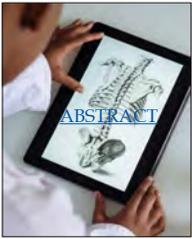


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## Comparison of Forces Exerted by a Chiropractor on Children and Adults During High-Speed, Low-Amplitude Spinal Manipulations: A Feasibility Study

Walter Herzog PhD; Peter Kevorkian DC; Brent Russell DC; Joel Alcantara DC

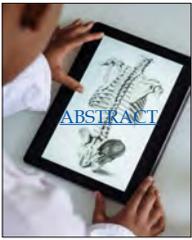
*Journal of Manipulative and Physiological Therapeutics* Volume 45, Issue 6, July—August 2022, Pages 389-399

[doi.org/10.1016/j.jmpt.2022.09.003](https://doi.org/10.1016/j.jmpt.2022.09.003).

### Abstract

**Objective:** The aim of this study was to demonstrate that quantification of the forces exerted by a single chiropractor on children and adults during high-velocity, low-amplitude spinal manipulations and the correlation of forces to age was feasible. **Methods:** The force-time profiles of high-velocity, low-amplitude spinal manipulations were measured in 48 children (109 manipulations) ranging from 14 weeks to 17 years of age, and 20 adults (49 manipulations) in a clinical setting. The measurements were taken using a thin, flexible pressure pad. Outcome variables (peak forces, preload forces, thrust forces, thrust durations, rates of force application, and thrust impulses) were quantified and compared across age groups using Kruskal-Wallis testing with Dunn post hoc analysis. Outcome variables were fitted with best-fitting linear regressions with age as the dependent variable. The level of significance for all statistical tests was set a priori at  $\alpha = 0.05$ . **Results:** Most outcome variables increased with the age of the patient. Specifically, peak forces, thrust forces, and the rate of force application were positively correlated with age, while thrust durations remained constant across all ages and preload forces decreased slightly with patient age for cervical spine manipulations. **Conclusion:** For this single chiropractor in private practice, the forces he used increased with the age of the patient, and he thus used lower forces in children than adults. This study shows that measuring the forces used by a chiropractor in clinical practice on patients with a range of ages was feasible.

**Key Indexing Terms:** Manipulation, Chiropractic, Infant, Child, Manipulation, Spinal, Mechanical Phenomena.



## Association Between Pregnancy-Related Hormones and Lumbopelvic Pain Characteristics in Pregnant Women: A Scoping Review

Catherine Daneau; Mariève Houle; Mégane Pasquier; Stephanie-May Ruchat; Martin Descarreaux

*J Manipulative Physiol Ther.* 2021 Sep;44(7):573-583.

[doi:10.1016/j.jmpt.2021.10.001](https://doi.org/10.1016/j.jmpt.2021.10.001). Epub 2021 Dec 9.

### Abstract

**Objectives:** The objectives of this scoping review were (1) to document and quantify the potential associations between lumbopelvic pain characteristics and pregnancy-related hormones, and (2) to identify research approaches and assessment tools used to investigate lumbopelvic pain characteristics and pregnancy-related hormones. **Methods:** The literature search was conducted in six databases (MEDLINE, Academic Search Complete, Cumulative Index to Nursing and Allied Health Literature, SportDiscus, PsycINFO, and Cochrane) from inception up to March 2020 and completed using search terms relevant to pregnant women, pregnancy-related hormones, and lumbopelvic pain. The risk of bias was assessed using the characteristics recommended by Guyatt et al. for observational studies. **Results:** The search yielded 1015 publications from which nine met the inclusion criteria. Relaxin was the most studied pregnancy-related hormone. An association between relaxin levels and lumbopelvic pain presence or severity was found in 4 studies, while five studies did not report an association between them. One study reported an association between relaxin and lumbopelvic pain presence or severity while two studies reported no association and were considered as having a low risk of bias. One study reported measures of estrogen and progesterone levels. It showed that progesterone levels were found to be significantly higher in pregnant women with lumbopelvic pain compared to those without, while estrogen concentrations were similar in both groups. **Conclusion:** The literature showed conflicting evidence regarding the association between pregnancy-related hormones and lumbopelvic pain characteristics in pregnant women. The assessment tools used to investigate lumbopelvic pain characteristics and pregnancy-related hormones are heterogeneous across studies. Based on limited and conflicting evidence, and due to the heterogeneity of assessment tools and overall poor quality of the literature, the association between pregnancy-related hormones and lumbopelvic pain characteristics is unclear.

**Keywords:** Estrogen; Low Back Pain; Pelvic Girdle Pain; Pregnancy; Progesterone; Relaxin.



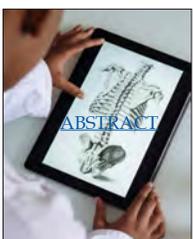
### Adverse infant outcomes among women with sleep apnea or insomnia during pregnancy: A retrospective cohort study

Jennifer N Felder; Rebecca J Baer; Larry Rand; Kelli K Ryckman; Laura Jelliffe-Pawlowski; Aric A Prather  
*Sleep Health* 2023 Feb;9(1):26-32.  
[doi:10.1016/j.sleh.2022.09.012](https://doi.org/10.1016/j.sleh.2022.09.012). Epub 2022 Nov 10.

#### Abstract

**Objective:** To evaluate whether sleep apnea or insomnia among pregnant people is associated with increased risk for adverse infant outcomes. **Design:** Retrospective cohort study **SETTING:** California **PARTICIPANTS:** The sample included singleton live births. Sleep apnea and insomnia were defined based on ICD-9 and -10 codes. A referent group was selected using exact propensity score matching on maternal characteristics, obstetric factors, and infant factors among individuals without a sleep disorder. **Measurements:** Adverse infant outcomes were obtained from birth certificate, hospital discharge, and death records (eg, Apgar scores, neonatal intensive care unit (NICU) stay, infant death, long birth stay, etc.). Logistic regression was used to calculate odds of an adverse infant outcome by sleep disorder type. **Results:** Propensity-score matched controls were identified for 69.9% of the 3371 sleep apnea cases and 68.8% of the 3213 insomnia cases. Compared to the propensity-matched referent group, individuals with a diagnosis of sleep apnea (n = 2357) had infants who were more likely to have any adverse outcome, low 1-min Apgar scores, NICU stay, and an emergency room visit in the first year of life. Infants born to mothers with a diagnosis of insomnia (n = 2212) were at increased risk of few negative outcomes relative to the propensity matched referent group, with the exception of an emergency room visit. **Conclusions:** In unadjusted analyses, infants born to individuals with a diagnosis of sleep apnea or insomnia were at increased risk of several adverse outcomes. These were attenuated when using propensity score matching, suggesting these associations were driven by other comorbidities.

**Keywords:** Infant outcomes; Insomnia; Pregnancy; Sleep apnea.



### Effect of Vitamin C Supplementation for Pregnant Smokers on Offspring Airway Function and Wheeze at Age 5 Years: Follow-up of a Randomized Clinical Trial.

Cindy T. McEvoy, MD, MCR; Lyndsey E. Shorey-Kendrick, PhD; Kristin Milner, BA1; et al.  
*JAMA Pediatr.* 2023;177(1):16-24. [doi:10.1001/jamapediatrics.2022.4401](https://doi.org/10.1001/jamapediatrics.2022.4401).

#### Abstract

**Importance:** Vitamin C supplementation (500 mg/d) for pregnant smokers has been reported to increase offspring airway function as measured by forced expiratory flow (FEF) through age 12 months; however, its effects on airway function at age five years remain to be assessed. **Objective:** To assess whether vitamin C supplementation in pregnant smokers is associated with increased and/or improved airway function in their offspring at age five years and whether vitamin C decreases the occurrence of wheeze. **Design, Setting, and Participants:** This study followed up the Vitamin C to Decrease the Effects of Smoking in Pregnancy on Infant Lung Function (VCSIP) double-blind, placebo-controlled randomized clinical trial conducted at three centers in the US (in Oregon, Washington, and Indiana) between 2012 and 2016. Investigators and participants remain unaware of the treatment assignments. Forced expiratory flow measurements at age five years were completed from 2018 to 2021. **Interventions:** Pregnant smokers were randomized to vitamin C (500 mg/d) or placebo treatment. **Main Outcomes and Measures:** The primary outcome was the prespecified measurement of FEF between 25% and 75% expired volume (FEF25-75) by spirometry at age five years. Secondary outcomes included FEF measurements at 50% and 75% of expiration (FEF50 and FEF75), forced expiratory volume in one second (FEV1), and occurrence of wheeze. **Results:** Of the 251 pregnant smokers included in this study, 125 (49.8%) were randomized to vitamin C and 126 (50.2%) were randomized to placebo. Of 213 children from the VCSIP trial who were reconsented into this follow-up study, 192 (90.1%) had successful FEF measurements at age five years; 212 (99.5%) were included in the analysis of wheeze. Analysis of covariance demonstrated that offspring of pregnant smokers allocated to vitamin C compared with placebo had 17.2% significantly higher mean (SE) measurements of FEF25-75 at age five years (1.45 [0.04] vs 1.24 [0.04] L/s; adjusted mean difference, 0.21 [95% CI, 0.13-0.30]; P < .001). Mean (SE) measurements were also significantly increased by 14.1% for FEF50 (1.59 [0.04] vs 1.39 [0.04] L/s; adjusted mean difference, 0.20 [95% CI, 0.11-0.30]; P < .001), 25.9% for FEF75 (0.79 [0.02] vs 0.63 [0.02] L/s; 0.16 [95% CI, 0.11-0.22]; P < .001), and 4.4% for FEV1 (1.13 [0.02] vs 1.09 [0.02] L; 0.05 [95% CI, 0.01-0.09]; P = .02). In addition, offspring of pregnant smokers randomized to vitamin C had significantly decreased wheeze (28.3% vs 47.2%; estimated odds ratio, 0.41 [95% CI, 0.23-0.74]; P = .003). **Conclusions and Relevance:** In this follow-up study of offspring of pregnant smokers randomized to vitamin C vs placebo, vitamin C supplementation during pregnancy resulted in significantly increased airway function of offspring at age five years and significantly decreased the occurrence of wheeze. These findings suggest that vitamin C supplementation for pregnant smokers may decrease the effects of smoking in pregnancy on childhood airway function and respiratory health.

**Trial Registration:** ClinicalTrials.gov Identifier: NCT03203603.

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## Treatment of infant colic with craniosacral therapy. A randomized controlled trial

Mercedes Castejón-Castejón; M A Murcia-González; J Todri; O Lena; R Chillón-Martínez

*Complement Ther Med.* 2022 Dec;71:102885.

[doi:10.1016/j.ctim.2022.102885](https://doi.org/10.1016/j.ctim.2022.102885). Epub 2022 Sep 13

### Abstract

**Objective:** To evaluate the number of craniosacral therapy sessions that can be helpful to obtain a resolution of the symptoms of infantile colic and to observe if there are any differences in the evolution obtained by the groups that received a different number of Craniosacral Therapy sessions at 24 days of treatment, compared with the control group which did not receive any treatment. **Methods:** Fifty-eight infants with colic were randomized into two groups of which 29 babies in the control group received no treatment and those in the experimental group received 1-3 sessions of craniosacral therapy (CST) until symptoms were resolved. Evaluations were performed until day 24 of the study. In this study crying hours served as primary outcome. The secondary outcome were the hours of sleep and the severity, measured by an Infantile Colic Severity Questionnaire (ICSQ). **Results:** Significant statistical differences were observed in favor of experimental group compared to the control group on day 24 in crying hours (mean difference = 2.94, at 95 %CI = 2.30-3.58;  $p < 0.001$ ) primary outcome, and also in hours of sleep (mean difference = 2.80; at 95 %CI = - 3.85 to - 1.73;  $p < 0.001$ ) and colic severity (mean difference = 17.24; at 95 %CI = 14.42-20.05;  $p < 0.001$ ) secondary outcomes. Also, the differences between the groups  $\leq 2$  CST sessions ( $n = 19$ ), 3 CST sessions ( $n = 10$ ) and control ( $n = 25$ ) were statistically significant on day 24 of the treatment for crying, sleep and colic severity outcomes ( $p < 0.001$ ). **Conclusion:** Babies with infantile colic may obtain a complete resolution of symptoms on day 24 by receiving 2 or 3 CST sessions compared to the control group, which did not receive any treatment.

**Keywords:** Craniosacral therapy; Crying; Infantile colic; Manual therapy; Osteopathy; Sleep.



## Longitudinal Associations Between Use of Mobile Devices for Calming and Emotional Reactivity and Executive Functioning in Children Aged 3 to 5 Years

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*JAMA Pediatr.* 2023 Jan 1;177(1):62-70.

[doi:10.1001/jamapediatrics.2022.4793](https://doi.org/10.1001/jamapediatrics.2022.4793)

### Abstract

**Importance:** Mobile devices are often used to keep young children occupied or calm, but it is not known whether this practice influences child development. **Objective:** To examine the longitudinal, bidirectional associations between the parent-reported frequency of using mobile devices to calm young children and children's executive functioning (EF) and emotional reactivity, testing moderation by child sex and temperament. **Design, setting, and participants:** This prospective cohort study included a community-based convenience sample of English-speaking parents of typically developing children aged three to five years. The study duration was from August 2018 to January 2020, with baseline (T1), 3-month follow-up (T2), and 6-month follow-up (T3) waves. **Exposures:** Parent-reported frequency of use of mobile devices to calm children when upset (5-point Likert scale). **Main outcomes and measures:** At each wave, the child's EF was assessed with the Behavior Rating Inventory of Executive Function-Preschool Version Global Executive Composite and emotional reactivity with the Child Behavior Checklist Emotional Reactivity subscale. Structural equation models were built to examine cross-lagged associations of the use of devices for calming, EF, and emotional reactivity, testing for moderation by child sex or temperament (Child Behavior Questionnaire-Very Short Form surgency score, median split). **Results:** Of 422 eligible parents with data at T1, 375 (88.9%) provided data at T2 and 366 (86.7%) at T3. At baseline, the mean (SD) age of the 422 children was 3.8 (0.5) years, the number of boys in the sample was 224 (53.1%), the number of individuals of non-Hispanic White race and ethnicity was 313 (74.2%), and among the parents, 254 (60.2%) had a college degree or higher. Among the boys, the use of devices to calm at T2 was associated with higher emotional reactivity at T3 ( $r$  [standardized regression coefficient] = 0.20; 95% CI, 0.10-0.30), while higher emotional reactivity at T2 had a nonsignificant association with increased device use for calming at T3 ( $r = 0.10$ ; 95% CI, -0.01 to 0.21). Among children with high temperamental surgency, the use of devices to calm at T2 was associated with increased emotional reactivity at T3 ( $r = 0.11$ ; 95% CI, 0.01-0.22), while higher emotional reactivity at T2 was associated with increased device use for calming at T3 ( $r = 0.13$ ; 95% CI, 0.02-0.24). **Conclusions and relevance:** The findings of this study suggest that the frequent use of mobile devices for calming young children may displace their opportunities for learning emotion-regulation strategies over time; therefore, pediatric health care professionals may wish to encourage alternate calming approaches.

**Conflict of Interest Disclosures:** Dr Radesky reported receiving personal fees from Noggin (Viacom/CBS) for serving on their scientific advisory board in 2021, and consulting fees from Melissa & Doug Toys outside the submitted work. Dr Kaciroti reported receiving grants from the University of Michigan during the conduct of the study. No other disclosures were reported.



### Sensitivity and Specificity of the Modified Checklist for Autism in Toddlers (Original and Revised): A Systematic Review and Meta-analysis

Andrea Trubanova Wieckowski; Lashae N Williams; Juliette Rando; Kristen Lyall; Diana L Robins

*JAMA Pediatr* 2023 Apr 1;177(4):373-383.

[doi:10.1001/jamapediatrics.2022.5975](https://doi.org/10.1001/jamapediatrics.2022.5975).

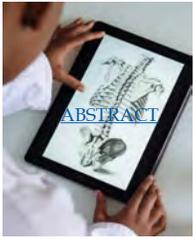
#### Abstract

**Importance:** The Modified Checklist for Autism in Toddlers (M-CHAT) and the M-CHAT, Revised With Follow-up (M-CHAT-R/F)-henceforth referred to as M-CHAT(-R/F)-are the most commonly used toddler screeners for autism spectrum disorder (ASD). Their use often differs from that in the original validation studies, resulting in a range of estimates of sensitivity and specificity. Also, given the variability in reports of the clinical utility of the M-CHAT(-R/F), researchers and practitioners lack guidance to inform autism screening protocols. **Objective:** To synthesize variability in sensitivity and specificity of M-CHAT(-R/F) across multiple factors, including procedures for identifying missed cases, likelihood level, screening age, and single compared with repeated screenings. **Data sources:** A literature search was conducted with PubMed, Web of Science, and Scopus to identify studies published between January 1, 2001, and August 31, 2022. **Study selection:** Articles were included if the studies used the M-CHAT(-R/F) (ie, original or revised version) to identify new ASD cases, were published in English-language peer-reviewed journals, included at least 10 ASD cases, reported procedures for false-negative case identification, screened children by 48 months, and included information (or had information provided by authors when contacted) needed to conduct the meta-analysis. **Data extraction and synthesis:** The systematic review and meta-analysis was conducted within the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guideline. The Quality Assessment of Diagnostic Accuracy Studies-2 tool evaluated bias in sample selection. Data extraction and quality assessment were performed by two authors independently. The overall diagnostic accuracy of the M-CHAT(-R/F) was assessed with the hierarchic summary receiver operating characteristic (HSROC) model. **Main outcomes and measures:** Sensitivity, specificity, diagnostic odds ratios, and HSROC curves of M-CHAT(-R/F). **Results:** The review included 50 studies with 51 samples. The pooled sensitivity of M-CHAT(-R/F) was 0.83 (95% CI, 0.77-0.88), and the pooled specificity was 0.94 (95% CI, 0.89-0.97). Heterogeneity analyses revealed greater diagnostic accuracy for low- vs high-likelihood samples, a concurrent vs prospective case confirmation strategy, a large vs small sample size, use of M-CHAT(-R/F) Follow-up, and non-English vs English only. **Conclusions and relevance:** Overall, results of this study suggest the utility of the M-CHAT(-R/F) as an ASD screener. The wide variability in psychometric properties of M-CHAT(-R/F) highlights differences in screener use that should be considered in research and practice.

**Conflict of Interest Disclosures:** Dr Wieckowski reported receiving grants from the Pennsylvania Medical Society and the Eagles Autism Foundation. Dr Lyall reported receiving grants from the Eagles Autism Foundation. Dr Robins reported receiving personal fees from M-CHAT LLC co-ownership, in which licensees pay royalties; receiving grants from the Eagles Autism Foundation, the National Institutes of Health, and the Pennsylvania Medical Society; having a contract to contribute to a Food and Drug Administration trial from Autism Speaks; receiving a gift to support pilot research from the Wawa Foundation; receiving personal fees from Quadrant Biosciences, Inc, for serving as a member of an advisory board; having a contract to collaborate on a toddler screening study in Monterrey, Mexico, from Autismo ABP outside the submitted work; and holding a copyright for M-CHAT, M-CHAT-R/F issued to M-CHAT, LLC (M-CHAT and M-CHAT-R/F are copyrighted instruments). No other disclosures were reported.

**Outdoor Play as a Mitigating Factor in the Association Between Screen Time for Young Children and**

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## Neurodevelopmental Outcomes

Mika Sugiyama; Kenji J Tsuchiya; Yusuke Okubo; Mohammad Shafiur Rahman; Satoshi Uchiyama; Taeko Harada; Toshiki Iwabuchi; Akemi Okumura; Chikako Nakayasu; Yuko Amma; Haruka Suzuki; Nagahide Takahashi; Barbara Kinsella-Kammerer; Yoko Nomura; Hiroaki Itoh 8; Tomoko Nishimura

*JAMA Pediatr.* 2023 Mar 1;177(3):303-310.

doi: [10.1001/jamapediatrics.2022.5356](https://doi.org/10.1001/jamapediatrics.2022.5356).

### Abstract

**Importance:** Whether the association between higher screen time in infancy and later suboptimal neurodevelopment can be mitigated by frequency of outdoor play is unknown. **Objective:** To investigate whether higher screen time at age two years is associated with neurodevelopmental outcomes at age four years and whether this association is mediated by frequency of outdoor play at age two years eight months. **Design, setting, and participants:** Participants were a subsample of the Hamamatsu Birth Cohort Study for Mothers and Children (HBC Study, N = 1258). Children were born between December 2007 and March 2012 and followed up from one year six months to four years. The analysis was conducted from April 2021 to June 2022. **Exposures:** Screen time longer than 1 hour a day at age two years was coded as higher screen time. **Main outcomes and measures:** Standardized scores for communication, daily living skills, and socialization domains of the Vineland Adaptive Behavior Scale, second edition, at age four years were used (mean [SD], 100 [15]). The mediating factor was frequency of outdoor play at age two years eight months, with six or seven days per week coded as frequent outdoor play. **Results:** Of 885 participants, 445 children (50%) were female; mean (SD) screen time per day was 2.6 (2.0) hours. Causal mediation analyses revealed that higher screen time at age 2 years was associated with lower scores in communication at age 4 years (nonstandardized coefficient  $b = -2.32$ ; 95% CI, -4.03 to -0.60), but the association was not mediated by frequency of outdoor play. Higher screen time was also associated with lower scores in daily living skills ( $b = -1.76$ ; 95% CI, -3.21 to -0.31); 18% of this association was mediated by frequency of outdoor play. Frequency of outdoor play was associated with socialization ( $b = 2.73$ ; 95% CI, 1.06 to 4.39), whereas higher screen time was not ( $b = -1.34$ ; 95% CI, -3.05 to 0.36). **Conclusions and relevance:** Higher screen time at age two years was directly associated with poorer communication at age four years. It was also associated with daily living skills, but frequency of outdoor play at age two years eight months alleviated it, suggesting outdoor play mitigated the association between higher screen time and suboptimal neurodevelopment. Future research should specify the nature of the associations and intervention measures, enabling targeted interventions that reduce the potential risk in screen time.



## Physical Activity Interventions to Alleviate Depressive Symptoms in Children and Adolescents: A Systematic Review and Meta-analysis

Francesco Recchia; Joshua D K Bernal; Daniel Y Fong; Stephen H S Wong; Pak-Kwong Chung; Derwin K C Chan; Catherine M Capio; Clare C W Yu; Sam W S Wong; Cindy H P Sit; Ya-Jun Chen; Walter R Thompson; Parco M Siu

*JAMA Pediatr.* 2023 Feb 1;177(2):132-140.

doi: [10.1001/jamapediatrics.2022.5090](https://doi.org/10.1001/jamapediatrics.2022.5090).

### Abstract

**Importance:** Depression is the second most prevalent mental disorder among children and adolescents, yet only a small proportion seek or receive disorder-specific treatment. Physical activity interventions hold promise as an alternative or adjunctive approach to clinical treatment for depression. **Objective:** To determine the association of physical activity interventions with depressive symptoms in children and adolescents. **Data sources:** PubMed, CINAHL, PsycINFO, EMBASE, and SPORTDiscus were searched from inception to February 2022 for relevant studies written in English, Chinese, or Italian. **Study selection:** Two independent researchers selected studies that assessed the effects of physical activity interventions on depressive symptoms in children and adolescents compared with a control condition. **Data extraction and synthesis:** A random-effects meta-analysis using Hedges  $g$  was performed. Heterogeneity, risk of bias, and publication bias were assessed independently by multiple reviewers. Meta-regressions and sensitivity analyses were conducted to substantiate the overall results. The study followed the PRISMA reporting guideline. **Main outcomes and measures:** The main outcome was depressive symptoms as measured by validated depression scales at postintervention and follow-up. **Results:** Twenty-one studies involving 2441 participants (1148 [47.0%] boys; 1293 [53.0%] girls; mean [SD] age, 14 [3] years) were included. Meta-analysis of the postintervention differences revealed that physical activity interventions were associated with a reduction in depressive symptoms compared with the control condition ( $g = -0.29$ ; 95% CI, -0.47 to -0.10;  $P = .004$ ). Analysis of the follow-up outcomes in 4 studies revealed no differences between the physical activity and control groups ( $g = -0.39$ ; 95% CI, -1.01 to 0.24;  $P = .14$ ). Moderate study heterogeneity was detected ( $Q = 53.92$ ;  $df = 20$ ;  $P < .001$ ;  $I^2 = 62.9\%$  [95% CI, 40.7%-76.8%]). The primary moderator analysis accounting for total physical activity volume, study design, participant health status, and allocation and/or assessment concealment did not moderate the main treatment effect. Secondary analyses demonstrated that intervention (ie, <12 weeks in duration, 3 times per week, unsupervised) and

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participant characteristics (ie, aged  $\geq 13$  years, with a mental illness and/or depression diagnosis) may influence the overall treatment effect. **Conclusions and relevance:** Physical activity interventions may be used to reduce depressive symptoms in children and adolescents. Greater reductions in depressive symptoms were derived from participants older than 13 years and with a mental illness and/or depression diagnosis. The association with physical activity parameters such as frequency, duration, and supervision of the sessions remains unclear and needs further investigation.



**Association of Habitual Checking Behaviors on Social Media With Longitudinal Functional Brain Development**  
 Maria T Maza; Kara A Fox; Seh-Joo Kwon; Jessica E Flannery; Kristen A Lindquist; Mitchell J Prinstein; Eva H Telzer  
*JAMA Pediatr.* 2023;177(2):160-167.

[doi:10.1001/jamapediatrics.2022.4924](https://doi.org/10.1001/jamapediatrics.2022.4924)

### Key Points

**Question:** Is adolescents' frequency of checking behaviors on three social media platforms (Facebook, Instagram, Snapchat) associated with longitudinal changes in functional brain development across adolescence. **Findings:** In this cohort study of 169 sixth- and seventh-grade students, participants who engaged in habitual checking behaviors showed a distinct neurodevelopmental trajectory within regions of the brain comprising the affective salience, motivational, and cognitive control networks in response to anticipating social rewards and punishments compared with those who engaged in nonhabitual checking behaviors. **Meaning:** These results suggest that habitual checking of social media in early adolescence may be longitudinally associated with changes in neural sensitivity to anticipation of social rewards and punishments, which could have implications for psychological adjustment.

### Abstract

**Importance:** Social media platforms provide adolescents with unprecedented opportunities for social interactions during a critical developmental period when the brain is especially sensitive to social feedback. **Objective:** To explore how adolescents' frequency of checking behaviors on social media platforms is associated with longitudinal changes in functional brain development across adolescence. **Design, Setting, and Participants:** A 3-year longitudinal cohort study of functional magnetic resonance imaging (fMRI) among sixth- and seventh-grade students recruited from three public middle schools in rural North Carolina. **Exposures:** At wave 1, participants reported the frequency at which they checked Facebook, Instagram, and Snapchat. **Main Outcome or Measure:** Neural responses to the Social Incentive Delay task when anticipating receiving social feedback, measured annually using fMRI for three years. Participants saw a cue that indicated whether the social feedback (adolescent faces with emotional expressions) would be a reward, punishment, or neutral; after a delay, a target appeared and students responded by pressing a button as quickly as possible; a display of social feedback depended on trial type and reaction time. **Results:** Of 178 participants recruited at age 12 years, 169 participants (mean [SD] age, 12.89 [0.58] years; range, 11.93-14.52 years; 91 [53.8%] female; 38 [22.5%] Black, 60 [35.5%] Latinx, 50 [29.6%] White, 15 [8.9%] multiracial) met the inclusion criteria. Participants with habitual social media checking behaviors showed lower neural sensitivity to social anticipation at age 12 years compared with those with nonhabitual checking behaviors in the left amygdala, posterior insula (PI), and ventral striatum (VS;  $\beta$ , -0.22; 95% CI, -0.33 to -0.11), right amygdala ( $\beta$ , -0.19; 95% CI, -0.30 to -0.08), right anterior insula (AI;  $\beta$  -0.23; 95% CI, -0.37 to -0.09), and left dorsolateral prefrontal cortex (DLPFC;  $\beta$ , -0.29; 95% CI, -0.44 to -0.14). Among those with habitual checking behaviors, there were longitudinal increases in the left amygdala/PI/VS ( $\beta$ , 0.11; 95% CI, 0.04 to 0.18), right amygdala ( $\beta$ , 0.09; 95% CI, 0.02 to 0.16), right AI ( $\beta$ , 0.15; 95% CI, 0.02 to 0.20), and left DLPFC ( $\beta$ , 0.19; 95% CI, 0.05 to 0.25) during social anticipation, whereas among those with nonhabitual checking behaviors, longitudinal decreases were seen in the left amygdala/PI/VS ( $\beta$ , -0.12; 95% CI, -0.19 to -0.06), right amygdala ( $\beta$ , -0.10; 95% CI, -0.17 to -0.03), right AI ( $\beta$ , -0.13; 95% CI, -0.22 to -0.04), and left DLPFC ( $\beta$ , -0.10, 95% CI, -0.22 to -0.03). **Conclusions and Relevance:** The results of this cohort study suggest that social media checking behaviors in early adolescence may be associated with changes in the brain's sensitivity to social rewards and punishments. Further research examining long-term associations between social media use, adolescent neural development, and psychological adjustment is needed to understand the effects of a ubiquitous influence on development for today's adolescents.

### Correction, February 13, 2023

Errors in Figures, *JAMA Pediatr.* 2023;177(4):440. [doi:10.1001/jamapediatrics.2022.4924](https://doi.org/10.1001/jamapediatrics.2022.4924)

In the article titled "Association of Habitual Checking Behaviors on Social Media With Longitudinal Functional Brain Development," published online January 3, 2023, in *JAMA Pediatrics*, the legends for the graphs in Figures 1 through 4 incorrectly labeled the participants' checking behavior. The green indicates moderate checking behavior, and the orange indicates low (nonhabitual) checking behavior. The article has been corrected.