Sleep science

EVALUATION OF TIMING AND RESPONSES TO PHYSIOTHERAPEUTIC TREATMENT

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ABSTRACT

In several treatment regimens, the recognition of chronobiology contributes to the therapeutic process through the effective use of temporization protocols. The purpose of the present study was to evaluate the relationship between the response to physiotherapeutic treatment and the time of day when such treatment was performed, as well as the chronotype of orthopedic and rheumatologic patients in a clinical physiotherapy school. The population studied was treated in the morning and evening periods. The patients were divided into three groups of pathologies with similar treatments, which were as follows: syndrome of shoulder impact (n=33), knee artrosis (n=17), and lombalgia (n=23). At the end of ten treatment sessions, data concerning pain, percentage of subjective improvement, chronotype, and age were compared. At the end of the study, it was observed that the time of day when treatment was performed influenced the results of individuals treated in the evenings but had no influence on the individuals treated in the morning. In addition, the evening schedule was the most well suited for intermediate individuals.

Key words: Physiotherapy, Chronobiology, Chronotype, Chronotherapy.

INTRODUCTION

The functions of the human body are rhythmic and typically follow a 24 hour cycle (1). These cycles, called circadian rhythms ('approximately one day'), represent a critical adaptation of the human body to environmental stimuli (2).

People prefer different schedules to perform their activities. Some feel good waking up very early; others feel better waking up later. Some prefer practicing physical activities in the evening, whereas others do not feel good practicing physical exercises at such late times. The biological concept determining these extreme individual differences in temporal preference is called chronotype (3).

It is known that, in several treatment regimens, chronobiology can contribute to the course of therapeutics through effective temporization protocols (4). In the case of physiotherapy, the determination of an optimal schedule for physiotherapeutic treatment could lead to the patient's early release and even to a better outcome.

Some studies have reported that synchronization with the environment and the maintenance of an internal temporal order is necessary for human physiological fitness and normal behavior (5). Therefore, disturbances in both internal and external temporal states may lead to health problems.

The purpose of the present study was to evaluate the relationship between the response to physiotherapeutic treatment and

the time of day when such treatment was performed. In addition, the chronotype of orthopedic and rheumatologic patients under treatment was compared for their responses to treatment performed in the morning period (during the day) versus that performed in the evening.

SUBJECTS AND METHODS

The population studied comprised all the orthopedic/rheumatologic patients treated both in the morning and evening periods in a clinical physiotherapy school located in Santa Catarina, Brazil, for a period of one year. Patients whose clinical diagnoses included syndromes of shoulder impact, knee artrosis, and lombalgia were included in the sample.

Criteria for excluding patients from the study were as follows: 1) patients who had not attended two or more consecutive treatment sessions; 2) a serious evaluation/revaluation error in the patient's records had been committed, thus preventing a comparison between the initial and final data; 3) the patient was under 18 years old.

The evaluations were based on the patient's records and the Horne and Ostberg's questionnaire on morningness-eveningness (HO) (6). The records included data on evaluation, treatment, and revaluation of patients in relation to the following variables: subjective degree of pain intensity and patient's subjective improvement.

A 10 cm visual analog scale (EAV) was utilized for measuring subjective pain. In brief, the patient was instructed to draw a vertical line at the point corresponding to the pain that he/she felt. For performing the comparison calculation, the value (in centimeters) for the revaluation was deducted from the value found in the initial evaluation.

For measuring the percentage of patient's subjective improvement, the individual was asked the following question: "What is, in your opinion, the percentage of your improvement (from zero to 100%) since you have started the physiotherapeutic treatment?" This value (according to the patient's own opinion) was taken as the patient's subjective improvement score.

The daily period for treating the morning group ranged from 8:00 to 11:00 h and from 18:30 to 21:30 h for the evening group. The HO was delivered to patients on their first visit, and they were briefed on every item in the questionnaire and of its respective contribution to the research. The participants answered the questionnaire at home and returned it upon the following visit. For the purposes of analysis, at the end of ten visits, the patient's revaluation was performed based on the same parameters used for the initial evaluation. The physiotherapeutic procedures utilized for treatment of each pathology group were the following:

- Group A (syndrome of shoulder impact): continuous ultrasound therapy with intensity ranging from 0.5 to 0.7 W/cm^2, strengthening of the rotator cuff with the use of thera-band®, and upper limbs proprioception.

- Group B (knee artrosis): application of shortwave therapy, exercises for strengthening lower limbs with leg warmers, and exercises for stretching lower limbs.

- Group C (Lombalgia): application of shortwave deep heat on the lombar spine, exercises for stretching the trunk back muscles, exercises for stretching the lower limbs, lombar and cervical spine pompages, and final relaxation.

Data were analyzed in a descriptive way so as to allow a comparison. In addition, a cluster analysis was conducted in order to group similar individuals under measured variables, such as chronotype, pain before and after treatment, absolute pain, self-evaluation, age, and HO scores. PAST ® software was utilized for these analyses.

In the revaluation, Spearman's linear correlation index was utilized to correlate the values with respect to pain, and the percentage of subjective improvement was calculated with the use of the software mentioned above. This test was performed with a 5% significance level and a 95% confidence level. A Wilcoxon test for dependent samples was utilized to check the existence of two similar populations and performed with a 5% significance level and 95% confidence level, according to Triola (7). Statdisk® software was utilized in this analysis.

The individuals who agreed to participate in the study signed a Free and Informed Consent Form. The present study was approved by the UNISUL Ethics Committee under register number 05.182.4.08.III.

RESULTS

A total of 211 patients participated in the present study, including 140 females (66.35%) and 71 males (33.65%). The average age was 43.41 years (± 14.33 years); the minimum age was 18.50 years; and the maximum age was 77.83 years. Out of this population, there were 88 intermediate individuals (I), 83 moderate morning-oriented individuals (MM), 21 moderate evening-oriented individuals (ME), 16 extreme morning-oriented individuals (EM), and 3 extreme evening-oriented individuals (EE) according to Horne and Ostberg's classification.

Considering these inclusion and exclusion criteria, the 74 samples were composed of 33 individuals that were classified under Group A, 18 under Group B, and 23 under Group C (Table 1).

Table 1 - Distribution of patients according to pathologies with similar treatments and chronotypes.

Chronotype	Group A	Group B	Group C
MM	20	7	11
EM	3	2	0
I	9	6	11
ME	1	3	1

MM = moderate morning-oriented; EM = extreme morning-oriented; I = intermediate; ME = moderate evening-oriented

In regard to chronotype, 50% of the male patients and 62% of the female patients were morning-oriented (MM and EM). A larger number of evening-oriented subjects were found among the male population in the present study (Table 2). The male group showed an average HO score of 56.8 (±11.15), and the female group showed and average score of 58.42 (±8.8). The Wilcoxon test showed a significant difference between these two groups ($p < 0.001$).

Table 2 - Distribution of patients according to chronotype and sex.

Chronotype	Male		Female	
	n	%	n	%
MM	9	37,5	29	58
EM	3	12,5	2	4
I	9	37,5	17	34
ME	3	12,5	2	4

MM = moderate morning-oriented; EM = extreme morning-oriented; I = intermediate; ME = moderate evening-oriented

The HO average score for individuals aged below the median (median = 45.88 years; n = 37) was 54.46 (±10.06), and the average score for those aged above the median was 61.32 (±7.82). The Wilcoxon test confirmed the existence of a difference between these two groups ($p < 0.001$). The first group mentioned included 15 morning-oriented individuals (EM and MM) and 5 evening-oriented individuals (ME). The second group included 28 morning-oriented individuals (EM and MM), and no evening-oriented individuals. The morning-oriented individuals corresponded to 40.54% of the first group and to 75.67% of the second group (EM and MM).

In addition, in the sample studied (n = 74), the older participants were predominantly morning-oriented individuals. Hence, when considering the median as the dividing factor, the younger group included around 40% of morning-oriented individuals, while the other group included 75% of morning-oriented individuals and no evening-oriented individual.

Male and female individuals reported similar complaints related to pain at the beginning of treatment. The percentage of male individuals who reported feeling 'almost no pain' was higher than the percentage of female individuals who reported the same (8.3% in the male group and 2% in the female group). Among the patients who reported 'severe pain', the percentage of male individuals was higher than the percentage of female individuals (50% in the male group and 44% in the female group), according to the qualitative pain classification mentioned before.

Despite the apparent similarity existing between the values found in the male and female groups, the Wilcoxon test showed a significant difference between the two groups ($p < 0.001$).

At the end of treatment, both groups showed similar variations. The male group maintained a higher percentage of individuals who reported feeling 'almost no pain' compared to the female group (41% in the male group and 36% in the female group). However, there was an inversion in the percentage of male and female individuals in the group that reported 'severe pain'. In this group, the rates of male individuals were lower than those of female individuals (4% in the male group and 10% in the female).

According to the EAV, the average pain among male individuals was 5.7 (±2.8), and the average pain among female individuals was 6.1 (±2.6). The minimum and maximum values were 0.0 and 10 for both sexes, respectively; the mode for the male sex was equal to 7, and that for the female sex was 5.5. In the revaluation, the average pain for the male sex was 2.2 (±2.3), and that for the female sex was 2.8 (±2.6). For the male sex, the minimum and maximum values were 0.0 and 9.5, respectively, and the respective values for the females were 0.0 and 10. The mode was equal to 0.0 for both sexes.

The percentage scores for subjective improvement showed a significant difference for the group of female patients who were treated in the morning compared to the female group who was treated in the evening ($p<0.001$). Nevertheless, 27 female patients included in the group treated in the evening (65.85%) showed a subjective improvement of 70% or above. On the other hand, in the groups treated in the morning (7MM, 1 EM, and 1I), only 3 individuals (33.33%) showed such a high percentage of subjective improvement (2MM).

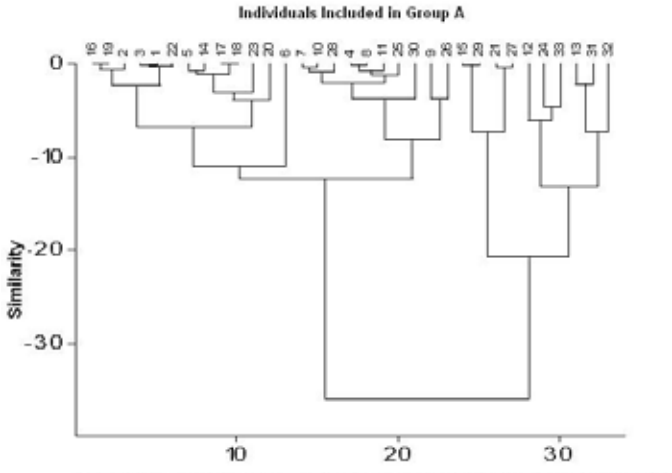
In the male group, the percentages of subjective improvement were also significantly different among those treated in the morning compared to those treated in the evening ($p<0.001$). Nevertheless, similar to the results of the female group, the majority of male patients treated in the evening (72.22%) showed a subjective improvement of 70% or above. However, in the morning groups (2 MM, 2 EM and 2 I), only 4 patients (66.67%) showed such a high percentage of subjective improvement.

By applying the Spearman's linear correlation test with a 95% confidence level ($\alpha=0.05$) and by comparing the value of the pain upon revaluation and the patient's subjective improvement, a negative correlation from moderate to severe could be observed among the female patients ($r_s = -0.57$; $p < 0.000$), and the same was observed in relation to male patients ($r_s = -0.56$; $p < 0.01$). Such analysis indicates the existence of a strong correlation between pain at the end of treatment and the value for the patient's subjective improvement. When comparing the group of patients who received treatment in the evening, the same negative correlation could be observed ($r_s = -0.57$; $p < 0.000$). A strong negative correlation could also be observed in the group of individuals treated during the daily period ($r_s = -0.69$; $p=0.004$).

It was also observed among the male individuals that there was a larger percentage of subjects who reported feeling 'severe pain' compared to female individuals (50% and 44%, respectively). However, during the revaluation, the number of male individuals who reported feeling 'almost no pain' was larger than the number of female patients (41.7% and 36%, respectively). Since the statistical test showed a significant difference, it appears that the female individuals in the present study were more prone to pain than the male individuals.

In the dendrogram analysis, the individuals included in groups A, B, and C were grouped according to the degree of pain present at the time of revaluation and the percentage of subjective improvement. In Group A, the treatment time did not seem to exert any influence upon moderate morning-oriented individuals. The best time for treating ME individuals was the daily schedule. For I individuals, the best time was the evening schedule. In the case of the single ME individual in this group, no influence concerning the time of the day when treatment was performed could be observed. In Group B, the schedule did not seem to have any influence upon morning-oriented individuals. In regard to I individuals, the best time was the evening schedule, and the same was observed concerning ME individuals. In Group C, the schedule seemed to have almost no influence on MM individuals. For the I and ME individuals included in this group, the best time was the evening schedule (Figures 1, 2, and 3).

Figure 1.

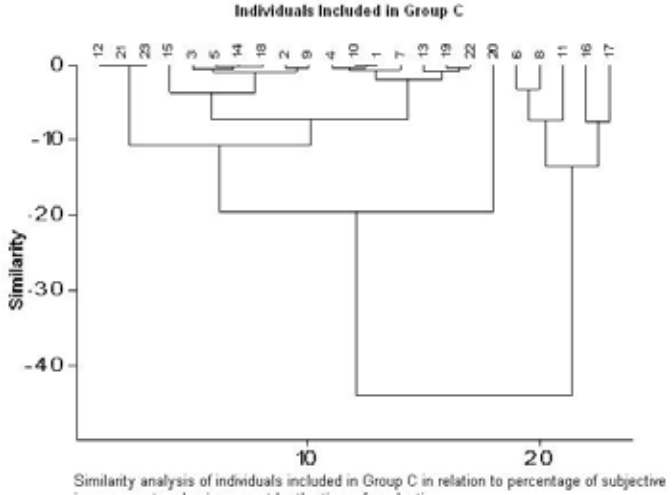


Similarity analysis of individuals included in Group A in relation to pain present by the time of revaluation and percentage of subjective improvement

Figure 2.

Similarity analysis of individuals included in Group B in relation to percentage of subjective improvement and pain present by the time of revaluation

Figure 3.



Similarity analysis of individuals included in Group C in relation to percentage of subjective improvement and pain present by the time of revaluation

DISCUSSION

The results of the present study corroborate other findings related to the Brazilian population selected. Such results confirm that morning preference prevails among the female sex when compared to the male sex. Therefore, the HO values for the female sex were higher than those for the male sex (8). As observed in the literature, the results of the present study showed that, as a person gets older, the tendency for morning preference increases significantly (9).

Some studies show consistent differences in the perception of pain according to sex (10). However, some authors point out that this evidence may be related to the fact that the pain stimulus was induced experimentally (11,12).

Thus, the sample used in the present study corroborates several other studies, which show that the degree of pain felt by the female sex is higher than that felt by the male sex. As a significant difference was observed in the correlation between pain at the end of the treatment and the percentage of subjective improvement assessed by patients, one could consider that this result is a good indicator of the response to treatment.

By summarizing the findings relative to the three groups studied, it can be observed that, on the whole, the time of the day when treatment was performed did not have any influence upon morning and evening individuals. Nevertheless, intermediate individuals showed a better response to evening treatment than to daily treatment.

The hypothesis that morning-oriented patients treated during the day might obtain a better response to treatment than those treated in the evening has not been confirmed. In general, the hypothesis that morning-oriented patients treated in the evening would obtain a better response to treatment than those treated during the day was confirmed. In addition, the hypothesis that intermediate patients would obtain the same response to treatment if they were treated either during the day or in the evening has not been confirmed, as such individuals showed a better response to treatment performed in the evening.

In general, when comparing the response to treatment time, it was observed that the evening schedule provided better results. We believe that, with strict control over some variables involved (treatment, social and labor influences, etc.) it will be possible to reaffirm the findings of the present study. No doubt, the difficulty of evaluating patients showing identical pathologies represented one of the limitations to the present study, as it does not allow an evaluation of the sample as a whole. Thus, the degree of variation in the responses to treatment among patients treated in the evening or morning cannot be assessed.

It is quite clear from the literature that the signs and symptoms of certain diseases may undergo daily, monthly, and/or yearly changes. These changes may be utilized to identify the causes for some disease states and their corresponding treatments (13,14). In view of this relationship, there is no doubt that chronobiology contributes to therapeutic treatments through effective temporally optimized protocols (8). In order to allow the development of such treatment regiments, further studies addressing the influence of circadian rhythms should thus be conducted.

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