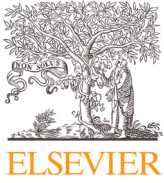




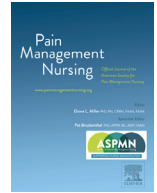
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Original Article

Depressive Symptoms Associated With Musculoskeletal Pain in Inactive Adults During COVID-19 Quarantine



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ABSTRACT

Background: Depression has been associated with episodes of musculoskeletal pain. However, it is not clear whether such relationships could be mitigated according to the physical activity level.

Aim: To describe, during the COVID-19 pandemic, the relationship between depression and musculoskeletal pain according to the physical activity levels.

Design: Cross-sectional study.

Methods: This research was conducted in Brazil between May 5 and March 17, 2020. Participants (N = 1872; 58% women) were invited through social media to answer a structured online questionnaire. Depressive symptoms were assessed through self-report of perception of depression during quarantine. Musculoskeletal pain was assessed based on the Nordic questionnaire identifying nine possible pain points in the body. Physical activity was assessed based on the weekly frequency, intensity, and duration of each session of physical activity the participants engaged in during COVID-19. The logistic binary regression analyzed the associations between depressive symptoms and musculoskeletal pain according to the participants' level of physical activity.

Results: Depressive symptoms were associated with pain in six different regions of the body in physically inactive participants. In physically inactive participants, those with depressive symptoms 1.51 (95% CI = 1.04–2.19) and 2.78 (95% CI = 1.81–4.26) times more likely to have pain in one or two and ≥three regions body regions, respectively. In active participants, depressive symptoms were not associated with pain.

Conclusion: During the COVID-19 pandemic, depression was associated with musculoskeletal pain in physically inactive participants.

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Epidemiological surveys have reported that prevalence of depressive symptoms increased from 16.5% to 20.1% during the coronavirus disease (COVID-19) outbreak (Huang & Zhao, 2020; Wang et al., 2020). It is hypothesized from these previous findings that poor mental health, particularly depression, is a secondary consequence of stay-at-home orders and social isolation during the

COVID-19 pandemic, which has negatively affected psychological well-being of many (Sønderskov et al., 2020).

Depression has been associated with several health consequences, including physical pain (IsHak et al., 2018), mainly neck and low back pain (Angst et al., 2020; Calvo Lobo et al., 2019; Fernandez et al., 2017; Zis et al., 2019). Chronic pain has been reported as the main barrier to physical activity in adults (Boutevillain et al., 2017), and body pain has negatively affected health-related quality of life (Kawai et al., 2017). A high amount of daily sedentary activities is positively associated with both depressive symptoms (Stubbs et al., 2018) and body pain (Mani et al., 2019) among adults.

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Physical activity has been negatively associated with depressive symptoms (Dugan et al., 2015; Kim et al., 2018) and chronic body pain (Šagát et al., 2020; Geneen et al., 2017; Puljak & Arienti, 2019). However, evidence suggests that individuals have drastically altered their lifestyles, with a reduction in physical activity and an increase in sedentary activities, because of quarantine during COVID-19 (Hall et al., 2021). It is possible that decreasing physical activity levels during the COVID-19 pandemic could make the adult population more vulnerable to the relationship between depressive symptoms and chronic pain. This study thus aimed to analyze the relationship between feelings of depression and pain in adults, according to physical activity levels during the COVID-19 pandemic.

Methods

Ethics, Sample, and Study Design

This survey research was conducted in Brazil between May 5 and May 17, 2020. Participants were invited through social media (Facebook, Twitter, Instagram, and WhatsApp) to answer a structured electronic questionnaire using the Google Forms platform. The sample of this study consists of adults aged 18 years or over. This study was approved by the Universidade Nove de Julho Ethics Committee before data collection (CAAE #30890220.4.0000.5511). Participants did not identify themselves, and their answers were included in the sample only if they signed the statement “I agree to participate in the survey” before the protocol started (Christofaro et al. 2021). All procedures follow the national legislation and the Declaration of Helsinki. Inclusion criteria were age higher than 18 years old and responding to all questions of the survey.

An electronic questionnaire with 70 items was developed by senior researchers with experience in different areas (science, nutrition, human movement science, physiology, neuroscience and behavior, public health). This questionnaire was divided into seven domains: (1) personal information; (2) COVID-19 personal care; (3) physical activity; (4) eating behavior; (5) health risk habits; (6) mental health; (7) overall health. For the purpose of the present study, we selected information about (1) personal information, (3) physical activity, (5) mental health, and (6) overall health domains for analysis. Below, we discuss the questions used in the present analysis (Diniz et al., 2020; Lofrano-Prado et al., 2021; Christofaro et al., 2021; Tebar et al., 2021).

Depressive Symptoms

Depressive symptoms were assessed by asking a simple question: “With the COVID-19 pandemic, have you been feeling depressed?” The answer possibilities were arrayed in a Likert scale with the following options: no; a little; sometimes; often; very often. Subsequently, participants were dichotomized into those without depressive symptoms (no; a little; sometimes) and those with depressive symptoms (often; very often).

Musculoskeletal Pain

The adapted Nordic questionnaire was used to assess the presence of musculoskeletal pain in nine different parts of the body (neck, thoracic area, shoulders, elbows, wrists/hands, low back, hips/thighs, knees, ankles/foot; Kuorinka et al., 1987). This questionnaire was used because it is easy to apply and has been validated for the Brazilian population (de Barros & Alexandre, 2003; Pinheiro et al., 2002). Owing to the variation in the time of social

Table 1

Adapted issues from Nordic questionnaire questions used in the present study.

Are you feeling any body pain? If yes, where?		
Neck	Yes	No
Shoulders	Yes	No
Elbows	Yes	No
Wrists/hands	Yes	No
Upper back	Yes	No
Low back	Yes	No
Hips/thighs	Yes	No
Knees	Yes	No
Ankles/feet	Yes	No

These questions were adapted from the Nordic questionnaire: Kuorinka et al, 1987.

isolation, we adapted the question from the Nordic questionnaire to “Are you feeling any body pain? If yes, where?”

The questions adapted from the Nordic questionnaire for use in this study are presented in Table 1.

Physical Activity

Weekly physical activity was assessed as previously described (Diniz et al., 2020; Christofaro et al., 2021). For the weekly physical activity coding, the daily time subjects reported as having spent engaged in moderate-to-high intensity physical activities was multiplied by the number of days per week that individual reported exercising. Those participants who reached 150 minutes or more of moderate to vigorous physical activity (MVPA) were considered “physically active,” whereas those with a weekly amount below this threshold were classified as “physically inactive,” according to global recommendations for the adult population (WHO, 2011).

Covariates

Information about gender (woman or man) and age (DD/MM/YYYY) was obtained. Weight (in kilograms) and height (in meters) were evaluated by self-report and used to calculate body mass index (BMI = kg/m²). Participants also reported their education level (elementary school, high school, college, or postgraduate).

Statistical Analysis

The sample characterization variables were presented according to frequency. The association between depressive symptoms and pain in different body regions was verified by the χ^2 test, according to levels of physical activity. The magnitude of these associations was verified by binary logistic regression, simultaneously adjusted by gender, age, education level, and BMI.

In addition, clusters of pain in different body regions were created [i.e., a participant who reported pain in three different places on the body (lumbar, neck and knees)]. From this cluster, the following categories were created: (1) without pain; (2) pain in one or two regions of the body; and (3) pain in three or more regions of the body. The level of significance adopted was $p < .05$ and the confidence interval was 95%. The statistical package used was SPSS version 24.0

Results

The sample for the present study was composed of 1,872 participants (58% women, $n = 1082$), with a mean age of 37.8 ± 13.2

Table 2
General characteristics of the sample (N = 1872).

	%	95% CI
Depressive symptoms	13.4	11.8–14.8
Physical activity	28.9	27.0–31.1
Sex		
Women	57.8	55.6–60.0
Men	42.2	39.9–44.4
BMI		
Normal weight	49.7	47.5–52.0
Overweight	50.3	48.0–52.5
Education level		
Elementary school	0.5	0.2–0.8
High school	9.5	8.2–10.8
College	42.0	39.8–44.3
Postgraduate	48.0	45.7–50.2
Body pain		
Neck	18.2	16.4–19.9
Thoracic	17.5	15.7–19.1
Shoulder	9.7	8.3–10.9
Elbow	2.7	2.0–3.5
Wrist and hands	7.6	6.4–8.8
Low back	28.5	26.6–30.6
Hip/thigh	6.0	5.0–7.1
Knee	13.8	12.3–15.4
Ankle/foot	5.8	4.9–7.9

CI = confidence interval; BMI = body mass index.

Table 3
Association between depressive symptoms in adults and pain in different body regions according to level of physical activity during COVID-19 pandemic (N = 1872).

	OR	95% CI	p value
Inactive			
Neck	1.48	1.04–2.13	.032
Thoracic	1.95	1.37–2.77	≤.001
Shoulder	2.41	1.55–3.75	≤.001
Elbow	1.96	0.84–4.55	.118
Wrist and hands	1.44	0.87–2.42	.159
Low back	1.42	1.07–2.07	.018
Hip/Thigh	2.00	1.10–3.61	.022
Knee	2.35	1.53–3.54	≤.001
Ankle/foot	1.30	0.69–2.43	.411
Active			
Neck	2.10	1.02–2.32	.043
Thoracic	2.40	1.18–4.89	.015
Shoulder	1.44	0.52–3.98	.474
Elbow	2.24	0.45–11.13	.321
Wrist and hands	2.71	1.06–6.87	.037
Low back	1.03	0.52–2.03	.926
Hip/thigh	0.53	0.12–2.30	.397
Knee	0.67	0.29–1.57	.365
Ankle/foot	0.94	0.27–3.28	.923

Adjusted by sex, age, education level, and body mass index. OR = odds ratio; CI = confidence interval.

Table 4
Association between depressive symptoms and sum of the number of body regions with pain according to physical activity levels.

	Odds ratio	95% CI	p value
Inactive			
No pain	1.00	1.00	
1–2 regions of pain	1.51	1.04–2.19	.030
≥3 regions of pain	2.78	1.81–4.26	≤.001
Active			
No pain	1.00	1.00	
1–2 regions of pain	1.07	0.57–2.01	.821
≥3 regions of pain	1.88	0.80–4.38	.145

Adjusted by sex, age, education level, and body mass index.

was associated with having depressive symptoms, with shoulders and knees being associated with the highest risk. Among physically active participants, reporting pain in only three of the nine body regions was associated with depressive symptoms (neck, thoracic area, and wrist and hands).

In this sample, participants who reported depressive symptoms and who were physically inactive presented a higher prevalence of pain in three or more body regions when compared to those participants who reported depression symptoms and were physically active ($p \leq .001$).

In the multivariate analysis (Table 4), physically inactive participants with depressive symptoms were more likely to have pain in one or two regions of the body and \geq three regions of the body, respectively. In physically active participants with depressive symptoms, no association was observed between depressive symptoms and pain.

Discussion

This study found that the presence of depressive symptoms during the COVID-19 quarantine was associated with musculoskeletal pain, both in physically inactive and physically active adults. However, participants who were physically inactive reported twice the number of body regions with pain. Depressive symptoms were associated with clustered pain in different body regions in physically inactive subjects, while in physically active subjects no association was observed.

This study was carried out during the COVID-19 quarantine, in which social isolation was mandated, and we observed a prevalence of 13.4% of depression symptoms. This prevalence was lower than that observed in a study with 7,236 Chinese participants, in which the prevalence of depressive symptoms was approximately 20% in the period under study (Huang & Zhao, 2020). It is possible that data collection for our study in Brazil occurred in a period of less spread of the disease than in China, where the pandemic started.

With this elevated prevalence of depressive symptoms, along with mental health impairments, physical problems such as musculoskeletal pain can also arise, since an association between clinical depression and musculoskeletal pain of the low back, hip, or knee has been previously reported (Angster et al., 2020; Schwarze et al., 2019). This association between depression and pain was reinforced in this study's findings, mainly in participants who were physically inactive, who were more likely to show an association of depression symptoms with pain in different body regions. Some mechanisms that can explain this relationship could be linked to neurotransmitters, such as serotonin and norepinephrine, which would make the connection between depression and pain (Sheng et al., 2017). Another factor is that de-

years and a mean BMI of 25.6 ± 4.5 kg/m². The prevalence of depression symptoms was higher in women (16.5%) than men (9.3%; $p \leq .001$). Pain in one or more body regions was reported by 54.8% of participants; the lower back was the body region most reported to have pain (28.5%). Approximately 30% of the participants reported engaging in at least 150 minutes of moderate-to-vigorous physical activity in the week. Table 2 shows the characteristics of the sample.

The magnitude of associations between depression symptoms and pain in different body regions according to physical activity level is shown in Table 3. Among physically inactive participants, it was observed that reporting pain in six of the nine body regions

pressive symptoms could be linked to kinesiophobia, in which the fear of movement could predict disability (Bilgin et al., 2019). Such relationships may have gotten stronger during COVID-19, with increase in mental health problems (Wang et al., 2020).

Encouraging physical activity is necessary, since it has been inversely correlated with depression symptoms (Aguilar et al., 2021; Ribeiro et al., 2020; Yasunaga et al., 2018) and pain (Geneen et al., 2017; Scarabattolo et al., 2019; Saraiva et al., 2020). In our study, participants with depressive symptoms, but who were physically active during quarantine, reported pain in fewer body regions and were less likely to show association of depressive symptoms with body pain when compared to those who were physically inactive. Similar findings during the COVID-19 quarantine were also observed in a study of 463 adults in Saudi Arabia, in which low back pain was associated with insufficient physical activity (Šagát et al., 2020). One possible reason for these findings is that physical activity contributes to the maintenance of muscle tone and strength, thus decreasing the chances of episodes of pain (Steffens et al., 2016).

Another possible reason for the protective role of physical activity in the association of depression symptoms and body pain is the release of pleasurable substances through physical activity, such as endorphins, which could cause analgesia to episodes of pain (Chaudhry & Gossman, 2021). In addition, the practice of physical activities, especially those with aerobic characteristics, could provide improvements in blood flow and successively decrease muscle stiffness (Gordon & Bloxham, 2016).

Several studies have reported the importance of maintaining physical activity during the COVID-19 pandemic (Chen et al., 2020; Jurak et al., 2020). Based on the findings of our study, we reinforce the importance of the practice of physical activity for mental and musculoskeletal health benefits in addition to its potential to act on this relationship between mind and body. Social distancing remains important, but staying at home must be accompanied by physical activities, either through online guidance or in places without close proximity between people, for good health maintenance. Digital physical therapy for musculoskeletal pain care may also be an important alternative in social isolation periods (Dantas et al., 2020).

This study has some limitations. The cross-sectional design precludes our ability to know about depressive symptoms and pain of participants prior to COVID-19 pandemic, so it is not possible to assume that these relationships are a consequence of the quarantine period. The application of the questionnaire in an online and self-reported manner is another limitation, but we emphasize that it was necessary to do so in order to avoid contact with the participants, and to comply with the imposed quarantine and avoid possible risks of transmission of COVID-19. The fact that depressive symptoms were assessed by a single self-reported question can be considered another limitation. Positive aspects include the large sample size and the fact that, evaluating behaviors and symptoms during the quarantine period helps to better understand this phenomenon.

We suggest that future studies evaluate the relationship between pain and depressive symptoms longitudinally, considering these characteristics before the pandemic to verify a possible cause-and-effect relationships. Measuring physical activity objectively by means of accelerometry would be another way to improve data accuracy.

We observed that the relationship between depressive symptoms and pain was weaker in physically active subjects. We suggest that even during quarantine, the population should try to maintain the practice of physical activity at home, respecting the safety rules for COVID-19 provided by health agencies.

Declaration of Competing Interest

None.

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To carry out the present study, a massive effort was necessary. The dissemination of the study on social media, as well as online data collection, was carried out in Brazil to evaluate the practice of physical activity, musculoskeletal pain, and depressive symptoms during the quarantine period during COVID-19. DGDC, WRT, GCRS, MDO, GGC, JPB, MAC, RMRD, MLP, and WLP participated with substantial contributions to the conception and design or acquisition of data or analysis and interpretation of data, as well as with the writing of the article or critical review of the intellectual content. It should be noted that all authors approved the final version of the manuscript.

References

- Aguilar, B., Tebar, W. R., Silva, S., Gomes, L. Q., Damato, T., Mota, J., Werneck, A. O., & Christofaro, D. (2021). Leisure-time exercise is associated with lower depressive symptoms in community dwelling adults. *European Journal of Sport Science*, 1–10 Advance online publication.
- Angst, F., Benz, T., Lehmann, S., Wagner, S., Simmen, B. R., Sandòr, P. S., Gengenbacher, M., & Angst, J. (2020). Extended overview of the longitudinal pain-depression association: A comparison of six cohorts treated for specific chronic pain conditions. *Journal of Affective Disorders*, 273, 508–516.
- Bilgin, S., Cetin, H., Karakaya, J., & Kose, N. (2019). Multivariate analysis of risk factors predisposing to kinesiophobia in persons with chronic low back and neck pain. *Journal of Manipulative Physiological Therapy*, 42(8), 565–571.
- Boutevillain, L., Dupeyron, A., Rouch, C., Richard, E., & Coudeyre, E. (2017). Facilitators and barriers to physical activity in people with chronic low back pain: A qualitative study. *PLoS One*, 12(7), Article e0179826.
- Lobo, Calvo, C., Vilar-Fernández, M., J., Losa-Iglesias, M. E., López-López, D., Rodríguez-Sanz, D., Palomo-López, P., & Becerro-de Bengoa-Vallejo, R. (2019). Depression symptoms among older adults with and without subacute low back pain. *Rehabilitation Nursing*, 44(1), 47–51.
- Chaudhry SR, Gossman W. Biochemistry. Endorphin. 2021 Apr 8. In: StatPearls. StatPearls Publishing; 2021 Jan-. PMID: 29262177.
- Chen, P., Mao, L., Nassis, G. P., Harmer, P., Ainsworth, B. E., & Li, F. (2020). Coronavirus disease (COVID-19): The need to maintain regular physical activity while taking precautions. *Journal of Sport and Health Science*, 9(2), 103–104.
- Christofaro, D. G. D., Werneck, A. O., Tebar, W. R., Lofrano-Prado, M. C., Botero, J. P., Cucato, G. G., Malik, N., Correia, M. A., Ritti-Dias, R. M., & Prado, W. L. (2021). Physical activity is associated with improved eating habits during the COVID-19 pandemic. *Frontiers in Psychology*, 12.
- Dantas, L. O., Barreto, R. P. G., & Ferreira, C. H. J. (2020). Digital physical therapy in the COVID-19 pandemic. *Brazilian Journal of Physical Therapy*, 24(5), 381–383.
- de Barros, E. N., & Alexandre, N. M. (2003). Cross-cultural adaptation of the Nordic musculoskeletal questionnaire. *International Nursing Review*, 50(2), 101–108.
- Diniz, T. A., Christofaro, D., Tebar, W. R., Cucato, G. G., Botero, J. P., Correia, M. A., Ritti-Dias, R. M., Lofrano-Prado, M. C., & Prado, W. L. (2020). Reduction of physical activity levels during the COVID-19 pandemic might negatively disturb sleep pattern. *Frontiers in Psychology*, 11, Article 586157.
- Dugan, S. A., Bromberger, J. T., Segawa, E., Avery, E., & Sternfeld, B. (2015). Association between physical activity and depressive symptoms: midlife women in SWAN. *Medicine and Science in Sports and Exercise*, 47(2), 335–342.
- Fernandez, M., Colodro-Conde, L., Hartvigsen, J., Ferreira, M. L., Refshauge, K. M., Pinheiro, M. B., Ordoñana, J. R., & Ferreira, P. H. (2017). Chronic low back pain and the risk of depression or anxiety symptoms: insights from a longitudinal twin study. *Spine Journal*, 17(7), 905–912.
- Geneen, L. J., Moore, R. A., Clarke, C., Martin, D., Colvin, L. A., & Smith, B. H. (2017). Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. *Cochrane Database Systematic Review*, 4(4), Article Cd011279.
- Gordon, R., & Bloxham, S. (2016). A systematic review of the effects of exercise and physical activity on non-specific chronic low back pain. *Healthcare (Basel)*, (2), 4.
- Hall, G., Laddu, D. R., Phillips, S. A., Lavie, C. J., & Arena, R. (2021). A tale of two pandemics: How will COVID-19 and global trends in physical inactivity and sedentary behavior affect one another? *Progressive Cardiovascular Disease*, 64, 108–110.
- Huang, Y., & Zhao, N. (2020). Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: A web-based cross-sectional survey. *Psychiatry Research*, 288, Article 112954.
- IsHak, W. W., Wen, R. Y., Naghdéchi, L., Vanle, B., Dang, J., Knosp, M., Dascal, J., Marcia, L., Gohar, Y., Eskander, L., Yadegar, J., Hanna, S., Sadek, A., Aguilar-Hernandez, L., Danovitch, I., & Louy, C. (2018). Pain and depression: A systematic review. *Harvard Review of Psychiatry*, 26(6), 352–363.

- Jurak, G., Morrison, S. A., Leskošek, B., Kovač, M., Hadžić, V., Vodičar, J., Truden, P., & Starc, G. (2020). Physical activity recommendations during the coronavirus disease-2019 virus outbreak. *Journal of Sport and Health Science*, 9(4), 325–327.
- Kawai, K., Kawai, A. T., Wollan, P., & Yawn, B. P. (2017). Adverse impacts of chronic pain on health-related quality of life, work productivity, depression and anxiety in a community-based study. *Family Practice*, 34(6), 656–661.
- Kim, S. Y., Jeon, S. W., Shin, D. W., Oh, K. S., Shin, Y. C., & Lim, S. W. (2018). Association between physical activity and depressive symptoms in general adult populations: An analysis of the dose-response relationship. *Psychiatry Research*, 269, 258–263.
- Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G., & Jørgensen, K. (1987). Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied Ergonomics*, 18(3), 233–237.
- Lofrano-Prado, M. C., do Prado, W. L., Botero, J. P., Cardel, M. L., Farah, B. Q., Oliveira, M. D., Cucato, G. G., Correia, M. A., & Ritti-Dias, R. M. (2021). The same storm but not the same boat: Effects of COVID-19 stay-at-home order on mental health in individuals with overweight. *Clinical Obesity*, 11(1), e12425.
- Mani, R., Adhia, D. B., Leong, S. L., Vanneste, S., & De Ridder, D. (2019). Sedentary behaviour facilitates conditioned pain modulation in middle-aged and older adults with persistent musculoskeletal pain: a cross-sectional investigation. *Pain Reports*, 4(5), e773.
- Pinheiro, F. A., Troccoli, B. T., & Carvalho, C. V. (2002). [Validity of the Nordic Musculoskeletal Questionnaire as morbidity measurement tool]. *Rev Saude Publica*, 36(3), 307–312. Validação do Questionário Nórdico de Sintomas Osteomusculares como medida de morbidade.
- Puljak, L., & Arienti, C. (2019). Can physical activity and exercise alleviate chronic pain in adults?: A Cochrane Review summary with commentary. *American Journal of Physical Medicine & Rehabilitation*, 98(6), 526–527.
- Ribeiro, F. E., Palma, M. R., Silva, D., Tebar, W. R., Vanderlei, L., Fregonesi, C., & Christofaro, D. (2020). Relationship of anxiety and depression symptoms with the different domains of physical activity in breast cancer survivors. *Journal of Affective Disorders*, 273, 210–214.
- Saraiva, B., Pinto, R. Z., Oliveira, C. B., Zanuto, E. F., Scarabottolo, C. C., Delfino, L. D., Suetake, V., Gil, F., & Christofaro, D. (2020). Continuity of physical activity practice from childhood to adolescence is associated with lower neck pain in both sexes and lower back pain in girls. *Journal of Back and Musculoskeletal Rehabilitation*, 33(2), 269–275.
- Scarabottolo, C. C., Cyrino, E. S., Nakamura, P. M., Tebar, W. R., Canhin, D., Gobbo, L. A., & Christofaro, D. (2019). Relationship of different domains of physical activity practice with health-related quality of life among community-dwelling older people: A cross-sectional study. *BMJ Open*, 9(6), Article e027751.
- Schwarze, M., Häuser, W., Schmutzer, G., Brähler, E., Beckmann, N. A., & Schiltenswolf, M. (2019). Obesity, depression and hip pain. *Musculoskeletal Care*, 17(1), 126–132.
- Sheng, J., Liu, S., Wang, Y., Cui, R., & Zhang, X. (2017). The link between depression and chronic pain: Neural mechanisms in the brain. *Neural Plasticity*, 2017, Article 9724371.
- Sønderskov, K. M., Dinesen, P. T., Santini, Z. I., & Østergaard, S. D. (2020). The depressive state of Denmark during the COVID-19 pandemic. *Acta Neuropsychiatrica*, 32(4), 226–228.
- Šagát, P., Bartík, P., Prieto González, P., Tohánean, D. I., & Knjaz, D. (2020). Impact of COVID-19 quarantine on low back pain intensity, prevalence, and associated risk factors among adult citizens residing in Riyadh (Saudi Arabia): A cross-sectional study. *International Journal of Environmental Research and Public Health*, 17(19), 7302.
- Steffens, D., Maher, C. G., Pereira, L. S., Stevens, M. L., Oliveira, V. C., Chapple, M., Teixeira-Salmela, L. F., & Hancock, M. J. (2016). Prevention of low back pain: A systematic review and meta-analysis. *JAMA Internal Medicine*, 176(2), 199–208.
- Stubbs, B., Vancampfort, D., Firth, J., Schuch, F. B., Hallgren, M., Smith, L., Gardner, B., Kahl, K. G., Veronese, N., Solmi, M., Carvalho, A. F., & Koyanagi, A. (2018). Relationship between sedentary behavior and depression: A mediation analysis of influential factors across the lifespan among 42,469 people in low- and middle-income countries. *Journal of Affective Disorders*, 229, 231–238.
- Tebar, W. R., Christofaro, D., Diniz, T. A., Lofrano-Prado, M. C., Botero, J. P., Correia, M. A., Cucato, G. G., Ritti-Dias, R. M., & do Prado, W. L. (2021). Increased screen time is associated with alcohol desire and sweetened foods consumption during the COVID-19 pandemic. *Frontiers in Nutrition*, 8, Article 630586.
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health*, (5), 17.
- World Health Organization. (2011). *Global recommendations on physical activity for health—18-64 years old* <https://www.who.int/dietphysicalactivity/physical-activity-recommendations-18-64years.pdf>.
- Yasunaga, A., Shibata, A., Ishii, K., Koohsari, M. J., & Oka, K. (2018). Cross-sectional associations of sedentary behaviour and physical activity on depression in Japanese older adults: An isotemporal substitution approach. *BMJ Open*, 8(9), Article e022282.
- Zis, P., Varrassi, G., Vadalouka, A., & Paladini, A. (2019). Psychological aspects and quality of life in chronic pain. *Pain Research and Management*, 2019, Article 8346161.