**Psychometric Evaluation of the French Version of the Children’s Chronotype Questionnaire: Sleep Habits and Academic Performance of Native and Immigrant Children in Luxembourg**

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**Acknowledgments**

This work was supported by the Psychology Research Center (CIP) of Universidade Autónoma de Lisboa, Luís de Camões (UAL), Lisbon, Portugal.

**Word Count: 6356**

**Abstract**

This paper examined the psychometric properties of the French version of the Children's Chronotype Questionnaire (CCTQ) attending two elementary schools in Luxembourg (n=172; ages 4-11 years, M= 8.0, SD= 2.1) of either Portuguese (n=11), Luxembourgian (n=147), or other (n=15) ethnicity. Parents completed the CCTQ, from which we used two chronotype scales (i.e. midsleep point on free days; MSF, multi-item morningness/ eveningness; M/E). Results indicated satisfactory internal consistency for M/E scale (α = .70), with high intercorrelation scores (*r* = .91 between items; *r* = .87 between scales). As hypothesized, the chronotype of morning and evening type children were different (*p*=.017, η2=.06), with the former having an earlier MSF (M= 5:29h) compared with the latter (M= 5:48h). The evening group showing the poorest outcomes for the qualitative grades at the end of two school years (2014/2015: F(7.308)= 2.34, p=.002; 2015/2016: F(7.996)= 2.46, p=.001). No significant differences in MSPc or the morningness/eveningness parent-report scores were found between natives and immigrants. The results indicate that the French version of the CCTQ has adequate reliability and validity for research studies. Evaluating chronotype and sleep behaviors in preschool and school age children is important, as both may have a negative impact on academic performance.

**Keywords**: chronotype, biological rhythms, validation, Children's Chronotype Questionnaire, academic performance, immigrants.

**Introduction**

This study describes the psychometric properties of the French version of the Children's Chronotype Questionnaire (CCTQ) (Werner et al. 2009) and examines sleep and wakefulness habits of multicultural groups of children who follow different school schedules. Although sleep and chronotype are increasingly recognized as significant factors influencing performance and optimization of wakefulness at different times of the day, these can vary according to the age and cultural characteristics of the individuals, especially in the context of schools with high immigrant and multilingual representation (Pande et al. 2018).

Chronotype or circadian preference refers to the phase position or diurnal preference of an individual, which is categorized into the following typologies: morning, intermediate and evening (chronotype or diurnal types) (Horne and Östberg 1977; Randler 2008). Chronotype has been measured mainly in adult samples using well-documented and validated instruments that are based on reports of sleep timing (i.e., bedtime, lights-off time, sleep onset latency, wake time, get out of bed time) on “free” days and on days with scheduled activities (e.g., school, professional schedules). From these variables, the midsleep point is computed, with a correction for oversleeping on free days if needed (Roenneberg et al. 2007; Werner et al. 2009). Circadian preference can also be evaluated from multi-item questionnaires that assess specific times of the day that an individual prefers to perform activities (Couto et al. 2014; Díaz-Morales and Randler 2017; Escribano and Díaz-Morales 2014; Smith 1989). Despite the growing number of studies of circadian preference and academic performance of adolescents and university students (Tonetti et al. 2015), understanding chronotype in school age children remains poor, not only in terms of description, but also with regard to examining associations between circadian preference and learning, health, and academic performance (Randler et al. 2019).

Children are thought to be more predisposed to morningness than eveningness (Tonetti et al. 2015), while adolescents undergo a delay in their phase preference, which reaches a maximum for the evening type around the age of 20 years (Crowley et al. 2008; De Souza and Hidalgo 2014; Randler 2008; Roenneberg et al. 2004; Tonetti et al. 2015). However, data from recent studies suggest that the peak of eveningness appears earlier in adolescence than previously observed (Clara et al. 2019; Randler et al. 2017; Shimizu et al. 2019; Tonetti et al. 2008). Individuals with an earlier chronotype show better performance on tests administered in the morning, but the quality of performance decreases throughout the day. Evening types present with an opposite pattern, with poor morning performance that increases later in the day (Escribano and Díaz-Morales 2014).

Arbabi et al. (2015) described MSP variability in 1125 children (~10 years of age) and found that morning type individuals were more likely to score higher on an IQ tests (administered on Arbabi et al. study) and also the participants show more conscientiousness. Conscientiousness is considered as one of the main predictors of academic achievement attending to the context of the Big Five-Factor Personality Inventory-Children (McGhee et al. 2007). Conscientiousness is related to the concentration for the tasks-execution and achievement. Similarly, Demirhan et al. (2018) and Carciofo et al. (2016) found associations between conscientiousness and other positive mental states with morning type individuals. On the other hand, Owens et al. (2016) and Carciofo et al. (2016) found that eveningness was related to daytime sleepiness and self-regulation. Due to assigned and rigid school schedules, children may not be in sync with their morningness/eveningness preference, thus being more vulnerable to sleep restriction (Chandrakar 2017). Such a mismatch may also result in poor sleep quality, daytime sleepiness and mood disturbances (Drake et al. 2003; Randler et al. 2019). There is likely an advantage for morning types, who attain better results compared to the performance of evening type persons, considering that the school tasks and tests take place mostly in the morning (Carciofo et al. 2016; Demirhan et al. 2018; Finimundi 2013; Menna-Barreto 2003).

Studies examining chronotype and its associations focus mostly on older populations (Escribano and Díaz-Morales 2014), including adults and adolescents (Di Milia et al. 2013; Tonetti et al. 2015) and concluding mostly high scores for evening type. However, Figueiredo et al. (2018) in a study evaluating the performance evaluation of children in WISC-IV tasks, found that the sample of children included a very high percentage of evening types, contrary to what the literature proposes for school age subjects. On the other hand, Clarisse et al. (2004), in a study with children aged 8 to 10 years, and Werner et al. (2009) in a study with children aged 4 to 11 years, concluded that children have different waking up, rising and falling asleep behaviors during the week, with relevance to the impact of type of school. Concerning the social jetlag, Chandrakar (2017) concluded that sleep schedules might suffer significant variance during the week considering habits such as the time spent watching television and mainly affecting young males.

The aim of this study was to describe the psychometric properties of a French version of the Children's Chronotype Questionnaire (CCTQ) and to examine its feasibility for the Luxembourgian population aged 4 to 11 years, intentionally including native and immigrant children. The CCTQ was initially developed based upon a sample of Swiss school age children and then translated to Portuguese and tested in 8 – 11 year old children (Couto 2011; Couto et al. 2014). Results indicated that the CCTQ had good internal consistency and reliability. In the present analysis, the chronotype and sleep/wake behaviors of Luxembourgian children (including native and immigrant children) were identified based on a parent report questionnaire. We hypothesize: (1) a greater proportion of morning type children than evening type children (Roenneberg et al. 2004); (2) sleep behaviors differ according to age and native/immigrant status: insufficient sleep time for older children and for immigrants; and (3) and better school performance for the morning than the evening type children.

**Method**

***Participants***

172 children, aged 4 to 12 years (M= 8.0, SD= 2.1), 78 (45,3%) males and 94 (54.7%) females. 147 (84.9%) born in Luxembourg, 11 (6.4%) born in Portugal and 14 (8.7%) born in another country. The participants attended two elementary schools according to the cycles of Basic Education - 4-11 years old - in Luxembourg’s educational system, in the north of the country, with three school schedules differentiated according to days of the week (the distribution of the schedules are similar in the schools studied): (1) morning/ afternoon (2), morning schedule and (3) and afternoon schedule. Children were included if aged 4.0-11.9 years and excluded if they had sleep disturbances pathologies. Table 1 presents the descriptive statistics regarding the age and school year of the sample.

TABLE 1 INSERT HERE

***Protocol***

We obtained permission from the School Board and parental consent according to the Helsinki model, which ensures the anonymity and confidentiality of the information collected. Parents then completed the questionnaire. During 2015-2016, the two schools were contacted and well informed to ensure the authorization to conduct this study, involving teachers, school administration, the Luxembourg Education Ministry and the families of children selected for the sample. Simultaneously, the authors authorized on October 2015 for the adaption of the original CCTQ to French language and considering the adaptation to the Luxembourgish population. Secondly we required permission to use the adapted Portuguese version of the CCTQ (Couto 2011; Couto et al. 2014;) to administer to the Portuguese immigrant children in Luxembourg.

For the adaptation and validation process, a multi-step was performed such as the translation, the semantic validation and the psychometric evaluation (Randler et al. 2019). The validation involved the translation and back-translation procedures: firstly the original CCTQ (Werner et al. 2009) was translated to French, then from French to Portuguese and backward. We utilized different bilingual translators for each step: translation and back-translation. The Principal Researcher of this project supervised the process and the translators were not informed about the original English version or the Portuguese translation of the CCTQ. Third, the adapted (and provisional) version was tested in a pilot sample (n =35), in Luxembourg’ schools, between January and February 2016. Test-retest reliability was assessed in this pilot group pre- and post-three weeks. The adaptation process in the linguistic phase was supervised by the translators who were from the Psychology and Sleep Research fields (Randler et al. 2019). As such, we ensured that conceptual and semantic equivalence were attained. Concerning cultural differences between natives (Luxembourgish) and the immigrants at the selected schools, the question of the original questionnaire were fully reviewed in order to ensure that the concepts of sleep and related habits were understood. The pilot study and support from a research assistant from Luxembourg and fluent in both Portuguese and French facilitated the cultural adaptation and clarity of the French version. Concepts such as the bedtime and sleepiness (considering the French language and dialects existent in the north of the Luxembourg) were reviewed in the new version, for Luxembourg context, in order to assure the comprehension of all the questions. Compared to the original version (Werner et al. 2009), there were no conceptual changes to be noticed and no factorial variance. The three scales were maintained as determined by the previous authors of the CCQT. After the semantic validation process based on the pilot study, the final French version of the CCTQ was established and sent to the schools. Before the distribution of the CCTQ, there were several sessions, at schools, to present the study and its impact for the sleep and educational research.

In May and June 2016, the Ministry of Education of Luxembourg (“Ministère de l'Éducation Nationale, de l'Enfance et de la Jeunesse”) allowed our group to initiate this study. The protocol followed the procedures of ethics and data protection (European Commission). The CCTQ was competed by parents at home (after each teacher ensure the delivery for the respective children’ families). 134 questionnaires were completed by the mother, 25 by the father, and 13 by both parents. The schools received the questionnaire directly from the parents and delivered it to the researcher assistant in the field.

***Instrument***

The CCTQ includes three scales to assess chronotype. In this study, we chose to report results from two scales:

i) The midsleep point provides data from items that measure two sleep regimes differentiated according to free days (MSF) and scheduled days. The days with schedules (SCDs) refer to school days or with school and extracurricular activities. The free days (FDs) refer to days without school and no scheduled activities. The MSP for both SCDs and FDs is obtained using the formula of Roenneberg et al. (2004) and corrected for any mismatch (deficit or excess hours) produced by the combination of sleeping hours in SCDs and FDs (MSFsc). For this correction, the following algorithm was used (Werner et al. 2009):

5 x sleep period during SCDs + 2 x sleep period during FDs/7

ii) The Morningness/Eveningness (M/E) scale includes 10 items that measure circadian preference of 4-11 years old children. The calculation results from the sum of the scores (Werner et al. 2009). All questions refer to the preferred habits and effective behaviors of children regarding their sleep/wake status. In this study, the scores varied between 17 and 35. According to the percentiles obtained, in the group of children aged 4-7 years, subjects with scores below 22 are of the morning type, those scoring between 23 and 24 are intermediate, and those with a score above 25 are evening type; in the 8-11 years old group, those with scores below 24 are of the morning type, those with up to 26 points are intermediate and those scoring above 27 points are of the evening type. The rational of the calculations presented above followed the standard of the original version of the instrument (Werner et al. 2009).

***Statistical Analysis***

Data were analyzed with SPSS, version 24. The descriptive analysis of the sample was first summarized. Univariate analysis of variance (ANOVA) was used to compare means between the groups (one-tailed test) based upon our study hypotheses. In the univariate analysis, the effect size eta squared (η2) calculations according to Cohen's standard were also presented. For the post-hoc tests we used the Bonferroni test. We considered the normality tests of the sample and the non-parametric Kruskal-Wallis test was used for non-homogeneous samples for variance analysis (verified using Levene’s test).

The midsleep point involves categories such as bedtime, falling asleep, wake-up, and get-up times as the study participants (the parents) often indicated several minute intervals for the referred variables, not being restricted to 15 minute intervals. This variety of answers was also seen in the Portuguese adapted study (Couto et al. 2014) and in this sample. Given that this variability led to asymmetry and kurtosis in the variables, we used non-parametric tests for these variables.

In order to determine the cut-off point of the three chronotype categories (morning, intermediate and evening), percentiles were used as it was the statistical test used by the authors of the instrument (Werner et al. 2009). MSF and MSFsc were calculated according to the reference algorithm identified above (Roenneberg et al. 2004). Also, for the validation objective of the French version of the instrument, the internal consistency between the scales was determined using the validity test (α).

**Results**

The French version of the CCTQ showed strong internal consistency for the M/E scale (α = .70), with high intercorrelations between scales and respective items (*r* = .87 between the scales; *r* = .91 between items).

Based upon the premise of the literature regarding the high prevalence of morning types in children, we first tested the hypothesis that younger children (age 4-7 years) would present with a predominantly morning type compared to older children (age 8-11 years). After computing descriptive statistics, we determined cutoff points based upon the following percentiles: 10 (extreme morning type), 25 (moderate morning type), 50 (intermediate type), 75 (moderate evening type) and 90 (extreme evening type). However, different cut-off points were used according to the two age groups (4-7 years and 8-11 years) and according to the procedure of the original version (Table 2). Results showed that 58 (31.5%) were morning type, 48 (26.1%) were intermediate type, and 66 (36%) were evening type. In contrast to the original psychometric study of the CCTQ and other validation studies on chronotype measurement in children, the M/E score was significantly associated with age. In addition, school age children were almost equally morning and evening chronotype, we observed a high evening type rate (began in 50th percentile for both age groups, see Table 2). Table 2 presents means and percentiles according for younger and older children by their chronotype classification.

TABLE 2 INSERT HERE

We then examined the differences between sleep behaviors (e.g. sleep period on free days and scheduled days, sleep inertia, MSFsc) on SCDs and FDs. We found that median sleep (attending to the Kruskal-Wallis test) was higher on FDs (M= 10.8h; SD= 9.1h) than on SCDs (M= 10h; SD=6.3h); the corrected MSF (MSFc) shown a median of 5.4h (SD= 1.03h) and sleep inertia (time difference between waking up and the time of being fully awake) was similar at both ages.

With regard to the comparison between the sleep period on SCDs and FDs (computing the results regarding the indicated time for effective onset of sleep and the results regarding the effective time the children wake up), the Wilcoxon test revealed statistically significant differences (Z = -7.20, p= .001), but no statistical differences between age groups were identified in sleep inertia. On the other hand, significant differences (Z = -10.41, p= .001) were found between the sleep period on days with schedules and the MSFc.

As for distribution, the Kolmogorov-Smirnov test revealed a normal distribution (p > .05) for the SCDs and FDs sleep periods, as well as for the MSFsc. Differently from what was observed in a previous study of the Portuguese version of the CCTQ (Couto 2011) there were significant differences between the MSFsc and other variables of chronotype such as sleep inertia.

Significant differences in sleep behaviors (sleep period on FDs and on SCDs, sleep inertia and MSFc) were expected among children according to their age and native/immigrant status. As there was homogeneity in the variance for the age-related samples, univariate tests of variance was conducted. Regarding the MSFsc, it revealed significant differences between the age groups, especially among children aged 4 and 10 years (F(71.074)= 9, p= .000, η2 .83) and also among children attending the morning/afternoon school schedule (F(2.665)= 8, p=.009, η2.136).

For chronotype, it was important to confirm that morning and evening children were significantly different (F(201.179)= 3, p=.000, η2 .81), the former having earlier MSFsc (M= 5:29h) compared to the latter (M= 5:48h). Nationality, mother tongue and school schedules were control variables for these univariate tests. However, there were no significant differences between natives and non-natives. Table 3 shows descriptive statistics of the three groups of participants according to the country of origin and attending to the variables (for example: awake time) with significant differences achieved between the three participants’ groups..

TABLE 3 INSERT HERE

For the variable "academic results" (here the academic results referring to the qualitative evaluation obtained at the end of each school year: “excellent” or “not satisfactory”), the ANOVA results showed significant differences between the chronotype groups (p < .05). The chronotype groups differed regarding the school results for the latest school academic years (considering the period of this study): 2014/2015 (F(7.308)= 2.34, p=.002) and 2015/2016 (F(7.996)= 2.46, p=.001). Concerning the school year of 2014/2015, the difference was significant between evening (M= 3.03; SD= 1.11) and intermediate type (M= 1.38; SD= .518) children. The intermediate type revealed to have better grades comparing to the evening type individuals. For the latest (2015/2016), the difference was significant between all the groups: morning, intermediate and evening types. The morning and intermediate types presented high means for positive classifications at the end of the school year compared to the evening children (Morningness: M= 2.21; SD= 1.03; Intermediate: M= 1.60; SD= .699; Eveningness: M= 3.03; SD= 1.01).

**Discussion**

The data obtained in this study extend results from previous research (Couto et al. 2014; Couto 2011; Werner et at. 2009), as well as the feasibility of the French version of the CCTQ with regard to the evaluation of chronotype and sleep/wake habits of school children (4-11 years old). The results suggest that the instrument has good psychometric properties for sleep and chronotype research involving children. Thus, the cut-off point values were slightly different from the cut-off points inferred from previous studies (Werner et al. 2009; Couto et al. 2014). The variability of cut-off points according to populations has been attributed to culture and geography, in addition to gender and age (Achari et al. 2007; Caci et al. 2009; Jankowski 2015). Studies in cultural and linguistically distinct populations (Díaz-Morales and Randler 2017; Doi et al. 2014; Pandeet al. 2018; Randler et al. 2019) have corroborated the importance of assessing chronotype to detect differences in sleep behavior.

In the present sample of 4-11 year-old children, a similar proportion of morning, intermediate and evening children were identified, which is not in line with the assumption that children are mainly morning types (Werner et al. 2009; Roenneberg et al. 2004; Arbabi et al. 2015; Díaz‐Morales 2007); however, within a narrow age range (30-36 months), both midpoint of sleep time on free days and the M/E score from the CCTQ were normally distributed. Further, Achari et al. (2007), Borisenkov et al. (2010), Díaz-Morales and Randler (2017), Randler (2008) and Randler et al. (2019) conducted studies of diverse nationalities to further understanding of how latitude and other factors influence the chronotype of populations in different geographies. The present results underline the need to understand the behaviors of children who present an evening chronotype that is usually associated with emotional and disciplinary problems, academic instability and other behaviors that may have implications on development (Couto et al. 2014; Yokomaku et al. 2008).

These data suggest differences between sleep behaviors on days with schedules and on free days. The results indicated that the midsleep phase is later on free days than on days with schedules, which was expected considering that on days without imposition of schedules the subjects are expected to compensate for sleep deficits resulting from the days with schedules. It should also be noted that the MSF on FDs and on SCDs differ in 19 minutes, which did not correspond to the data obtained in previous studies (Arbabi et al. 2015; Clarisse et al. 2004; Couto 2011; Couto et al. 2014;). Moreover, the sleep inertia in both types of periods (FDs and SCDs) was also 15 minutes, without significant variation (Werner et al. 2009). On the other hand, this study presented additional data insofar as the previous study of this instrument in Portugal (Couto 2011; Couto et al. 2014) found no significant differences between the MSFc and other factors. It should be noted that in this study, variables such as nationality, mother tongue and school hours are new factors that were not examined in previous studies.

It should be noted that the 4 and 10-year-old children were the two specific age groups with the greatest differences in midsleep period (MSF). That is, the chronotype of the 4-year-old child is different from the chronotype of the 10-year-old child, which has repercussions on sleep and waking time. This result is consistent with other studies (Yokomaku et al. 2008), which concluded that preschool children may present significant differences in waking up, getting up and getting to bed behavior compared to other groups of children, which influences the child's psychosocial behavior. Further, previous studies indicate that the proportion of evening types is similar to that of morning and intermediate types in infancy, even though the morning type would be expected to predominate. On the other hand, it is likely that the preschool age group is more of the morning type, whereas the school-aged children are less morning type (Sadeh et al. 2002; Simpkin et al. 2014). The chronotype implications associated with children's performance have been reported in previous studies of 10-year-old children (Arbabi et al. 2015). Still, with regard to the native and non-native group, it was not confirmed that there were statistically significant differences regarding their sleep time and MSF.

We found differences regarding the qualitative classifications obtained by the three chronotypes considering two school years (2014/2015 and 2015/2016). Those classifications were determined as a general (qualitative) score only referring to the end of the school year. Specifically, there were differences between the evening and intermediate type children (2014/2015 school year) and also between evening and morning/intermediate type individuals (2015/2016 school year), who differed in their academic classifications, with prejudice for the evening type. These data are in line with previous studies confirming that academic performance is impaired by problems in the organization of the sleep cycle (Bryant 2013; Finimundi et al. 2013; Lack et al. 2007; Menna-Barreto 2003 ). Academic performance is very sensitive to chronotype variations (Baum et al. 2014) and the evening type is usually associated with a higher risk of academic failure because of the difficulty they have adapting to school schedules (Achilles 2003). Thus, the data in this study regarding the highest failure rate of the evening type children replicate the conclusions of previous studies. Despite our findings, further analysis is needed on associations between academic performance and chronotype.

Overall, our results suggesting the French version of the CCTQ has satisfactory reliability and validity for use in research studies; however, this study has several limitations. First, there was a lack of control for nationality variables. For example, different language speakers might influence sleep habits and sleep schedules and they should be controlled as covariates in future studies. Second, this study was conducted through parent-report, which may result in bias regarding the categorization of behavior, especially regarding the academic performance of children. Third, we did not distinguish between who reported on the chid’s behavior. It would be interesting to determine if the results would differ when answered by father/mother (Randler et al. 2012; Yamazaki 2007). Finally, the sample was not balanced in terms of the number of immigrants compared to natives and our sample size was overall small, which likely decreased our power in detecting differences between ethnic groups. Immigration is becoming a variable of interest in the area of sleep, thus, it is crucial to replicate our study findings on chronotype with a larger sample of non-native children. Furthermore, future studies should consider replication in the same population (Luxembourg) who experience differentiated school schedules. Additionally, work is needed that focuses on the multicultural issue of classes and the impact of immigration (and refugee groups) on the variability in MSF and defining chronotype, which may have direct implications on the school schedules assigned to students.

**Conclusion**

In summary, this study contributes to international sleep research in children and suggests the French version of the CCTQ has adequate psychometric properties for research studies. It is a pioneering study for the Luxembourgian population: to our knowledge, there are no similar studies involving this population that also considered their diverse cultural characteristics and the practice of different school schedules. On the one hand, this study presents new data on the chronotype of childhood populations in terms of nationality and school schedules. On the other hand, it highlights data consistent with previous studies on variations in MSP, the preferences of morning and evening types regarding school tasks at specific times of the day, and on performance and its relation to the chronotype of the children. It is necessary to replicate this type of study in more samples in order to more effectively assess chronotype and ascertain its implications for the development and performance of school-aged children, particularly in terms of the adequacy of schoolwork schedules. Considering the increase in the school age refugee population, assessing chronotype differences due to time zone, sleep habits, and different school and health habits is an important area of future investigation.

**Acknowledgments**

This work was supported by the Psychology Research Center (CIP) of Universidade Autónoma de Lisboa, Luís de Camões (UAL), Lisbon, Portugal.

**Disclosure statement**

The authors report no conflicts of interest. We confirm that participants in this research consented to the inclusion of material pertaining to themselves and the data is anonymous.

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Table 1.

|  |  |  |
| --- | --- | --- |
| Variable |  | Frequency (%) |
|  | 3-5 | 24 (13%) |
|  | 6 | 19 (10%) |
|  | 7 | 22 (12%) |
|  | 8 | 44 (24%) |
|  | 9 | 21 (11%) |
|  | 10 | 13 (7%) |
|  | 11 -12 | 30 (16%) |
| Total |  |  |
| L’année scolaire \* | Cycle 1 | 34 (20%) |
|  | Cycle 2.1 | 20 (12%) |
|  | Cycle 2.2 | 51 (30%) |
|  | Cycle 3.1 | 23 (13%) |
|  | Cycle 3.2 | 16 (9%) |
|  |  |  |

*Sample statistics: Age and grade level*

|  |  |  |
| --- | --- | --- |
| Age | 4-5 | 24 (13%) |
|  | 6 | 19 (10%) |
|  | 7 | 22 (12%) |
|  | 8 | 44 (24%) |
|  | 9 | 21 (11%) |
|  | 10 | 13 (7%) |
|  | 11 -12 | 30 (16%) |
|  |  |  |
| Grade level\* | Preschool (1st Cycle) | 34 (20%) |
|  | 1° Year (Cycle 2.1) | 20 (12%) |
|  | 2° Year (Cycle 2.2) | 51 (30%) |
|  | 3° Year (Cycle 3.1) | 23 (13%) |
|  | 4° Year (Cycle 3.2) | 16 (9%) |
|  | 5° Year (Cycle 4.1) | 17 (10%) |
|  | 6° Year (Cycle 4.2) | 12 (7%) |

\*Note: Grades levels are classified by the current educational system of Luxembourg for 4-11 year-old children.

Table 2.

*Morningness / Eveningness chronotype: Differences between 4-7 year-old and 8–11 year-old groups*

|  |  |  |  |
| --- | --- | --- | --- |
|  | | | |
|  | | Chronotype\*  4-7 year old | Chronotype\*  8-11 year old |
| N | Valid | 64 | 108 |
| Missing | 120 | 76 |
| Mean | | 23.97 | 25.83 |
| Standard Deviation | | 4.9 | 4.3 |
| Variance | | 24.9 | 18.6 |
| Kurtosis | | -.49 | -.15 |
| Min. | | 16 | 17 |
| Max. | | 37 | 36 |
| Percentiles | 10th | 18.00 | 20.00 |
| 25th | 20.00 | 23.00 |
| 50th | 24.00 | 26.00 |
| 75th | 28.00 | 28.00 |
| 90th | 30.00 | 33.00 |

\*Chronotype was determined as morning/evening type based upon the percentiles described in the text. In the 4-7 year-old group, scores <22=morning type; 23-24= intermediate; >25=evening type; in the 8-11 year-old group: <24=morning type; 25-26=intermediate; >27=evening type.

Table 3.

*Nationality: School day and free day differences in sleep parameters (minutes)*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | |
| Country of origin | | Q.1.  SCDs Awake time | Q.4.  SCDs Night Wake time | Q.8. SCDs Falling asleep | Q.9.  FDs Awake time | Q.11. FDs Get-up time | Q.12.  FDs awakeness | Q.14. FDs bedtime | Q.15.  FDs somnolence |
| Luxembourg | Mean | 3.94 | 4.78 | 4.29 | 9.36 | 10.04 | 10.17 | 9.70 | 10.45 |
| N | 146 | 146 | 146 | 121 | 121 | 121 | 122 | 122 |
| Std. Deviation | 1.26 | 1.37 | 1.89 | 3.90 | 4.11 | 4.42 | 3.24 | 3.28 |
| Median | 4.00 | 5.00 | 4.00 | 9.00 | 9.00 | 9.00 | 9.00 | 11.00 |
| Portugal | Mean | 4.55 | 5.55 | 4.36 | 11.91 | 12.64 | 13.00 | 12.82 | 12.45 |
| N | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| Std. Deviation | 1.12 | 1.36 | 2.20 | 4.76 | 5.22 | 5.44 | 2.22 | 2.58 |
| Median | 5.00 | 5.00 | 4.00 | 11.00 | 13.00 | 13.00 | 13.00 | 13.00 |
| Another country | Mean | 4.20 | 5.00 | 4.27 | 11.29 | 11.71 | 12.29 | 9.43 | 10.29 |
| N | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| Std. Deviation | .862 | 1.00 | 1.90 | 3.22 | 3.36 | 3.40 | 2.84 | 2.86 |
| Median | 4.00 | 5.00 | 4.00 | 11.00 | 12.00 | 12.50 | 9.00 | 10.50 |
| Total | Mean | 400 | 4.85 | 4.29 | 9.74 | 10.40 | 10.59 | 9.91 | 10.59 |
| N | 172 | 172 | 172 | 146 | 146 | 146 | 147 | 147 |
| Std. Deviation | 1.22 | 1.35 | 1.90 | 3.97 | 4.18 | 4.48 | 3.24 | 3.22 |
| Median | 4.00 | 5.00 | 4.00 | 9.00 | 9.00 | 9.00 | 10.00 | 11.00 |

Note: The means refer to the minutes for each variable item/question of CCTQ related to the sleep habits in SCDs (days with school schedules) and in FDs (free days).