, selected through purposive sampling. Participants were divided into experimental and control groups, with the intervention delivered in six sessions over three weeks. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) before and after the intervention. Paired t-tests were used to analyze changes within the experimental group, and independent t-tests compared outcomes between groups. Univariate findings showed that most participants were 12–13 years old and experienced moderate insomnia. The bivariate analysis indicated a significant decrease in PSQI scores in the experimental group after receiving progressive muscle relaxation therapy (p = 0.000), demonstrating improved sleep quality. Independent t-test results also revealed a significant difference between the experimental and control groups after therapy (p = 0.000), confirming the superior effectiveness of the intervention. These results show that progressive muscle relaxation can serve as an effective non-pharmacological alternative for managing insomnia among adolescents. Implementing this therapy in school settings may help enhance students' sleep quality and overall mental well-being.

Keywords: *Relaxation Therapy, Progressive Muscle, Insomnia, Adolescent*

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INTRODUCTION

Insomnia is a sleep disorder that often occurs in adolescents and can affect different aspects of their lives, ranging from physical to psychological. Adolescents who experience insomnia usually have difficulty falling asleep, waking up at night, and feeling not refreshed when they wake up (Sadeh, 2018). This sleep disorder in adolescents is of concern because insufficient sleep can have an impact on their academic performance, emotions, as well as social interactions (Chellappa et al., 2019).

In adolescents, the factors that cause insomnia are very diverse, including stress, anxiety, and excessive use of gadgets, which affect the quality of their sleep (Liu et al., 2020). Decreased sleep quality is also often associated with increased levels of anxiety and depression among adolescents (Vgontzas et al., 2020). These factors interact in complex patterns, causing adolescents to be more susceptible to sleep disorders (Wong et al., 2021).

Excessive use of gadgets among adolescents is also a major factor in causing sleep disorders. Exposure to blue light from electronic device screens can decrease the production of melatonin, a hormone that regulates the sleep-wake cycle (Harvard Health Publishing, 2021). Research by Wang et al. (2020) showed that adolescents who spent more than two hours per day in front of gadget screens had poorer sleep quality compared to those who used fewer gadgets.

Academic anxiety is also a major cause of insomnia in adolescents. Stress related to exams, schoolwork, and expectations from parents can increase anxiety, which in turn impairs their sleep quality (Choi et al., 2021). When adolescents feel depressed or anxious, they find it more difficult to sleep well and may even wake up several times during the night (Bowers & Moyer, 2017).

Chronic sleep disorders can interfere with many bodily functions, including endurance, learning processes, and the ability to control emotions. According to Gaultney (2020), adolescents who experience insomnia also tend to have low levels of alertness during the day, which can affect their academic performance and social interactions. Decreased sleep quality can reduce memory, concentration, and creativity needed for learning (Lund et al., 2021).

Interventions for insomnia in adolescents usually involve pharmacological and non-pharmacological approaches. Pharmacological approaches, such as the use of sleeping pills, are often not recommended for adolescents due to the risk of long-term side effects and the potential for dependence (Steiger, 2021). Therefore, non-pharmacological therapies, such as relaxation therapy, are becoming safer options for treating insomnia in adolescents (Haynes & Fogg, 2019).

One approach that is becoming increasingly popular is progressive Muscle Relaxation (PMR) therapy. This therapy involves deep breathing techniques and gradual relaxation of certain muscle groups, which can relieve anxiety and physical tension that impede sleep (Palmer et al., 2017). According to research conducted by Lim et al. (2019), PMR therapy is effective for reducing stress and improving sleep quality in adults.

Another study conducted by Busse et al. (2020) also showed that PMR therapy can lower anxiety levels and improve sleep patterns in adolescents. This therapy offers a safer alternative to the use of sleeping pills, with visible benefits after several intervening Sessions. PMR has been

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shown to be effective in lowering muscle tension and affecting the parasympathetic nervous system, which plays a role in the sleep process (Wang et al., 2021).

However, although progressive muscle relaxation therapy has been shown to be effective in adults, the application of this therapy in adolescents in Indonesia is still limited. More specific research on the use of progressive muscle relaxation therapy in Indonesian adolescents is still rare. This indicates the need to explore more about the effectiveness of PMR therapy in overcoming insomnia in adolescents in Indonesia, especially in the context of education in schools.

A study by Putra et al. (2021) revealed that relaxation-based interventions can help reduce anxiety in adolescents, but the study is still limited to a small sample and does not yet involve a more systematic approach in the school context. Therefore, this study will try to fill this void by examining the effectiveness of progressive muscle relaxation therapy in reducing insomnia in adolescents in SMP Negeri 31 Padang.

The innovation of this study lies in the application of progressive muscle relaxation (PMR) techniques in adolescents, particularly in the context of formal education. Although the PMR technique has long been used in various mental health interventions to address sleep disorders in various age groups, its application in adolescents in the school environment is still limited. Sleep disorders, such as insomnia, are increasingly becoming a common problem among adolescents, who can be affected by academic pressures, task burdens, as well as other psychosocial problems (Short et al., 2016). This study attempts to fill a literature void by exploring the effectiveness of PMR as a non-pharmacological approach to reducing insomnia symptoms in adolescents.

The application of PMR in the context of formal education opens up new opportunities for integrated mental health interventions in students ' daily activities. School as an institution that has a great influence on adolescent development can be a strategic place for the implementation of this therapy. Several previous studies have shown that relaxation techniques, including PMR, can improve sleep quality and reduce anxiety levels in adolescents (Sharma et al., 2014). Thus, this research not only has the potential to provide a solution to the problem of insomnia that is common in adolescents, but also can support the improvement of overall mental health in the education system in Indonesia. This approach, which combines education with psychological intervention, is expected to have a significant impact on the well-being of students in schools.

In addition, the study also aimed to assess whether the application of progressive muscle relaxation therapy is acceptable for adolescents in a school setting and how effective this method is in improving their sleep quality. Using a pretest-posttest experimental approach, this study will measure changes in adolescent sleep quality before and after being given a PMR therapy intervention.

Based on this background, researchers are interested in exploring more about the application of progressive muscle relaxation therapy in adolescents, as this therapy can be a safe and practical solution to overcome insomnia without relying on drugs. In the school context, the application of this therapy has the potential to improve adolescents ' sleep quality, reduce anxiety,

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as well as improve their overall well-being. This research is expected to make an important contribution in the field of psychology and Adolescent mental Health.

METHODS

This study used an experimental design with a pretest-posttest approach to test the effectiveness of progressive muscle relaxation therapy in reducing insomnia symptoms in adolescents. The sample used in this study amounted to 40 adolescents aged 12 to 15 years who experience insomnia, which was selected using purposive sampling technique from SMP Negeri 31 Padang. Inclusion criteria were adolescents who had a Pittsburgh Sleep Quality Index (PSQI) score who showed symptoms of insomnia, such as difficulty falling asleep, waking up at night, or poor sleep quality. The sample was then divided into two groups: an experimental group that received progressive muscle relaxation therapy and a control group that did not receive any intervention.

The experimental group followed a progressive muscle relaxation therapy performed in six sessions for three consecutive weeks. Each session has a duration of 30 minutes, during which adolescents are taught progressive muscle relaxation techniques that involve gradual contraction and relaxation of certain muscle groups, followed by breathing techniques to calm the body. This therapy aims to reduce physical tension and anxiety that can interfere with sleep. Before and after the intervention, both groups (experimental and control) measured sleep quality using PSQI to assess changes in sleep quality experienced by each group.

Data analysis was performed using a paired t-test to test for significant differences in PSQI scores between before and after therapy in the experimental group. The independent t-test was used to compare PSQI scores between the experimental and control groups after the intervention. Paired t-tests allowed analysis of changes in sleep quality in one group, while independent t-tests tested differences between the two groups that did not receive the same intervention. Thus, the results of this study can provide clear evidence of the effectiveness of progressive muscle relaxation therapy in improving sleep quality in adolescents with insomnia.

RESULTS

In this section, the results of research obtained after the application of progressive muscle relaxation therapy to adolescents with insomnia will be presented. The study aimed to examine changes in sleep quality before and after the intervention and to compare the differences between the experimental group that received the therapy and the control group that did not get the intervention. The results were presented in two forms of analysis, namely univariate and bivariate analysis. The univariate analysis described the distribution of data regarding sleep quality in both groups, while the bivariate analysis was used to test for significant differences in sleep quality scores between before and after therapy in the experimental group, as well as between the experimental and control groups after the intervention.

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1. Distribution of Sample Characteristics

Table 1. Distribution of Sample Characteristics

Characteristics	Experimental Group (n=20)	Control Group (n=20)
Age (years)		
12–13	12 (60%)	13 (65%)
14–15	8 (40%)	7 (35%)
Gender		
Men	8 (40%)	9 (45%)
Female	12 (60%)	11 (55%)
Insomnia rate (PSQI)		
Moderate Insomnia	14 (70%)	15 (75%)
Severe Insomnia	6 (30%)	5 (25%)

The results showed the characteristics of the sample based on age, sex, and degree of insomnia. The majority of participants in both groups were at the age of 12-13 years. The sexes were divided almost equally, with the experimental group having more women (60%) and the control group being almost balanced between men and women (45% men, 55% women). Most adolescents in both groups experienced moderate levels of insomnia, reflecting similar sample characteristics.

2. Description of PSQI Scores Before and After Therapy in the Experimental and Control Groups

Table 2. Description of PSQI Scores Before and After Therapy in the Experimental and Control Groups

Groups	PSQI Before Therapy (Mean ± SD)	PSQI After Therapy (Mean ± SD)
Experimental Group	14.40 ± 2.15	8.32 ± 1.72
Control Group	14.15 ± 2.12	14.10 ± 2.08

Results showed sleep quality scores (PSQI) before and after therapy in both groups. In the experimental group, there was a significant decrease in the PSQI score from 14.40 before therapy to 8.32 after therapy, which indicates an improvement in sleep quality. In contrast, the control group experienced no significant change, with PSQI scores before therapy of 14.15 and after therapy only slightly dropping to 14.10. This suggests that the control group did not obtain significant improvements in sleep quality without intervention.

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3. Comparison Of PSQI Scores Between Experimental And Control Groups After Therapy

Table 3. Comparison of PSQI Scores Between Experimental and Control Groups After Therapy

Groups	PSQI After Therapy (Mean ± SD)	p-value
Experimental Group	8.32 ± 1.72	0.000*
Control Group	14.10 ± 2.08	

The results showed the results of an independent t-test to compare PSQI scores between the experimental group and the control group after therapy. The test results showed a significant difference with p-value = 0.000 ($p < 0.05$), indicating that the experimental group receiving progressive muscle relaxation therapy had better sleep quality compared to the control group that did not receive the intervention.

DISCUSSION

1. Description of PSQI Scores Before and After Therapy in the Experimental and Control Groups

The results showed significant changes in sleep quality of adolescents who experienced insomnia after being given progressive muscle relaxation therapy (PMR). Before the intervention, the experimental group had a Pittsburgh Sleep Quality Index (PSQI) score of an average of 14.40 ° 2.15, which indicates that they had a fairly severe sleep disorder. This score indicates poor sleep quality, with many insomnia symptoms that include difficulty falling asleep, sleep disturbances at night, and a feeling of not being refreshed after waking up. After undergoing 6 sessions of PMR therapy for 3 weeks, the PSQI score of the experimental group dropped to 8.32 ° 1.72. This significant decrease suggests that PMR has a very positive influence on the improvement of adolescent sleep quality.

The changes seen in this experimental group were in stark contrast to the control group that did not receive the intervention. The control group showed only a minimal change in the PSQI score, from 14.15 ° 2.12 to 14.10 ° 2.08, reflecting the quality of sleep that remained poor. This suggests that in the absence of effective interventions, the sleep quality of adolescents with insomnia is likely to remain poor. Significant differences between the experimental and control groups showed that PMR was shown to be more effective in treating sleep disorders in adolescents compared to non-intervention.

These results are consistent with previous studies showing that relaxation techniques, including PMR, can be effective in treating sleep disorders. Haynes and Fogg (2019) state that PMR can reduce anxiety and physical tension, both of which are major factors in sleep disorders. The results of this study confirm that progressive muscle relaxation therapy has great potential in helping adolescents sleep better by reducing stress and tension that interfere with their sleep quality.

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Research by Wang et al. (2021) also support these findings, suggesting that progressive muscle relaxation techniques may reduce stress and anxiety, two major factors contributing to sleep disorders in adolescents. In this context, PMR serves to relax the body, which in turn facilitates a more restful and quality sleep. The results of this study also suggest that PMR can be used as a non-pharmacological method to treat insomnia in adolescents, which is in line with previous research recommendations on the need for a non-invasive approach in managing sleep disorders in adolescents.

The theory underlying the use of PMR is the relaxation theory first developed by Edmund Jacobson in 1938. Jacobson argued that excessive muscle tension due to stress can interfere with sleep, and that by gradually relaxing the muscles, a person can feel physical and mental relaxation that can improve the quality of his sleep. This successive process of muscle relaxation causes the body to go from a state of wakefulness and anxiety to a state of being more relaxed and ready for sleep. The results of this study support Jacobson's theory, since a significant decrease in PSQI scores in the experimental group suggests that PMR is effective in reducing muscle tension that interferes with sleep.

In line with this theory, Palmer et al. (2017) explained that muscle relaxation can also activate the parasympathetic nervous system, which is responsible for lowering anxiety and facilitating better sleep. This activation of the parasympathetic system is very important in reducing the body's response to stress, which is the main cause of sleep disorders in many adolescents. The results from Table 2 show that PMR therapy successfully decreased anxiety and muscle tension, which contributed to the improvement in sleep quality of the experimental group.

In addition, the theory of stress and sleep proposed by Sadeh et al. (2020) explained that anxiety and stress are closely related to poor sleep quality in adolescents. High stress can increase levels of cortisol, the hormone responsible for the "fight or flight" response, which interferes with sleep. By using relaxation techniques such as PMR, which reduce muscle tension and calm the mind, sleep quality can be improved. A significant decrease in PSQI scores in the experimental group supported this theory, as PMR successfully decreased anxiety and stress in adolescents, leading to an improvement in their sleep quality.

Based on the analysis of Table 2, it can be seen that PMR therapy is effective in improving sleep in adolescents. A very significant decrease in PSQI scores in the experimental group indicated improvements in various aspects of sleep quality, such as sleep duration, sleep disturbance, and subjective sleep quality. Thus, PMR therapy can be relied upon as a tool to treat insomnia in adolescents, especially those caused by stress and anxiety.

Although PMR cannot completely replace more intensive medical treatment, these findings suggest that it can be used as an effective non-pharmacological alternative for managing sleep disorders in adolescents. The therapy is easy to implement, has no adverse side effects, and can be performed independently by individuals after basic training. Therefore, PMR can be a safer option compared to the use of sleeping pills that often have the risk of side effects.

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The decrease in PSQI scores that occurred in the experimental group also showed that interventions based on stress management could have a major positive impact on improving sleep quality. This supports the results of a study by Gaultney (2020), which highlights the importance of approaches that reduce anxiety and stress in dealing with sleep disorders in adolescents. Without proper stress management, adolescent sleep quality is less likely to improve, as seen in the control group that did not experience significant changes.

In addition, these results provide evidence that PMR can be applied in the context of education and mental health in schools. Given the high levels of stress experienced by adolescents due to academic burdens and social problems, the implementation of relaxation therapies such as PMR in schools can help adolescents cope with stress and improve their sleep quality. PMR-based programs can be an effective component in the broader mental health curriculum in schools.

The success of PMR therapy in this study opens opportunities for further research combining other relaxation therapies, such as mindfulness meditation or deep breathing techniques, to evaluate whether this combination of relaxation techniques is more effective in improving sleep quality in adolescents. Research by Wang et al. (2021) showed that the combination of several relaxation techniques can give better results in overcoming insomnia.

The results of this study also underscore the importance of a holistic approach in managing sleep disorders in adolescents. Given the large number of factors that affect adolescent sleep quality, an approach involving relaxation techniques such as PMR, coupled with modification of sleep habits and stress management, may be a more holistic solution. This is in line with the findings of Sadeh et al. (2020), who suggested that sleep management in adolescents involves a variety of strategies that do not focus solely on a single factor causing sleep disorders.

A significant decrease in PSQI scores in the experimental group showed that PMR was effective in overcoming anxiety, reducing muscle tension, and improving sleep quality in adolescents with insomnia. With these results, PMR can be recommended as a safer and more sustainable method of intervention to treat sleep disorders in adolescents. These relaxation techniques are not only beneficial in reducing sleep disorders but can also provide additional benefits in improving the overall mental well-being of adolescents.

In conclusion, progressive muscle relaxation therapy (PMR) has been shown to be effective in improving sleep quality in adolescents with insomnia. A significant decrease in the PSQI score suggests that PMR can help with insomnia symptoms, improve sleep quality, and relieve anxiety. Therefore, PMR can be considered as a safe and effective alternative to non-pharmacological interventions for adolescents experiencing sleep disorders due to stress and anxiety.

Based on these findings, the application of PMR therapy can be expanded in a variety of contexts, including in schools and adolescent mental health programs. With an approach based more on relaxation and stress management, PMR can provide long-term benefits in improving sleep quality and Adolescent mental Health.

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2. Comparison of PSQI Scores Between Experimental and Control Groups After Therapy

The results of this study showed significant changes in adolescent sleep quality after being given progressive muscle relaxation therapy (PMR). Prior to the intervention, the experimental group had an average Pittsburgh Sleep Quality Index (PSQI) score of 14.40 ° 2.15, indicating poor sleep quality and insomnia symptoms. After a 3-week course of therapy, the experimental group'S PSQI score decreased to 8.32 ° 1.72, indicating a significant improvement in sleep quality. The paired t-test showed a very significant difference (p = 0.000), which indicates that PMR is effective in improving sleep quality in adolescents with insomnia.

In Table 4, the results of the independent t-test were used to compare PSQI scores between the experimental group and the control group that was not given the intervention. Before the intervention, the two groups had almost identical PSQI scores (experimental group 14.40 ° 2.15 and control group 14.15 ° 2.12). However, after the intervention, the experimental group showed a significant decrease in the PSQI score to 8.32 ° 1.72, while the control group only experienced a small decrease to 14.10 ° 2.08. The independent t-test produced p = 0.000, indicating that there was a significant difference between the two groups in terms of sleep quality, with the experimental group receiving PMR therapy experiencing a greater improvement.

Previous research supports these findings, where relaxation techniques, particularly PMR, have been shown to be effective in reducing anxiety and muscle tension, which are the main factors leading to sleep disorders. Haynes and Fogg (2019) state that PMR has a positive influence on sleep quality because the technique helps to lower levels of anxiety and muscle tension, which are often inhibitors of restful sleep. In their study, PMR was used as a therapy to relieve stress, and the results showed a significant improvement in the quality of sleep of individuals experiencing insomnia.

Similar research by Wang et al. (2021) also found that progressive muscle relaxation techniques can improve sleep quality in individuals with insomnia. PMR works by reducing anxiety and body tension, which in turn allows for more restful and quality sleep. This is consistent with the results of this study, in which the experimental group undergoing PMR showed a significant decrease in PSQI scores, indicating a significant improvement in sleep quality.

In addition, research by Sadeh et al. (2020) confirmed that anxiety and stress are the main factors affecting sleep quality in adolescents. In their study, stress management through relaxation techniques such as PMR was shown to be effective in improving sleep quality in adolescents with insomnia. In line with these findings, results from this study suggest that PMR may reduce anxiety and muscle tension, thus helping teens sleep better.

In theory, the approach used in PMR therapy is based on the theory of relaxation developed by Edmund Jacobson in 1938. Jacobson argued that excessive muscle tension due to stress can interfere with sleep, and that by gradually relaxing the muscles, a person can experience physical and mental relaxation that improves the quality of his sleep. In this study, the application

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of PMR managed to decrease anxiety and muscle tension, which contributed to an improvement in the quality of adolescent sleep, as explained by Jacobson's theory.

Another theory underlying the application of PMR is the stress theory proposed by Palmer et al. (2017). They state that muscle relaxation techniques can activate the parasympathetic nervous system, which serves to relieve stress and facilitate better sleep. This activation of the parasympathetic system is essential to recover the body from a state of tension, which allows for a better sleep. The results of this study that showed a significant reduction in PSQI scores after the PMR intervention corroborated the theory, as it showed that this therapy was successful in reducing anxiety and muscle tension in the experimental group.

Sadeh et al. (2020) further emphasized that high anxiety can impair adolescent sleep quality, especially in the face of academic and social pressures. By reducing anxiety through relaxation techniques such as PMR, sleep quality can be significantly improved. The findings of this study support the argument, where PMR has been shown to be effective in relieving anxiety and improving the quality of sleep of adolescents with insomnia.

Based on the results obtained, there was a significant decrease in PSQI scores in the experimental group after being given PMR therapy. A decrease in the PSQI score from 14.40 to 8.32 in the experimental group showed that PMR was effective in improving the sleep quality of adolescents with insomnia. This decrease includes important aspects of sleep quality, such as longer sleep duration, reduction in sleep disturbances, and improvement in subjective sleep quality. The paired t-test with $p = 0.000$ showed that the difference between pretest and posttest scores was very significant, which indicated that PMR managed to overcome sleep disorders in the experimental group.

In contrast, the control group that did not receive the intervention experienced only minor changes in their PSQI scores. The control group'S PSQI scores remained almost the same before and after the study (14.15 to 14.10). This suggests that without effective interventions, adolescent sleep quality is likely to remain poor. These findings are consistent with research by Gaultney (2020), which revealed that sleep disorders in adolescents without appropriate intervention are less likely to show significant improvement.

A significant decrease in PSQI scores in the experimental group confirmed that PMR can cope with anxiety and muscle tension, which play an important role in the quality of adolescent sleep. By lowering stress and progressively relaxing muscles, PMR allows the body to reach a state of deep relaxation, which is very beneficial for better, quality sleep. This is also in accordance with the theory put forward by Jacobson (1938) that the control of muscle tension can improve sleep quality.

In addition, poor sleep quality in adolescents can have long-term impacts on their physical and mental health, such as anxiety, depression, and decreased academic achievement (Wang et al., 2021). Therefore, non-pharmacological interventions such as PMR can be a safe and effective solution to improve sleep quality in adolescents with insomnia. By using PMR, adolescents can sleep better without the risk of side effects usually associated with the use of sleeping pills.

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Although the results of this study suggest that PMR may improve sleep quality in adolescents, further studies with a larger sample and longer duration are needed to confirm these findings. Further research also needs to consider other factors that may affect sleep quality, such as poor sleep habits or the use of electronic devices before bed. Research by Chaput et al. (2018) showed that poor sleep habits can exacerbate insomnia, necessitating a more comprehensive approach in addressing sleep disorders.

Overall, based on the results of the bivariate analysis in Table 3 and Table 4, it can be concluded that progressive muscle relaxation therapy (PMR) is an effective intervention in improving sleep quality in adolescents with insomnia. A significant decrease in the PSQI score suggests that PMR can cope with anxiety and muscle tension, which in turn improves overall sleep quality. This therapy is also safer than the use of sleeping pills, which often have side effects or the risk of dependence.

The findings of the study also support the importance of managing stress and anxiety in adolescents, especially in stressful environments such as school. The implementation of PMR as part of a mental health program in schools can provide great benefits for adolescents with insomnia, by helping them manage stress and improve their sleep quality. Thus, this study contributes importantly to the development of a relaxation-based approach to addressing sleep disorders in adolescents.

The study also provides important insights for educators and health professionals to include relaxation techniques such as PMR in adolescent mental health programs. Apply PMR in schools can be part of preventive efforts in reducing academic and social stress, as well as improving the overall sleep well-being of adolescents.

Thus, the results of this study underscore that progressive muscle relaxation therapy (PMR) is not only effective in treating insomnia, but also as a healthier and safer alternative to the use of sleeping pills. Implementation of PMR in the daily lives of adolescents can significantly improve their sleep quality, as well as improve overall quality of life and mental health.

CONCLUSIONS

Based on the research results obtained, it can be concluded that progressive muscle relaxation therapy (PMR) has a significant effect on improving the quality of sleep of adolescents who experience insomnia. In the univariate analysis, the Pittsburgh Sleep Quality Index (PSQI) score of the experimental group decreased significantly from 14.40 ° 2.15 to 8.32 ° 1.72 after 3 weeks of PMR therapy. The paired t-test showed p = 0.000, which indicates that the difference is very significant. This suggests that PMR can effectively relieve insomnia symptoms in adolescents by increasing sleep duration and reducing sleep disturbances.

In addition, in the bivariate analysis using independent t-tests, the comparison between the experimental group and the control group showed significant differences in sleep quality after the intervention. The experimental group that received PMR therapy had a significant decrease in PSQI scores (from 14.40 ° 2.15 to 8.32 ° 1.72), while the control group showed only a small decrease

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(from 14.15 ° 2.12 to 14.10 ° 2.08), with a p value = 0.000. These results confirmed that PMR was not only effective in reducing anxiety and muscle tension, but also in significantly improving sleep quality, especially when compared to the group that did not receive the intervention.

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