

1 **Health-related behaviors among school-aged children and adolescents**
2 **during the Spanish Covid-19 confinement**

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31 **Abstract**

32 In response to the Covid-19 world pandemic, affected countries such as Spain enacted measures
33 comprising of compulsory confinement as well as restrictions regarding free movement. Such measures
34 likely influence children's and adolescents' lifestyles. Our study aimed to investigate the impact that
35 the Covid-19 confinement has on health-related behaviors (HRBs) among Spanish children and
36 adolescents. An online survey was administered to 516 parents to collect data about 860 children and
37 adolescents (49.2% girls) aged between 3 and 16 years in relation to physical activity, screen exposure,
38 sleep time, and fruit and vegetable consumption during the Covid-19 confinement. Respectively t-
39 paired test and t-test between groups served to check differences between HRBs levels before and
40 during the confinement as well as between strict and relaxed confinement. Significant differences were
41 found for a reduction of weekly minutes of physical activity during the confinement (-102.5, SD 159.6)
42 ($p < 0.001$), an increase of daily hours of screen exposure (2.9, SD 2.1) ($p < 0.001$), and a reduction of
43 daily fruit and vegetable consumption (-0.2, SD 1.6) ($p < 0.001$). Sleep time showed a significant
44 difference between strict and relaxed confinement (-0.3, SD 0.1) ($p < 0.05$), whereas binomial logistic
45 regression adjusted for covariates (age, sex, education of the parents, siblings, current condition,
46 exposure to Covid-19, and previous health risk behavior) showed significantly lower odds for screen
47 exposure risk behavior with relaxed confinement (OR 0.60, 95%CI 0.40-0.91). The present study
48 suggests that Covid-19 confinement reduced physical activity levels, increased both screen exposure
49 and sleep time, and reduced fruit and vegetable consumption. Therefore, most HRBs worsened among
50 this sample of Spanish children and adolescents. Closure of schools, online education, and the lack of
51 policies addressing the conciliation between labor and family life could have played an important role
52 in HRBs worsening among pupils, which might be mitigated with adequate conciliation policies,
53 parental guidance, and community support.

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67 1 Introduction

68 The global pandemic of Covid-19 has forced many countries to enact confinement measures to reduce
69 the spread of the virus (SARS-CoV-2). The Spanish Government declared a state of alarm followed by
70 a compulsory set of measures including strict free movement restrictions implemented from 15th
71 March of 2020 (1,2). To date, these measures have been observed effective since new contagious have
72 been substantially reduced, which has permitted to start with a de-escalation phase towards usual daily
73 routine. However, the experience of a long period of confinement may have had a significant impact
74 on those who have suffered the strictest restrictions of free movement and other potential consequences
75 such as the problems for families derived from the lack of conciliation between labor and family life.

76 In this regard, the compulsory movement restriction meant the prohibition of movement of children
77 outside households up to six or more weeks in a row, with no certainty about potentially damaging
78 consequences on their health and wellbeing. Additionally, because 94.1 % of the Covid-19 infected
79 children do not present symptoms or have mild to moderate disease (3), affecting mainly to the elderly
80 with who the minors share households (4), social distancing measures were put in place across Europe
81 to reduce the human-to-human infection; such measures included the closing of schools and high
82 schools. Consequently, several pupils have been affected by the temporary closing of their schools and
83 high schools and the adoption of online learning platforms instead (5).

84 The United Nations stated that the mitigation measures may inadvertently do more harm than good (6),
85 and in this context, the closing of schools and high schools suppose the isolation and social deprivation
86 of many children of all ages around the world. Numerous studies have previously linked isolation to
87 different conditions such as cardiovascular disease among children (i.e. elevated total cholesterol,
88 elevated blood pressure, overweight, low high-density lipoprotein level, low maximum oxygen
89 consumption, and elevated glycated hemoglobin concentration), and social deprivation have been
90 observed to have a negative effect over social cognition, and both emotional and motor development
91 (7–10). Therefore, since a substantial amount of children and adolescents might have been temporarily
92 deprived of parental care, adequate healthy and sustained routines, and cognitive and physical stimuli
93 for their age, research relating to this topic is urgently required. For instance, due to the Covid-19
94 movement restrictions, a higher homestay would be expected, which, in turn, might increase screen
95 exposure (11); at the same time, higher levels of screen exposure might also lead to lower levels of
96 physical activity and, eventually, lower sleep time (12,13), which along with circadian deregulation
97 may influence Covid-19 infection and severity (14). Furthermore, recent studies have observed a
98 significant reduction in physical activity levels of adults during the Covid-19 confinement (15,16).
99 Moreover, such studies have found that adults experiencing higher reductions in physical activity levels
100 or performing lower levels of physical activity during the Covid-19 pandemic have poor mental health
101 and wellbeing (17,18). Indeed, similar associations observing poorer mental health as a consequence
102 of a reduction of physical activity levels due to the Covid-19 confinement might also exist for children
103 and adolescents.

104 In this unprecedented situation due to Covid-19 confinement, where infection mitigation measures may
105 have had an impact on the usual lifestyle, there are no studies yet examining how the experience of
106 Covid-19 confinement has influenced health-related behaviors (HRBs) in children and adolescents.
107 Therefore, the present study aimed to analyze the influence of confinement over HRBs in Spanish
108 children and adolescents, which could contribute to informing future public health strategies as aimed
109 at this specific population. Based on previous literature, we hypothesized that both strict and relaxed
110 Covid-19 confinement would be associated with unfavorable HRBs when compared to pre-Covid-19

111 confinement setting. Indeed, stronger associations between strict confinement and worse HRBs are
112 expected.

113 **2 Methods**

114 A parent-reported questionnaire was conducted to assess associations between phases of confinement
115 and HRBs during the Covid-19 pandemic in children and adolescents.

116 **2.1 The survey**

117 A web-form link served to collect data regarding HRBs during the period 22nd of March to 10th of
118 May, 2020 (i.e. from the seventh day of enacted national confinement in Spain up to the fifteenth day
119 of relaxed confinement for children). The survey was launched on social media on 22nd March 2020,
120 together with initial information about the aim of the study. Adults residing in Spain, aged 18 years
121 and over, having children, and currently confined due to Covid-19 were eligible to participate.
122 Convenience sampling was used to select the participants of the study; according to server analytics,
123 650 adult media users covering all the Spanish regions were invited to participate. Participants were
124 provided with an information sheet about the study aims as well as the instructions for the survey, gave
125 informed consent to participate, and confirmed the confined status of their children. Provided data were
126 anonymously treated in accordance with Spanish law for general data protection. At the end of the
127 survey, participants were provided with recommendations regarding health habits. Overall, 516 parents
128 provided data about 860 children and adolescents in relation to the following variables: age, gender,
129 education of the parents, previous condition, number of siblings, phase of confinement, exposure to
130 Covid-19, physical activity, screen exposure, sleep time, and fruits and vegetable consumption.

131 **2.2 Ethics**

132 The study was conducted following the principles of the World Medical Declaration of Helsinki and
133 was approved by the Ethics Committee of Research in Humans of the University of Valencia (register
134 code 1278789). The study was reported accordingly to the Strengthening the Reporting of
135 Observational Studies in Epidemiology statement (19).

136 **2.3 The phase of confinement (exposure)**

137 Data from web server corresponding to the date of completing the survey served to categorize this
138 variable into those experiencing strict confinement (i.e. those completing the questionnaire from 1st of
139 April up to 25th April), and those experiencing relaxed confinement (i.e. those completing the
140 questionnaire from 26th April up to 10th May). These date intervals were set in accordance to the
141 measures enacted by the Spanish Government in relation to the Covid-19 pandemic (1,2); strict
142 confinement did not allow any free movement of minors outside the household if not for medical
143 reasons or, in the case of those aged 15 or over, to do the shopping or take a dog for a short walk once
144 a day, and, in any case, keeping a compulsory social distance of one and a half meters from others. On
145 the other hand, relaxed confinement permitted minors aged below 14 years to go outside once a day
146 for no more than an hour, accompanied by an adult, in a time band from 9:00 a.m. to 9:00 p.m. and
147 keeping a social distance of two meters from others. Also, minors aged 14 years joined the group of
148 those aged 15 years or over to be allowed to do the same from that moment. Finally, from 2nd May
149 those aged 14 years or over were permitted to do physical activity outside the household in two specific
150 time bands (6:00 a.m. to 10:00 a.m. and 8:00 p.m. to 11:00 p.m.), whereas the time band for those aged
151 below 14 years was restricted to 12:00 a.m. to 7:00 p.m. for activities outside the home. Figure 1
152 displays an illustration of the key dates regarding this study.

153 **Insert Figure 1 here.**

154 2.4 Health-related behaviors (outcome)

155 Outcome variables were estimated through a set of four questions included in the survey in relation to
156 four HRBs (i.e. physical activity, screen exposure, sleep time, and fruit and vegetable consumption).
157 The answers of the parents to the following single-item questions were used as proxy measures of their
158 children's HRBs: "How many minutes of physical activity does your child usually perform weekly?",
159 and answers ranging from "0" to "More than 720", "How many hours is your child usually exposed to
160 screens such as TV, cell phone, and tablet daily?", with possible answers ranging from "0 hours" to
161 "more than 10 hours", "How many hours does your child usually sleep daily?, with answers comprising
162 from "less than 5 hours" to "more than 10 hours", "How many pieces of fruit and vegetables do your
163 child usually eat daily? , and possible answers ranging from "0" to "more than 5". These questions
164 were asked twice to the parents; first, referred to before the confinement setting and, second, regarding
165 the confinement setting. Single-item questions used to estimate HRBs such as physical activity have
166 shown high reproducibility (Spearman's rank correlation coefficients [$r=0.72-0.82$]), as well as a strong
167 agreement when meeting physical activity guidelines ($\kappa=0.63$, 95% CI 0.54-0.72) (20). Also, the
168 use of parents self-reporting to estimate children's physical activity and sedentary time has shown
169 significant positive associations when both were accelerometer-measured ($P<0.001$) (21).

170 Based on current guidelines and relevant research, a corresponding health risk behavior was defined
171 for each HRB as follows: less than 420 weekly minutes of physical activity (physical activity); more
172 than two hours of daily screen time (screen exposure); less than nine daily sleep hours (sleep time);
173 and less than three pieces of fresh fruits and vegetables a day (fruit and vegetable consumption) (22–
174 25). For each HRB participants were categorized into those meeting the definition of health risk
175 behavior and those not meeting the definition of health risk behavior.

176 2.5 Covariates

177 According to previous research (26–28), the present study also estimated age, gender, education of the
178 parents, previous condition, number of siblings, and exposure to Covid-19. Responses of the parents
179 regarding their children were categorized as follows: age (cut-off points for years were set according
180 to current school stages in Spain: infants [3-5 years], primary [6-12 years], and secondary [13-16
181 years]); education of the parents ("any of the parents holding a university degree" or "none of the
182 parents holding a university degree"); current condition ("experiencing any physical or mental
183 condition" or "not experiencing any physical or mental condition"; number of siblings ("having one or
184 more siblings" or "not having any sibling"); and Covid-19 exposure ("infected with Covid-19 or close
185 to an infected person" or "not exposed"). Finally, the previous health risk behavior of the children (i.e.
186 meeting or not meeting the definition of health risk behavior before the Covid-19 confinement) was
187 also considered.

188 2.6 Statistical analyses

189 Statistical analyses were conducted through Stata version 16.1 (StataCorp, Texas, USA). The
190 Kolmogorov–Smirnov test served to check normality. Differences between each HRB before and
191 during the confinement as well as between strict and relaxed confinement were respectively assessed
192 using paired t-test and t-test between groups. Also, the effect size for these differences was checked
193 calculating Cohen's d . Associations between type of confinement due to Covid-19 and each HRB were
194 assessed using binomial logistic regressions adjusted for covariates, providing adjusted odds ratios
195 (ORs) and 95% confidence intervals (CIs) for the whole sample. We also conducted stratified analyses

196 to check associations concerning gender, and age. Finally, propensity score with nearest-neighbor
197 matching served to further check the differences between strict and relaxed confinement for each HRB.
198 Participants with missing data in any study variable were discarded for the study (n=45). Levels of
199 significance were set at $p < 0.05$.

200 **3 Results**

201 The characteristics of the sample are presented in Table 1. A total of 860 children and adolescents on
202 average aged 9.6 (SD 3.9) participated in this study. Of those, 423 (49.2%) were girls, and 611 (71.1%)
203 were experiencing strict confinement. At the time of the questionnaire reply, 35 (4.1%) participants
204 declared having being exposed to Covid-19 and 144 (16.7%) having a previous condition. Overall, the
205 number of participants with siblings is 692 (80.5%), whereas those with any parent holding a university
206 degree represents a 28.8% of the sample.

207 ****Insert Table 1 here.****

208 Table 2 shows previous levels for each HRB as well as differences between before and during Covid-
209 19 confinement. Previous physical activity levels were estimated in 198.6 (SD 180.9) weekly minutes
210 for the whole sample; boys and younger participants reached the highest levels with 211.9 (SD 188.4)
211 and 223.0 (SD 198.0) weekly minutes, respectively. Screen exposure was overall estimated as 2.0 (SD
212 1.6) daily hours; boys 2.1 (SD 1.7) and older participants reach the highest levels 2.4 (SD 1.3) for this
213 HRB. Concerning daily sleep hours, these are estimated in 9.1 (SD 1.2) for the entire sample; the
214 subgroup of younger participants shows the highest values for this HRB: 9.8 (SD 1.2). Finally, daily
215 fruit and vegetable consumption is estimated in 3.2 (SD 2.0) pieces for all the participants: boys with
216 3.3 (SD 2.1) and those from the younger subgroup present the highest values for this HRB with 3.7
217 (SD 2.1) daily pieces in subgroup comparisons. Overall physical activity as well as all gender and age
218 subgroups display significant reduction between before and during the confinement; the subgroup of
219 participants aged between 6 and 12 years displays the highest reduction of weekly minutes (-120.4 [SD
220 159.0]). Also, screen exposure shows a significant increase for all the participants as well as for all
221 subgroups; the highest increase is observed for older participants who show 3.3 (SD 2.1) more daily
222 hours. Sleep time present significant differences only for the younger and older participant subgroups
223 with respectively -0.4 (SD 1.8) and 0.6 (SD 1.7) daily hours. Concerning daily fruits and vegetable
224 consumption, all the subgroups present significant reductions with the exception of the subgroup of
225 older participants; the highest reductions are presented in the subgroup of the younger participants (-
226 0.6 [SD 2.0]).

227 ****Insert Table 2 here.****

228 Table 3 shows differences concerning HRBs between strict and relaxed Covid-19 confinement. Sleep
229 time is the only HRB that shows significant differences in both overall and specific subgroups such as
230 boys (-0.4 [SD 0.2] daily sleep hours) and participants aged between 6 and 12 years (-0.3 [SD 0.2]
231 daily sleep hours).

232 ****Insert Table 3 here.****

233 Adjusted odds ratios for each health risk behavior during COVID-19 confinement are presented in
234 Table 4. Solely screen exposure shows significant odds reduction of health risk behavior overall (OR
235 0.60 95%CI 0.40-0.91) as well as in girls (OR 0.55 95%CI 0.31-0.99) and participants aged between 6
236 and 12 years (OR 0.26 95%CI 0.03-0.92).

237 **Insert Table 4 here.**

238 Finally, Table 5 shows the average treatment effect on treatment (relaxed confinement participants), in
239 which none of the HRBs present significant treatment effects.

240 **Insert Table 5 here.**

241 **4 Discussion**

242 The present study provides novel data from an unprecedented set of public health measures restricting
243 the mobility of children and adolescents as a result of the Covid-19 pandemic. The most relevant
244 finding in this study with an important sample of the Spanish child and adolescent population was that
245 overall examined HRBs, except for sleep time, worsened with the confinement. Also, only levels and
246 odds of health risk behavior for screen exposure significantly improved during the first weeks of
247 relaxed confinement, although further analyses did not confirm such a trend. Values for physical
248 activity, screen exposure, and fruit and vegetable consumption also worsened during the confinement
249 in all gender and age subgroups except for ≥ 13 and ≤ 16 years subgroup for the last case (i.e. fewer
250 minutes of weekly physical activity, more hours of daily screen exposure, and less daily pieces of fruit
251 and vegetable consumed), whereas only screen exposure improved (i.e. less time exposed to screens).

252 **4.1 Physical activity**

253 The association between social isolation and lower levels of physical activity in children was reported
254 a few decades ago (29). More recently, a reduction of physical activity (i.e. 2.30 hours/week) has been
255 found in prior research regarding confined children and adolescents due to Covid-19 (30); such values
256 were higher than those found in the present study, which observed a difference of 1.40 hours/week
257 respecting previous confinement levels. Differences between the two studies concerning physical
258 activity could be attributed to different sample characteristics; for instance, children from higher
259 socioeconomic backgrounds have shown higher levels of physical activity, whereas the context of
260 confinement might influence physical activity levels (e.g. more time confined or experiencing stricter
261 confinement can modify ordinary levels of physical activity) (28-31,32). Closure of schools during
262 both strict and relaxed confinement might play a key role in this found reduction since schools, and,
263 particularly physical education classes provide an adequate environment to promote active behaviors
264 among children and adolescents (33–35). Also, current research does not show evidence enough to
265 consider the possibility that such activity behaviors could be compensated at home (36,37). Finally,
266 because healthy habits such as active commuting to schools (i.e walking or cycling), which has been
267 associated to increasing overall physical activity, and reducing sedentary behaviors (38,39), have been
268 restricted during both strict and relaxed confinement, it was difficult to expect that those physically
269 active behaviors could be compensated at home; this might partially explain the finding of a recent
270 study observing adolescents living in rural areas as more prone to reduce their physical activity levels
271 during the Covid-19 pandemic when compared to their rural counterparts (40). Particularly, adolescents
272 with lower physical fitness were observed to greatly reduce their physical activity levels during the
273 Covid-19 pandemic (40, 41).

274

275 **4.2 Screen exposure**

276 With higher time spent at home, it was expected that screen exposure could reach higher levels than
277 before the Covid-19 confinement. A recent study found screen exposure to increase by 4 hours/day

278 among Italian children and adolescents during COVID-19 strict confinement (30). Furthermore, online
279 gaming and streaming activity have been observed to raise in different countries during the Covid-19
280 confinement (42). Also, ordinary school attendance has been largely substituted by both digital
281 homework and digital classes in Spain, which could have added more screen time to the already
282 existing before the confinement. Particularly, mobile phones could have had a significant impact on
283 teenagers' socialization processes and have added more screen time while confined (43); the lower
284 odds for health risk behavior observed for the ≥ 13 and ≤ 16 years' subgroup with the relaxed
285 confinement, could be also explained by higher opportunities to physically meet their friends.
286 Moreover, since Spanish workers have been instructed to telework at home during the Covid-19
287 confinement, the use of electronic devices might have contributed to increasing children's behavior as
288 regards exposure to screen since there is a possibility of children being influenced by their parent's
289 behaviors regarding this issue; family environment concerning screen exposure have been observed to
290 directly associate with children's exposure to screens (44). Further, the increase of hours exposed in
291 front of a screen observed in this study might also explain the lower levels of physical activity found
292 since higher screen time has been previously associated with lower physical activity among Spanish
293 adolescents (12).

294 **4.3 Sleep time**

295 Because children were experiencing a change as regards their usual daily habits, it was expected to
296 find different sleep times in this study; overall, sleep time variations are normal among children aged
297 between 3 and 7 years (45). However, contrarily to expected, sleep time tended to slightly increase
298 during the confinement, even though higher screen time and lower physical activity could have reduced
299 sleep time since the opposite was observed in prior research with children (46,47). However, this
300 increase was similar to what was found in another study among Italian children and adolescents during
301 the Covid-19 confinement (30), thus, this situation might have contributed to reinforcing timetables,
302 which, in turn, might have been useful to mitigate potential detrimental effects over adequate sleep
303 time (48). In contrast, a recent study among French adults found that 47% reported a decrease in sleep
304 quality during quarantine, with sleep reduction being the most associated factor (49).

305 **4.4 Fruit and vegetable consumption**

306 There is no prior evidence on how Covid-19 confinement might have influenced eating habits as
307 regards fruits and vegetables among children and adolescents. Interestingly, our study found an
308 important significant reduction of fruit and vegetable consumption during the Covid-19 confinement
309 for the subgroup of children aged between 3 to 5 years. A possible explanation for this finding might
310 be related to difficulties balancing family and working life since many parents have had to telework
311 while taking care of their children during the Covid-19 pandemic; this situation might have led to
312 poorer eating habits, particularly among those children potentially less independent (i.e. younger
313 children). Similarly, a study with Italian children and adolescents confined due to Covid-19 pandemic
314 showed higher red meat, potato chip, and sugary drink consumption (30), which suggests that, as
315 observed in the present study, eating habits overall might have worsened during the confinement. In
316 contrast, a recent survey among 600 Spanish adults reported that most of the participants maintained
317 vegetable and fruit consumption during the first five confinement weeks, although these results might
318 have changed after the whole confinement period (50). Also, lower food away from home consumption
319 was linked to changes in diet quality (i.e. less added sugars and added fats, and more fiber consumption)
320 (51), although, for this specific and unprecedented context differences regarding usual eating habits
321 and socioeconomic family status (i.e. higher family socioeconomic status usually lead to healthier
322 eating habits), self-regulating behaviors, and knowledge might play an important role (52). Also,

323 school canteen deprivation could influence the fruit and vegetable consumption since that has observed
324 to worsen healthy habits concerning diet (53). Besides, since the likelihood of eating at convenience
325 during Covid-19 confinement might have increased, that could have contributed to maintaining similar
326 levels of fruit and vegetable consumption during this period as the active choice could benefit this
327 behavior among children (54).

328 Overall, both parental guidance and example can strongly influence children's and adolescent
329 behaviors regarding diet, screen, and physical activity habits (55,56), which, in turn, could be also
330 influenced by socioeconomic variables such as education and income (i.e. higher education or higher
331 income may lead to healthier HRB) (52,57). Health complications for children and adolescents derived
332 from prolonged confinement or repeated viruses' outbreaks might comprise a higher fat percentage,
333 lower bone mineral density, lower motor competence, higher blood pressure, and higher socio-
334 emotional behavior problems later among others (58–63). Therefore, further research examining
335 longitudinal consequences of confinement over objectively assessed health behaviors (e.g. use of
336 accelerometers for estimating physical activity) would contribute to better understand the reasons for
337 changes in HRBs as well as to define better strategies aimed at vulnerable populations such as children
338 and adolescents; also, the study of adaptative patterns for HRBs as those observed for adults during the
339 Covid-19 confinement could contribute to better understand the nature and severity of these changes
340 (28).

341 **4.5 Strengths and limitations**

342 Strengths of the current study consist of examining a large and well-disseminated sample of Spanish
343 children and adolescents (i.e. participants from all the Spanish regions), and the analysis of an
344 important set of control variables such as previous health conditions or exposure to Covid-19 in the
345 referred time. Besides, the trends for specific HRBs such as physical activity or screen exposure remain
346 consistent overall as well as in subgroup analyses. On the other hand, an important limitation of this
347 study was self-reported data by parents, which may lead to recall bias; as suggested by Thorn et al.
348 (64) outcomes such as physical activity, screen, and diet reported by children possibly lead to different
349 estimations as regards their parents. Owing to their brevity, single-item questions have been
350 recommended to apply in specific contexts of illness and frailty (65), thereby, the authors decided to
351 use it in this specific context of confinement due to Covid-19 pandemic even though these specific
352 questions were not specifically validated. Also, the convenience sampling method used to recruit
353 participants might lead to a selection bias which, in turn, could have shown a biased estimation of the
354 study variables concerning the study population; thus interpretation of the results of this study should
355 be made in the light of this information. Further, the wide age range used for this study hampers
356 generalizations on populations of children of a specific age. Last, the observational design of the study
357 does not allow us to infer any causality.

358 **5 Conclusion**

359 The results found in the present study suggest that Covid-19 confinement substantially reduced
360 physical activity levels, increased both screen exposure and sleep time, and reduced fruit and vegetable
361 consumption, thus, most of HRBs worsen among a sample of Spanish children and adolescents. Also,
362 the first weeks of confinement did not seem to significantly improve HRBs, except sleep time.
363 Restrictive mobility measures with the closure of schools and high schools could have played an
364 important role in this HRBs worsening, which could be mitigated with policies for labor and family
365 time conciliation, parental guidance, and community support.

366 **Conflict of Interest**

367 The authors declare that the research was conducted in the absence of any commercial or financial
368 relationships that could be construed as a potential conflict of interest.

369 **Data Availability Statement**

370 The raw data supporting the conclusions of this article will be made available by the authors, without
371 undue reservation.

372 **Ethics Statement**

373 The studies involving human participants were reviewed and approved by Ethics Committee of
374 Research in Humans of the University of Valencia. The patients/participants provided their written
375 informed consent to participate in this study.

376 **Author Contributions**

377 RL-B, GL-S, AG-S, IG, LS, and JC contributed to the conception and design of the study. RL-B
378 organized the database. RL-B and LS performed the statistical analysis. RL-B wrote the first draft of
379 the manuscript. JC, AG-S, LS, IG, MT, and JAC wrote sections of the manuscript. All authors
380 contributed to manuscript revision and read and approved the submitted version.

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Table 1. Characteristics of the study sample.

N=860	n(%)	Mean(SD)
Gender		
Boys	437(50.8)	
Girls	423(49.2)	
Age		9.6(3.9)
Confinement		
Strict	611(71.1)	
Relaxed	249(28.9)	
Education of the parents		
Holding a university degree	248(28.8)	
Not holding a university degree	612(71.2)	
Siblings		
Yes	692(80.5)	
No	168(19.5)	
Current condition		
Yes	144(16.7)	
No	716(83.3)	
Exposure to Covid-19		
Yes	35(4.1)	
No	825(95.9)	
Physical activity (weekly minutes)		
Before confinement		198.6(180.9)
During strict confinement		95.5(123.8)
During relaxed confinement		97.8(121.4)
Screen exposure (hours/day)		
Before confinement		2.0(1.6)
During strict confinement		4.9(2.3)
During relaxed confinement		4.8(2.3)
Sleep time (hours/day)		
Before confinement		9.1(1.2)

Health behaviors in children and adolescents

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During strict confinement		9.3(1.6)
During relaxed confinement		9.0(1.7)
Fruit and vegetable consumption (portion/day)		
Before confinement		3.2(2.0)
During strict confinement		3.1(2.1)
During relaxed confinement		2.8(1.9)

Table 2. Differences regarding health-related behaviors before and during Covid-19 confinement.

	n(%)	Before confinement Mean (SD)	During confinement Mean (SD)	Difference (before and during confinement) (SD)	<i>t</i>	df	P value ^a	<i>d</i> ^b
Physical activity (minutes/week)								
Overall (n=860)		198.6(180.9)	96.1(123.0)	-102.5(159.6)	18.8	859	0.0000	0.66
Gender								
Boys	437(50.8)	211.9(188.4)	104.8(130.0)	-107.1(170.2)	13.1	436	0.0000	0.66
Girls	423(49.2)	184.9(172.0)	87.2(114.9)	-97.7(148.0)	13.6	422	0.0000	0.67
Age								
≥3 and ≤5y	162(18.8)	223.0(198.0)	131.0(160.2)	-92.0(174.0)	6.7	161	0.0000	0.51
≥6 and ≤12y	459(53.4)	209.0(180.0)	88.6(112.4)	-120.4(159.0)	16.2	458	0.0000	0.80
≥13 and ≤16y	239(27.8)	162.1(165.3)	86.9(109.3)	-75.2(146.4)	7.9	238	0.0000	0.54
Screen exposure (hours/day)								
Overall (n=860)		2.0(1.6)	4.9(2.3)	2.9(2.1)	39.4	859	0.0000	1.43
Gender								
Boys	437(50.8)	2.1(1.7)	5.0(2.4)	2.9(2.2)	28.0	436	0.0000	1.43
Girls	423(49.2)	1.9(1.5)	4.7(2.3)	2.8(2.1)	27.7	422	0.0000	1.44
Age								
≥3 and ≤5y	162(18.8)	1.7(1.9)	3.9(2.0)	2.2(2.4)	11.6	161	0.0000	1.13
≥6 and ≤12y	459(53.4)	1.9(1.5)	4.7(2.3)	2.9(2.0)	30.8	458	0.0000	1.46
≥13 and ≤16y	239(27.8)	2.4(1.3)	5.8(2.3)	3.3(2.1)	24.7	238	0.0000	1.74
Sleep time (hours/day)								
Overall (n=860)		9.1(1.2)	9.2(1.6)	0.1(1.8)	1.5	859	0.1288	0.06
Gender								
Boys	437(50.8)	9.1(1.2)	9.3(1.6)	0.2(1.7)	1.9	436	0.0648	0.11
Girls	423(49.2)	9.1(1.2)	9.1(1.7)	0.0(1.8)	0.3	422	0.7635	0.02
Age								
≥3 and ≤5y	162(18.8)	9.8(1.2)	9.4(1.7)	-0.4(1.8)	3.1	161	0.0025	0.30
≥6 and ≤12y	459(53.4)	9.2(1.1)	9.2(1.6)	0.0(1.7)	0.1	458	0.9563	0.00
≥13 and ≤16y	239(27.8)	8.5(1.0)	9.1(1.7)	0.6(1.7)	5.4	238	0.0000	0.44
Fruit and vegetable consumption (portion/day)								
Overall (n=860)		3.2(2.0)	3.0(2.1)	-0.2(1.6)	3.4	859	0.0007	0.09
Gender								
Boys	437(50.8)	3.3(2.1)	3.1(2.2)	-0.2(1.6)	2.3	436	0.0213	0.08
Girls	423(49.2)	3.1(1.9)	2.9(1.9)	-0.2(1.6)	2.5	422	0.0125	0.11
Age								
≥3 and ≤5y	162(18.8)	3.7(2.1)	3.1(2.1)	-0.6(2.0)	3.7	161	0.0003	0.28
≥6 and ≤12y	459(53.4)	3.1(2.0)	2.9(2.0)	-0.2(1.5)	2.7	458	0.0064	0.10

Health behaviors in children and adolescents

≥13 and ≤16y	239(27.8)	3.0(2.0)	3.1(2.1)	0.1(1.4)	1.1	238	0.2800	0.05
^a T-paired test (before and during confinement). ^b Cohen's d: Small 0.20; Medium 0.50; Large 0.80.								

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Health-behaviours in children and adolescents

Table 3. Differences regarding health-related behaviors between strict and relaxed Covid-19 confinement.								
	n(%)	Strict confinement Mean (SD)	Relaxed confinement Mean (SD)	Difference (strict and relaxed confinement) (SD)	t	df	P value^a	d^b
Physical activity (minutes/week)								
Overall(n=860)		95.5(123.8)	97.8(121.4)	2.3(9.3)	0.2	858	0.8051	0.02
Gender								
Boys	437(50.8)	103.8(130.0)	107.4(130.6)	3.6(13.7)	0.2	435	0.7924	0.03
Girls	423(49.2)	86.9(116.7)	87.9(110.8)	1.0(12.3)	0.1	421	0.9341	0.01
Age								
≥3 and ≤5y	162(18.8)	119.8(148.0)	156.2(183.7)	36.4(27.2)	1.3	160	0.1826	0.23
≥6 and ≤12y	459(53.4)	90.2(119.9)	84.9(93.2)	-5.3(11.4)	0.5	457	0.6414	0.05
≥13 and ≤16y	239(27.8)	89.6(113.0)	78.8(99.5)	-10.8(16.3)	0.7	237	0.5098	0.10
Screen exposure (hours/day)								
Overall		4.9(2.3)	4.8(2.3)	0.1(0.2)	0.8	858	0.4345	0.06
Gender								
Boys	437(50.8)	5.1(2.4)	4.8(2.3)	-0.3(0.2)	1.2	435	0.2075	0.13
Girls	423(49.2)	4.7(2.3)	4.7(2.4)	0.0(0.2)	0.2	421	0.8478	0.02
Age								
≥3 and ≤5y	162(18.8)	4.0(1.9)	3.9(2.2)	-0.1(0.3)	0.3	160	0.7290	0.06
≥6 and ≤12y	459(53.4)	4.7(2.3)	4.8(2.3)	0.1(0.2)	0.4	457	0.6543	0.05
≥13 and ≤16y	239(27.8)	5.9(2.3)	5.4(2.4)	-0.4(0.3)	1.2	237	0.2315	0.18
Sleep time (hours/day)								
Overall		9.3(1.6)	9.0(1.7)	-0.3(0.1)	2.3	858	0.0209	0.17
Gender								
Boys	437(50.8)	9.4(1.6)	9.0(1.6)	-0.4(0.2)	2.2	435	0.0255	0.23
Girls	423(49.2)	9.2(1.6)	9.0(1.8)	-0.2(0.2)	1.0	421	0.2956	0.11
Age								
≥3 and ≤5y	162(18.8)	9.5(1.6)	9.2(1.8)	-0.3(0.3)	0.9	160	0.3715	0.15
≥6 and ≤12y	459(53.4)	9.3(1.6)	9.0(1.7)	-0.3(0.2)	2.1	457	0.0350	0.21
≥13 and ≤16y	239(27.8)	9.2(1.6)	9.0(1.8)	-0.2(0.2)	0.8	237	0.4010	0.13
Fruit and vegetable consumption (portion/day)								
Overall		3.1(2.1)	2.8(1.9)	-0.2(0.2)	1.6	858	0.1127	0.12
Gender								
Boys	437(50.8)	3.2(2.3)	2.9(1.9)	-0.3(0.2)	1.4	435	0.1554	0.15
Girls	423(49.2)	2.9(1.9)	2.8(2.0)	-0.2(0.2)	0.8	421	0.4356	0.08
Age								
≥3 and ≤5y	162(18.8)	3.2(2.0)	3.1(2.4)	-0.1(0.4)	0.2	160	0.8463	0.03
≥6 and ≤12y	459(53.4)	3.0(2.1)	2.7(1.8)	-0.3(0.2)	1.3	457	0.2073	0.13

≥13 and ≤16y	239(27.8)	3.2(2.2)	2.8(1.9)	-0.3(0.3)	1.1	237	0.2828	0.16
^a T-test between groups (strict and relaxed confinement). ^b Cohen's d: Small 0.20; Medium 0.50; Large 0.80.								

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Table 4. Adjusted odds ratios (95% confidence interval) for each health risk behavior during Covid-19 confinement in the entire study population and in age and gender subgroups (reference group: strict confinement).

n=860	Confinement	n(%)	Physical activity		Screen exposure		Sleep time		Fruits and vegetable consumption	
			Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b	Model 1 ^a	Model 2 ^b
All	Strict	611(71.1)	1	1	1	1	1	1	1	1
	Relaxed	249(29.0)	0.98(0.50-1.92)	0.72(0.34-1.54)	0.66(0.44-0.99)	0.60(0.40-0.91)	1.40(1.03-1.93)	1.31(0.95-1.81)	1.13(0.77-1.66)	0.79(0.46-1.36)
Gender										
Boys	Strict	311(71.2)	1	1	1	1	1	1	1	1
	Relaxed	126(28.8)	1.04(0.44-2.42)	0.78(0.30-2.03)	0.66(0.36-1.20)	0.63(0.34-1.19)	1.34(0.86-2.11)	1.30(0.81-2.09)	0.93(0.56-1.56)	0.60(0.28-1.28)
Girls	Strict	300(70.9)	1	1	1	1	1	1	1	1
	Relaxed	123(29.1)	0.85(0.28-2.60)	0.74(0.20-2.71)	0.66(0.38-1.14)	0.55(0.31-0.99)	1.47(0.95-2.28)	1.31(0.83-2.05)	1.42(0.80-2.54)	1.03(0.47-2.28)
Age										
≥3 and ≤5y	Strict	112(69.1)	1	1	1	1	1	1	1	1
	Relaxed	50(30.9)	0.51(0.19-1.39)	0.36(0.11-1.22)	0.60(0.29-1.27)	0.57(0.26-1.23)	1.17(0.55-2.49)	1.02(0.46-2.62)	0.97(0.43-2.17)	1.10(0.28-4.29)
≥6 and ≤12y	Strict	320(69.7)	1	1	1	1	1	1	1	1
	Relaxed	139(30.3)	2.10(0.57-7.17)	1.10(0.26-4.39)	0.81(0.48-1.38)	0.78(0.45-1.36)	1.38(0.90-2.11)	1.25(0.80-1.93)	1.36(0.79-2.32)	0.90(0.44-1.84)
≥13 and ≤16y	Strict	179(74.9)	1	1	1	1	1	1	1	1
	Relaxed	60(25.1)	1.05(0.20-5.45)	0.66(0.11-4.16)	0.31(0.09-0.99)	0.26(0.03-0.92)	1.62(0.88-2.96)	1.60(0.86-2.98)	0.92(0.44-1.94)	0.31(0.09-1.05)

^aAdjusted for age and gender (all participants), for gender (age categories), and for age (boys, girls)

^bModel 1+ education, siblings, current condition, exposure to Covid-19, and previous health risk behavior.

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Table 5. Differences between relaxed confinement and strict confinement for each health-related behavior.				
Health-related behavior	ATT			
	Treated	Control	Difference (SD)	p
Physical activity (minutes/week)	97.8	90.0	7.8(9.5)	0.393
Screen exposure (hours/day)	4.8	4.9	-0.1(0.2)	0.464
Sleep time(hours/day)	9.0	9.1	-0.1(0.2)	0.270
Fruits and vegetable consumption (portion/day)	2.8	3.1	-0.3(0.2)	0.105
ATT=average treatment effect on treated calculated as a difference for each health-related behavior between the relaxed confinement (treated) and strict confinement (control); difference = treated – controls SD=Standard Deviation				

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Figure 1. Timeline of the most important Covid-19 confinement measures regarding minors in Spain.

