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Avaliação da influência do turno escolar e dos componentes circadianos do sono no comportamento de crianças e adolescentes

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Porto Alegre, Junho de 2016

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Avaliação da influência do turno escolar e dos componentes circadianos do sono no comportamento de crianças e adolescentes

Tese apresentada ao curso de Pós-Graduação em Psiquiatria e Ciências do Comportamento da Universidade Federal do Rio Grande do Sul como requisito parcial para obtenção do título de Doutora em Psiquiatria

Orientador: Professora Doutora Maria Paz Loayza Hidalgo

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E ricordatevi che il tempo vola.

E noi no.

Incredibile sarebbe se noi volassemo e il tempo no:

finalmente il cielo sarebbe pieno di uomini con gli orologi fermi.

Alessandro Bergonzoni, La cucina del frattempo, 1994.

SUMÁRIO

ABREVIATURAS EM PORTUGUÊS

HPA – Hipotálamo-hipófise-adrenal

NSQ – Núcleo supraquiasmático

IMC–índice de massa corporal

ABREVIATURAS E ACRÔNIMO EM INGLÊS

BMI – Body mass index

Bedtime difference – Weekend/weekday difference in bedtime

CBCL – Child Behavior Checklist

ICD-10 – International Statistical Classification of Diseases and Related Health Problems, 10^{th} revision

MEQ – Morningness-Eveningness Questionnaire

SCN – Suprachiasmatic nucleus

SD – Sleep duration

Sleep deficit – Weekend/weekday difference in sleep duration

Sleep onset – SO

Wake up difference – Weekend/weekday difference in waking time

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RESUMO

Objetivo: Avaliar a relação do turno escolar e o ritmo circadiano de crianças e adolescentes sob a expressão de sintomas comportamentais e de níveis de cortisol e melatonina. **Métodos:** Estudo transversal envolvendo 639 estudantes do ensino fundamental e médio (idade média de 13,03 anos, variando de 8–18; 58,5% meninas) recrutados em cidades localizadas na região do Vale do Taquari, Rio Grande do Sul, Brasil. Na segunda fase, 80 participantes foram selecionados aleatoriamente para coleta de saliva para análise de melatonina e cortisol. Os parâmetros circadianos do sono foram acessados pelo auto-relato de duração do sono nos dias de semana e fins de semana, diferenças no horário de acordar e dormir, déficit de sono, ponto médio do sono nos dias de semana e fins de semana, jetlag social e pela versão em português do *Morningness-Eveningness Questionnaire (MEQ)* para avaliação do cronotipo. Os desfechos, níveis de melatonina e cortisol salivares, foram medidos através de amostras de saliva pela manhã, tarde e noite, e problemas de comportamento (sintomas psiquiátricos), foram avaliados usando a Lista de verificação comportamental para crianças e adolescentes (em inglês, *Child Behavior Checklist, CBCL*). O estudo foi realizado de acordo com as diretrizes éticas internacionais (número de aprovação no comitê de ética: 12-0386 GPPG/HCPA).

Resultados: No primeiro artigo, estudantes do turno da manhã eram significativamente mais velhos, apresentavam maior diferença entre os horários de acordar e dormir, maior déficit de sono e jetlag social. O déficit de sono apresentado por meninas foi maior do que o observado em meninos da mesma idade. A regressão multivariada, utilizando o método passo-a-passo, identificou jetlag social, diferença nos horários de acordar nos dias de semana e fins de semana e ponto médio nos fins de semana como preditores significativos de déficit de sono. O segundo artigo demonstrou que o turno escolar influenciou a secreção de melatonina, a qual se correlacionou com os parâmetros do sono circadianos, diferentemente para o grupo não-clínico e clínico. Os níveis de melatonina foram positivamente correlacionados com ponto médio do sono em estudantes do turno da manhã, e negativamente correlacionados com ponto médio do sono em estudantes do turno da tarde. No terceiro artigo, identificou-se idade, horário de início da escola, ponto médio de sono e duração do sono nos dias de semana como preditores de sintomas psiquiátricos, avaliados pelo CBCL. Os estudantes do turno da manhã, classificados como cronotipo do tipo vespertino, apresentaram menor duração do sono durante a semana e maior jetlag social do que estudantes do tipo matutino. Além disso, os alunos do turno da manhã com sintomas psiquiátricos apresentaram menor duração do sono e padrão circadiano de sono mais cedo. **Conclusões:** Os achados do presente estudo mostram que o turno escolar influencia os parâmetros circadianos de sono, fatores fisiológicos e sintomas psiquiátricos em crianças e adolescentes. Nossos resultados reforçam a importância de redirecionar crianças e adolescentes para um turno escolar que contemple as preferências individuais de sono, prevenindo as consequências negativas à saúde, tanto no sono quanto em sintomas psiquiátricos.

Palavras-chave: Cronobiologia; ritmo circadiano; turno escolar; sono; melatonina; cortisol; problemas de comportamento; sintomas psiquiátricos.

ABSTRACT

Objective: To evaluate the relationship of the school schedules and the circadian rhythm of children and adolescents under the expression of behavioral symptoms and cortisol and melatonin levels. **Methods:** This cross-sectional study involved 639 elementary and high school students (mean age 13.03 years, range 8–18, 58.5% female) recruited from the cities located in the Vale do Taquari region, Rio Grande do Sul, Brazil. In the second phase, 80 participants were randomly selected for saliva collection to analyze melatonin and cortisol. Circadian sleep parameters were assessed by self-reported sleep duration on weekdays and weekends, bedtime and wake time differences, sleep deficit, midpoint of sleep on weekdays and weekends, social jetlag, and the Portuguese version of Morningness-Eveningness Questionnaire (MEQ) for assessment of chronotype. The outcomes, salivary melatonin and cortisol levels, were measured in morning, afternoon, and night saliva samples, and behavior problems (psychiatric symptoms) were assessed using the Child Behavior Checklist (CBCL). This study was performed according to international ethical guidelines (ethics committee approval number: 12–0386 GPPG/HCPA). **Results:** In the first article, the morning-school-time students presented significantly higher age, bedtime and wake up differences, sleep deficits, and social jetlag. The sleep deficit presented by girls was greater than that observed in boys of the same age. A step-by-step multivariate logistic regression identified social jetlag, the difference between waking times on weekdays and weekends, and the mid-point of sleep on weekends as significant predictors of sleep deficit. In the second article, school start time influenced the melatonin secretion, which correlated with circadian sleep parameters, although differently for non-clinical and clinical groups. Melatonin levels were positively correlated with sleep midpoint in morning students, and negatively correlated with sleep midpoint in afternoon students. In the third article, we identified age, school start time, midpoint of sleep on weekdays, and sleep duration on weekdays as predictors of psychiatric symptoms, as evaluated by the CBCL. Students with a morning school start time whose chronotype was classified as evening had shorter sleep duration on weekdays and higher social jetlag than morning-type participants. Moreover, students with a morning school start time and psychiatric symptoms had shorter duration of sleep and earlier circadian sleep patterns. **Conclusion:** The findings of the present study showed that school start time influences on the circadian sleep patterns, physiological factors and psychiatric symptoms in children and adolescents. Our findings emphasize the importance to redirect children and adolescents for a school start time that includes the individual preferences of sleep, preventing the negative health consequences, both in sleep and in psychiatric symptoms.

Keywords: Chronobiology; circadian rhythm; school start time; sleep; melatonin; cortisol; behavior problems; psychiatric symptoms.

1. INTRODUÇÃO

Alterações significativas nos sincronizadores sociais ocorrem durante o período escolar, as quais são concomitantes com mudanças biológicas típicas da adolescência. Por exemplo, o adolescente apresenta um atraso de fase e necessidade de duração do sono maior que os adultos. Porém, neste período a organização social (turnos escolares) permanece privilegiando os turnos matutinos, provocando situações em que o adolescente precisa adaptar-se. Para que estas transições ocorram de forma sincronizada e sem comprometimento fisiológico, é importante avaliar-se os aspectos cronobiológicos intrínsecos ao sistema temporizador.

Um dos aspectos cronobiológicos que se reflete no comportamento humano é a característica interindividual denominada cronotipo, então se faz necessário compreender como o cronotipo é relacionado com o funcionamento adaptativo em todo este período de desenvolvimento mental. Além disso, o turno escolar influencia tanto no ciclo circadiano, podendo causar desregulação, quanto no comportamento, podendo refletir no desenvolvimento de transtornos psiquiátricos.

Alterações do comportamento infantil geralmente dividem-se em problemas de internalização, como depressão e ansiedade, e problemas de externalização, como por exemplo, agressão e comportamentos de oposição. Na prática clínica, instrumentos validados auxiliam na detecção de casos mais graves, possibilitando melhor direcionamento. O estudo sobre a relação entre turno escolar, duração de sono e/ou cronotipo é crescente, contudo a literatura é escassa sobre a influência destes fatores no comportamento, mais especificamente sintomas psiquiátricos.

Pelas razões apresentadas, justifica-se a realização do presente estudo com o propósito de avaliar componentes circadianos do sono e a relação com sintomas psiquiátricos, como agressividade, ansiedade, depressão e déficit de atenção nas transições de ciclo vital (crianças e adolescentes) e em diferentes turnos escolares.

Para tanto, delineou-se um estudo transversal aninhado a um estudo de coorte. Para o doutoramento, serão apresentados os dados do estudo transversal, cujo fator de estudo foi o ritmo biológico e os desfechos avaliados foram os problemas comportamentais. A amostra do estudo transversal foi de 639 estudantes. Dentre os estudantes, 80 foram sorteados, fazendo coletas salivares para análise de melatonina e cortisol.

2. REVISÃO DE LITERATURA

2.1 Desenvolvimento – infância e adolescência

O desenvolvimento normal inclui uma ampla gama de diferenças individuais, sendo influenciado por características herdadas, efeitos de gênero, classe social, raça e etnicidade, além da presença ou ausência de incapacidade física, mental ou emocional, envolvendo o equilíbrio entre crescimento e declínio ao longo da vida.[1]

Na infância, há um crescimento gradual caracterizado pelo desenvolvimento físico como, por exemplo, peso e altura, bem como em habilidades envolvendo mudanças no comportamento e aquisição da personalidade. Já a adolescência é definida como o período de transição emocional, cognitivo e social entre a infância e a idade adulta,[2] incluindo a maturação gonadal e comportamental.[3]

Fatores socioculturais (como por exemplo, desigualdade de gênero, baixa escolaridade materna e redução de acesso aos serviços), fatores psicossociais, fatores parentais (depressão materna e exposição à violência), riscos biológicos (pré-natal e crescimento pós-natal), deficiências nutricionais, doenças infecciosas, bem como condições econômicas são fatores relacionados ao prejuízo no desenvolvimento infantil.[4,5]

Da infância para a adolescência, o desenvolvimento é acompanhado por mudanças nos horários e na quantidade de sono-vigília, o que pode resultar em alterações psicossociais e estilo de vida.[6] A regulação do sono define-se através do processo homeostático do sono-vigília trabalhando com o sistema biológico circadiano.

Os hábitos não saudáveis de crianças e adolescentes podem afetar o comportamento, bem como causar consequências prejudiciais à saúde. Por exemplo, a utilização de meios eletrônicos tem impacto negativo sobre o sono de crianças e de adolescentes, incluindo assistir televisão, uso de computadores, jogos eletrônicos, e/ou internet, telefones celulares, e música.[7,8] Deitar mais tarde, menor tempo total de sono e sono não reparador são consequências relacionadas ao uso dessas mídias.[9,10,11] A exposição à luz artificial dessas telas pode influenciar na expressão de hormônios, como melatonina.[12,13]

Além disso, rotinas diárias irregulares, mudanças de hábitos alimentares, com ingestão de alimentos não saudáveis e maior sedentarismo também causam aumento nos índices de sobrepeso e obesidade.[14,15] A obesidade, por sua vez, tem sido associada ao sono de curta duração em crianças e em adolescentes.[16,17]

Sincronizadores sociais (*zeitgebers;* palavra de origem alemã que significa "doador de tempo"), como o horário de dormir ou fazer refeições,[18] são modificados significativamente durante a infância e adolescência, concomitantes com mudanças biológicas que envolvem o desenvolvimento na adolescência. Para que estas transições ocorram de forma sincronizada e sem comprometimento fisiológico, é importante a avaliação dos aspectos cronobiológicos.

2.2 Cronobiologia/Ritmo circadiano

Cronobiologia é a ciência que estuda os ritmos biológicos, incluindo os aspectos biológicos da ritmicidade, descrição e quantificação dos ritmos.[19] Os marcos iniciais referentes à contribuição dos pesquisadores para o sucesso desta disciplina estão descritos na Figura 1.

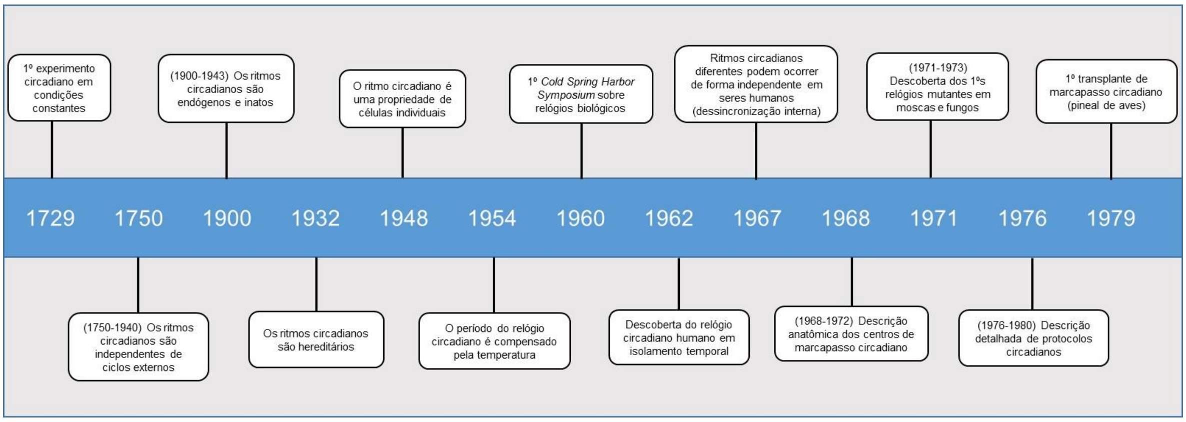

Figura 1. Linha do tempo dos marcos da pesquisa circadiana. Adaptada de Roenneberg e Merrow (2005).[20]

Os estudos em Cronobiologia iniciaram em 1729,[21] como demonstrado na Figura 1, quando o astrônomo Jean Jacques d’Ortus De Mairan, a partir da observação da planta mimosa pudica, descobriu que ela continuava a abrir e fechar sua folhagem a cada dia, mesmo na ausência de luz solar. Com a descoberta de que a folhagem não é controlada pela luz/escuro, o astrônomo sugeriu a investigação em outras plantas, considerando ciclos de temperatura diária. Também, estendeu suas observações a pacientes humanos com problemas de sono. Após algumas décadas, experimentos fisiológicos demonstraram a natureza endógena do relógio biológico em plantas.[22]

Em 1960, a pesquisa sobre relógios biológicos desenvolveu-se como uma nova disciplina, e 157 pioneiros neste campo reuniram-se para a primeira conferência internacional.[23]

Jürgen Aschoff, um dos mais importantes biólogos que estudou os ritmos circadianos em seres humanos, aves e camundongos, descobriu variações espontâneas na temperatura em 24 horas. Sabe-se que os ritmos de atividade em animais persistem em condições constantes e são gerados endogenamente. Aschoff estabeleceu que essa ritmicidade é inata. Além disso, ele postulou que um oscilador biológico inato em condições naturais é sincronizado com a rotação da Terra pela resposta a um *zeitgeber*. Consequentemente, ele foi capaz de testar previsões sobre o comportamento do sistema circadiano em resposta a diferentes propriedades dos *zeitgeber.*[24,25]

Aschoff e seu colaborador, Rütger Wever (1962), através de experimentos em humanosna busca de total isolamento das dicas temporais ambientais, construíram *bunkers,* possibilitando controle sobre iluminação, temperatura e ambiente, bem como a observação dos ritmos de atividade-repouso, alimentação e excreção dos participantes.[26] Conforme evidenciado na Figura 2, o ritmo é considerado circadiano se a sua oscilação tem um período de aproximadamente 24 horas e é contínuo sob condições constantes, tais como a luz ou escuridão. A ausência de ritmicidade nestas condições pode indicar que o ritmo não é circadiano ou que existe dessincronização entre os osciladores. Quando ocorre a dessincronização, os ritmos podem ser circadianos, mas não há sensitividade suficiente para detectar a presença de ritmicidade.

Os ritmos têm uma tendência a aderir preferências de fase relacionadas, como por exemplo, os ritmos da temperatura do corpo e o ritmo sono-vigília.[27] O núcleo supraquiasmático (NSQ, em inglês *suprachiasmatic nucleus, SCN*), localizado no hipotálamo, é o marcapasso circadiano primário em mamíferos.[28] Ele regula a estrutura temporal circadiana que envolve os órgãos no corpo (pulmão, rim, fígado, etc), chamada osciladores periféricos, controlando aspectos da fisiologia do organismo (por exemplo, atividade, temperatura corporal e sono).[29] O controle dá-se através do ciclo claro-escuro, sendo que o NSQ recebe informação da luz ambiental através da retina, por meio de células ganglionares com um pigmento chamado melanopsina, que transmitem essa informação ao NSQ através do trato retino-hipotalâmico. O NSQ interpreta o sinal sobre a luminosidade externa e direciona para a glândula pineal. Em resposta ao estímulo, essa glândula secreta o hormônio melatonina, cujos níveis são baixos durante o dia e aumentam à noite. Além disso, o NSQ recebe e integra informações de outros reguladores externos, nomeadamente *zeitgebers*, tais como alimentação, atividade física, interações sociais, a fim de preparar o corpo para estas funções.[30]

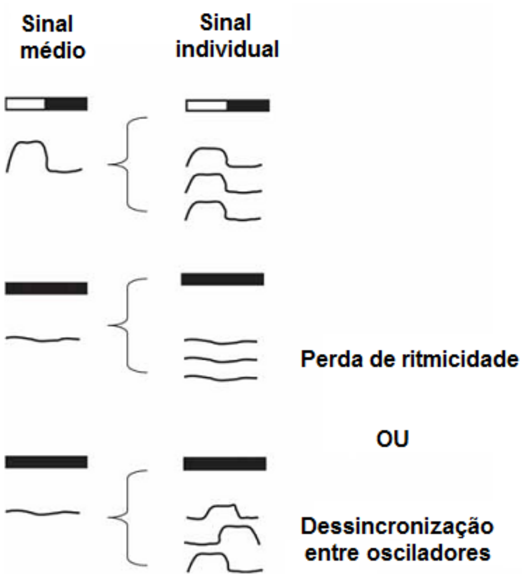

Figura 2. Sinal médio e sinal individual de ritmicidade e ausência de ritmicidade. Adaptada de Kuhlman et al. (2007).[26]

Conforme representado na Figura 3, o relógio circadiano pode conter vias aferentes, oscilador central (ou marcapasso), e vias eferentes. O oscilador central produz o ritmo biológico endógeno e pode ser sincronizado com o ambiente por meio das vias aferentes através de sinais, tais como luz ou temperatura. As vias eferentes conduzem ritmos do relógio para alvos *downstream* e, assim, regulam atividades rítmicas. Alguns sistemas circadianos consistem em vias mais elaboradas (mostrados nas linhas tracejadas) que incluem osciladores múltiplos, sincronizados e retroalimentação positiva ou negativa das atividades controladas pelo relógio para o oscilador e/ou componentes aferentes.[26]

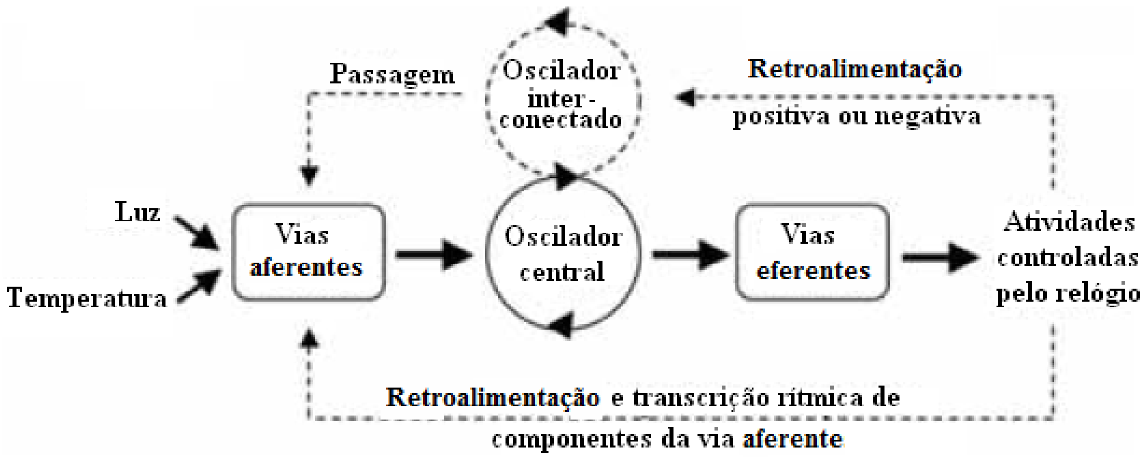

Figura 3. Representação das divisões do relógio circadiano. Adaptada de Kuhlman et al. (2007).[26]

Os níveis de vários hormônios flutuam de acordo com o ciclo claro-escuro e também são afetados pelo sono, alimentação e comportamento em geral. A regulação e o metabolismo destes hormônios são influenciados por interações entre os efeitos do sono e o sistema circadiano, como hormônio do crescimento, melatonina, cortisol, leptina e níveis de grelina.[31]

2.3 Hormônios e sono: Melatonina e cortisol

A melatonina é sintetizada e secretada, principalmente, pela glândula pineal durante a noite, sob condições ambientais normais. Ela atinge valores máximos no meio da noite e, em seguida, diminui progressivamente para atingir valores mínimos na manhã.[32,33] O ritmo endógeno de secreção é gerado pelo NSQ e conduzido através do ciclo de claro/escuro, sendo que a luz é capaz de suprimir ou sincronizar a sua produção,[34,35] como demonstrado na Figura 4. Efeitos supressores mínimos de melatonina são observados com espectro de intensidade de luz de 200-300 lux,[36,37] enquanto a supressão completa é obtida com intensidades de luz acima de 2000-2500 lux.[38] A melatonina desempenha um papel na regulação do ciclo vigília-sono circadiano.[31] O ritmo circadiano de secreção de melatonina é uma das vias através da qual o marcapasso circadiano modula o ritmo de propensão ao sono, estrutura do sono e da temperatura corporal central.[39] O efeito modulatório da melatonina sobre a secreção de cortisol foi demonstrado na glândula adrenal em primatas. Neste estudo, a utilização de doses fisiológicas de melatonina inibiu a produção de cortisol *in vitro*, estimulada por adrenocorticotropina, hormônio produzido pelas células corticotróficas da adeno-hipófise.[40] Além disso, a melatonina pode retardar os processos de envelhecimento, atuando como antioxidante,[41] e influencia na regulação da reprodução, sistema imunológico e cardiovascular.[42]

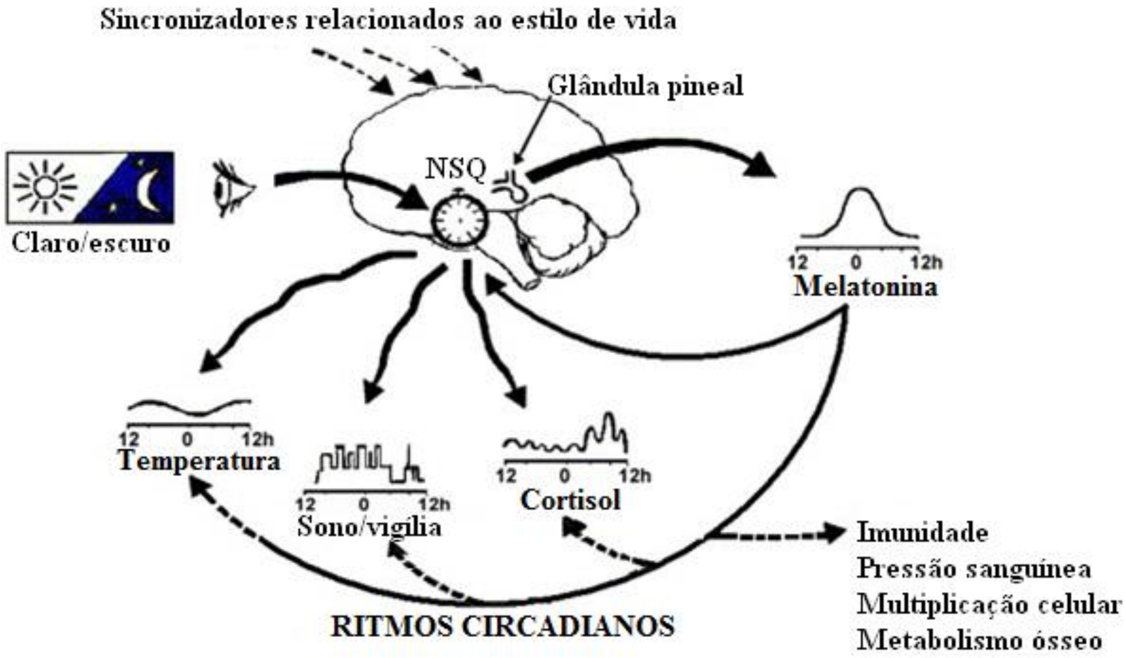

Figura 4. Ação da melatonina como um sincronizador endógeno. Adaptada de Claustratet al. (2005).[34]

O cortisol também é um hormônio regulado pelo sistema circadiano. Ele é produzido no eixo hipotálamo-hipófise-adrenal[43] e tem o seu pico perto do horário de vigília habitual,[44] em declínio ao longo do dia e permanecendo baixo até as horas posteriores do sono.[45] O cortisol é um indicador de estresse em crianças e adultos. Altos níveis deste hormônio na saliva estão associados com redução da função imunológica, dificultando a cura e, consequentemente prolongando o tempo de recuperação; déficit do crescimento físico infantil; aumento da pressão arterial e da frequência cardíaca em crianças e adultos; e tem uma relação com problemas psicológicos, como depressão ou ansiedade.[46]

Melatonina e cortisol desregulados têm sido associados a algumas comorbidades. Uma revisão de literatura refere que a melatonina é recomendada normalmente para crianças com deficiências de desenvolvimento, sendo que as mesmas apresentam menor latência de início do sono com o tratamento de melatonina.[47] Crianças em idade pré-puberal, recebendo doses semelhantes de melatonina, tendem a metabolizá-la mais rapidamente que os adultos, talvez porque a glândula pineal pré-puberal tenha um ritmo de secreção maior.[48]

O nível médio diário de cortisol foi relacionado com fatores psicossociais e psiquiátricos, como sintomas depressivos e estresse.[49] Pacientes deprimidos mostraram níveis mais elevados e um ritmo diurno mais acentuado de cortisol comparado ao grupo não deprimido.[50] Durante a exposição ao estresse, meninos tiveram aumento dos níveis de cortisol na presença de níveis elevados de comportamentos externalizantes e de ansiedade; a diminuição do cortisol foi maior naqueles indivíduos que tinham níveis elevados de comportamentos externalizantes e baixos níveis de ansiedade.[51] Em infratores agressivos, os níveis de cortisol são reduzidos.[52,53] Em crianças com problemas de comportamento graves, encontrou-se maior desregulação de cortisol. Nesse estudo, medidas de comportamentos de internalização e de externalização foram obtidas através de relato da mãe e de professores, tanto na infância quanto na adolescência.[54] Esses resultados suportam o modelo teórico de embotamento do eixo hipotálamo-hipófise-adrenal (HPA) ao longo do tempo. Enquanto o eixo HPA pode mostrar hiperexcitação quando os jovens demonstram comportamentos iniciais, a exposição prolongada pode levar à hipoexcitação do eixo HPA, que culmina em ritmo diurno desregulado. Atividade alterada no eixo HPA em meninos delinquentes com transtorno do comportamento disruptivo também foi encontrada.[55]

A melatonina e o cortisol, ritmos biológicos do próprio organismo, têm uma relação temporal com o ciclo sono-vigília, um dos ritmos mais robustos para o relógio circadiano. Este ritmo é sincronizado com fatores ambientais e oscila em um período de 24 horas.[56] A concordância estreita entre sono habitual e horário de vigília com fases circadianas torna difícil distinguir a influência do sono e fatores ambientais sobre esses hormônios.[44]

2.4 Ritmo Sono-vigília

O padrão de sono é regulado por ritmos circadianos internos (endógenos), componentes homeostáticos (pressão de sono, a qual se acumula ao longo do período acordado e diminui durante o sono) e fatores ambientais.[57] O sono é um processo dinâmico caracterizado por mudanças periódicas na atividade eletrofisiológica e está associado a alterações do comportamento e exposição à luz, os quais afetam a secreção endócrina.[44]

Na adolescência, período de maturação da regulação biológica do sono, o sistema circadiano de temporização sofre um atraso de fase. A dissipação de pressão homeostática de sono não muda até o final da adolescência, quando demonstra evidências de desaceleração, sendo tardia durante a puberdade. Na figura 5, demonstram-se fatores contribuintes para o atraso/diminuição no tempo de sono, tais como: fatores psicossociais, como autonomia dos adolescentes nos horários de dormir, resposta à pressão acadêmica e a disponibilidade e uso de tecnologia e redes sociais à noite; aliados a fatores sociais, como o horário de início da escola. Estes resultados suportam a noção de que a necessidade de sono é estável (ou aumenta) durante o desenvolvimento do adolescente e que o atraso no horário de adormecer é influenciado pela mudança circadiana, bem como pela acumulação de pressão homeostática tardia de sono.[58]

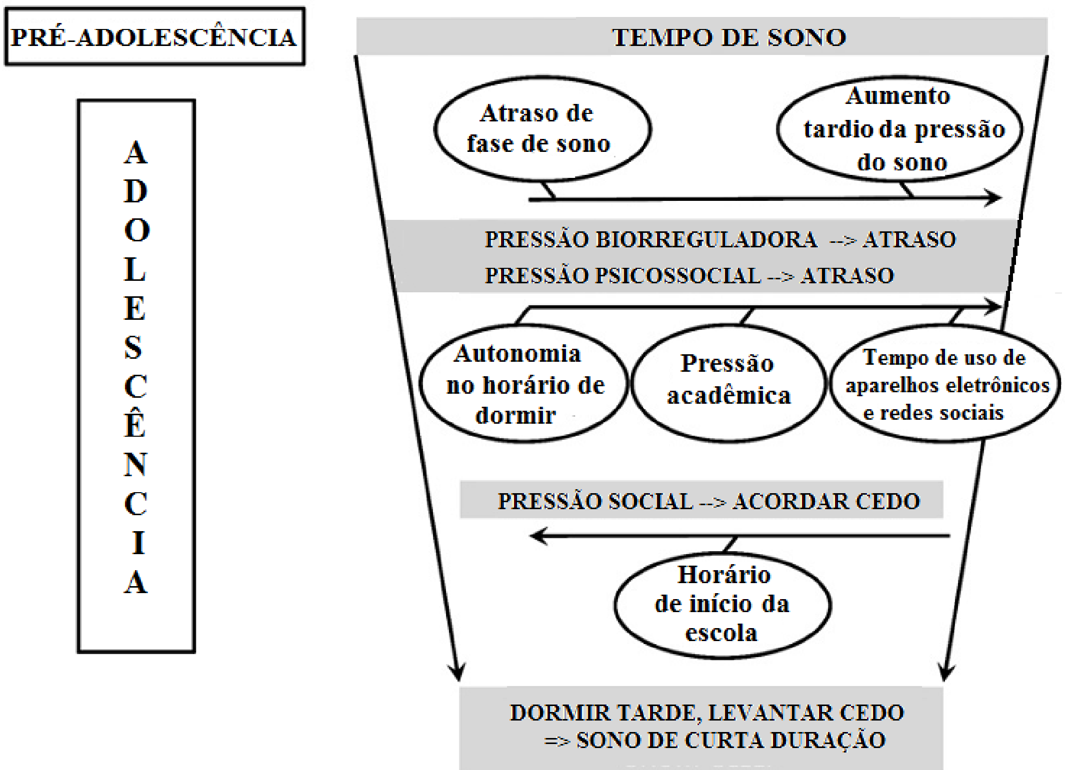

Figura 5. Tempo de sono desde a pré-adolescência até a adolescência, destacando os fatores que afetam o sono. Adaptada de Carskadon (2011).[58]

A irregularidade do sono em adolescentes está relacionada a algumas consequências, como por exemplo, sintomas de sonolência diurna, fadiga, dificuldade em adormecer à noite e/ou despertar na parte da manhã, configurados como sintomas do jetlag social.[59] Além disso, adolescentes com problemas relacionados ao sono mostram pior desempenho escolar.[60]

Para este trabalho, analisaram-se os seguintes componentes circadianos do sono:

- Duração de sono nos dias de semana e fins de semana: Com base nas questões "A que horas você dorme?" e "A que horas você normalmente acorda?" realizadas tanto para os dias de semana, quanto para os fins de semana, calculou-se a quantidade de horas dormidas.
- Diferença nos horário de dormir e acordar: Definida como a discrepância entre os horários de dormir e acordar nos fins de semana e dias de semana (diferença no horário de dormir = horário de dormir nos fins de semana – horário de dormir nos dias de semana; diferença no horário de acordar = horário de acordar nos fins de semana – horário de acordar nos dias de semana).
- Déficit de sono: Diferença na duração do sono dos fins de semana para os dias de semana (déficit de sono = duração do sono nos fins de semana - duração do sono nos dias de semana).
- Ponto médio de sono nos dias de semana e fins de semana: Definido como período de sono nos fins de semana e nos dias da semana [ponto médio de sono durante a semana = início do sono (em inglês, *sleep onset*, SO) em dias de semana, mais a duração do sono (em inglês, *sleep duration*, SD) em dias de semana divididos por dois (SD/2): SO + SD/2; ponto médio de sono nos fins de semana = início do sono nos fins de semana, mais a duração do sono nos fins de semana dividido por dois: SO + SD/2].[61]
- Jetlag social: definido como a discrepância entre os relógios biológicos e sociais. É calculado através da diferença entre o ponto médio de sono nos fins de semana e nos dias de semana (jetlag social = ponto médio de sono nos fins de semana – ponto médio de sono nos dias de semana).[62,63]
- Cronotipo: Avaliado por meio do Questionário de Matutinidade-Vespertinidade (em inglês, *Morningness-Eveningness Questionnaire*, MEQ) desenvolvido por Horne e Ostberg.[64] O MEQ é composto por 19 questões relativas às preferências

circadianas subjetivas, com pontuação total variando de 16 a 86 pontos. As pontuações mais altas indicam tipo matutino.

Evidências sugerem que os adolescentes experimentam transformações no contexto social e na fisiologia durante o início da puberdade, onde há uma tendência à vespertinidade, predispondo-os a ir dormir mais tarde à noite e a acordar mais tarde na manhã do que crianças e adultos (Crowley et al., 2007). Esta preferência circadiana diverge dos compromissos sociais, como o horário de início de escola.

2.5 Turnos escolares

O turno escolar tem sido investigado como um fator que influencia na quantidade e qualidade de sono. O atraso no horário de início da escola tem aumentado a duração do sono de adolescentes durante a semana.[65,66] Em revisão de literatura.[66] observou-se na maioria dos 38 estudos avaliados aumento significativo na duração do sono, mesmo com atrasos relativamente pequenos nos horários de início de escola (em média de meia hora). Além disso, houve melhora na assiduidade e no desempenho acadêmico, e também diminuição nos atrasos para a aula e na frequência com que os alunos adormecem nas aulas. Nesta revisão, em quatro estudos houve diminuição de acidentes de trânsito envolvendo estudantes com 18 anos ou mais.

Hansen e colaboradores[67] referem que adolescentes diminuíram 120 minutos de sono por noite durante a semana, após o início das aulas. O tempo de sono no fim de semana foi significativamente mais longo (média de 30 minutos) em comparação com o período anterior ao início das aulas (agosto). Além disso, todos os estudantes tiveram melhor desempenho durante à tarde do que pela manhã.

A Academia Americana de Pediatria[68] apoia o aumento das horas dormidas em estudantes (8h30min-9h30min), indicando horários mais tardios de início da escola (a partir das 8h30min). Com base nessa diretriz de atraso do horário, além da melhora do sono, podem-se obter outros benefícios, como melhora no desempenho físico (por exemplo, redução do risco de obesidade), mental (por exemplo, menores níveis de depressão), saúde, segurança (por exemplo, menor risco de acidentes de trânsito devido à sonolência), desempenho acadêmico, e qualidade de vida.

Atraso do horário de início da escola traz implicações importantes para as políticas públicas e benefícios para a saúde. O alinhamento dos ritmos circadianos e as necessidades de sono dos adolescentes podem contribuir para o aumento de produtividade e melhoria da qualidade de vida.

3. JUSTIFICATIVA

O estudo derivado desta tese justifica-se com base nos seguintes pontos:

- Necessidade de compreensão de como o turno de escola é relacionado com o funcionamento adaptativo em todo o período de desenvolvimento;
- Deve-se investigar a influência do ciclo circadiano desregulado e padrões comportamentais no desenvolvimento de transtornos psicológicos;
- Existe uma preocupação em relação a influência do turno escolar no rendimento de crianças e adolescentes;
- Não se tem conhecimento se o turno escolar e o cronotipo associados podem estar relacionados a sintomas psiquiátricos;
- Transtornos psiquiátricos no adulto podem ser transtornos desenvolvidos e não tratados na infância, os quais poderiam ter sido prevenidos por adaptação ao turno escolar conforme as necessidades de sono.
- Os moldes de organização da sociedade contemporânea deveriam ser repensados, de forma a respeitar a fisiologia (cronotipo).

Pelas razões apresentadas, justifica-se a realização do presente estudo com o propósito de avaliar os componentes circadianos do sono, como horário de acordar e dormir, cronotipo, déficit de sono, ponto médio de sono nos dias de escola e fins de semana, e a relação com sintomas psiquiátricos nas transições de ciclo vital (crianças e adolescentes) e em diferentes turnos escolares.

4. HIPÓTESE

Iniciar o horário da escola mais cedo pode ser um fator de risco para a desregulação do ritmo circadiano, tanto de padrões de sono, como da secreção de melatonina e do cortisol e, consequentemente a criança ou o adolescente poderá apresentar sintomas psiquiátricos (Figura 6).

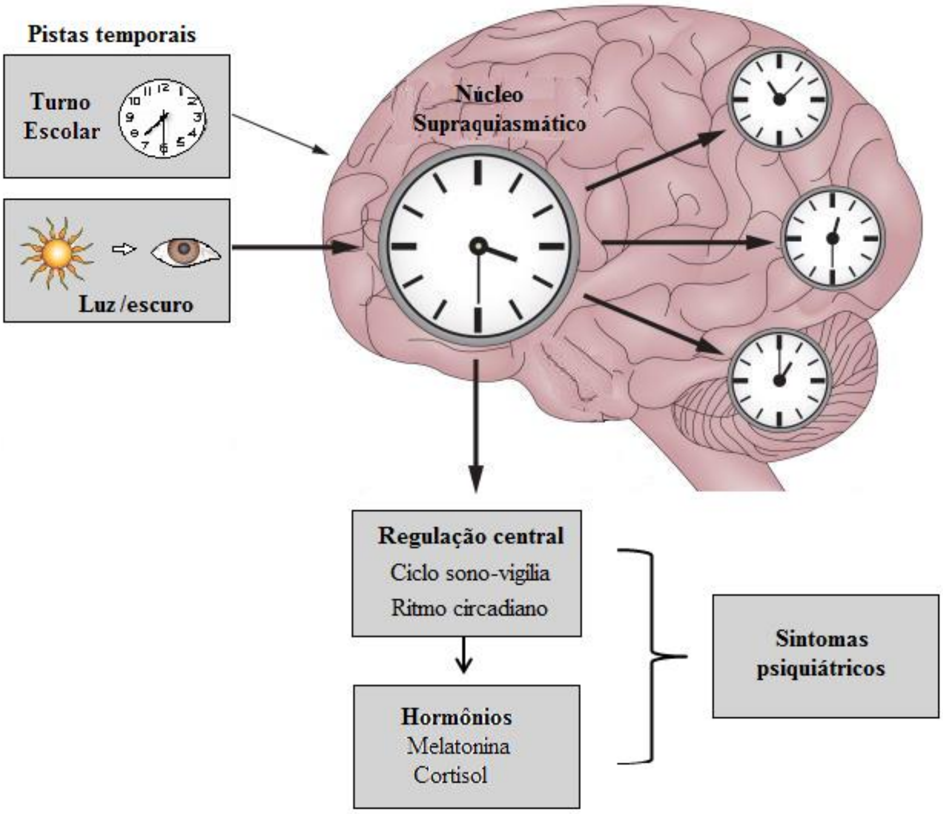

Figura 6. Hipótese do presente estudo.

5. OBJETIVOS

5.1. OBJETIVO PRIMÁRIO

Avaliar a relação do turno escolar e o ritmo circadiano de crianças e adolescentes sob a expressão de sintomas comportamentais.

5.2. OBJETIVOS SECUNDÁRIOS

- Avaliar a influência do horário de início de escola sobre padrões de sono (acordar, dormir, cronotipo e déficit de sono) de crianças e adolescentes;
- Avaliar o efeito do horário de início de escola sobre os níveis de cortisol e melatonina;
- Avaliar as medidas de cortisol e melatonina, correlacionando com escores da Lista de verificação comportamental para crianças e adolescentes (em inglês, *Child Behavior Checklist, CBCL*);

- Investigar a influência do ritmo circadiano do sono nos sintomas psiquiátricos;
- Comparar o ritmo circadiano de sono e os escores do CBCL entre os turnos escolares e de acordo com o cronotipo.

6. ARTIGO 1

The influence of school time on sleep patterns of children and adolescents

Artigo publicado na revista *Sleep Medicine* (fator de impacto: 3,78).

Link para o artigo: http://www.sleep-journal.com/article/S1389-9457(15)02031-6/abstract

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The influence of school time on sleep patterns of children and adolescents

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ABSTRACT

Objective: This epidemiological study evaluated the impact of school time on sleep parameters of children and adolescents.

Methods: This cross-sectional study involved 639 elementary and high school students (mean age 13.03 years, range 8-18, 58.5% female) from the south of Brazil. Participants answered the Morningness-Eveningness Questionnaire (MEQ), and were asked about their sleeping habits on weekdays and weekends. Sleep deficit was defined as the difference between sleep duration on weekdays and weekends.

Results: The morning-school-time students presented significantly higher age, bedtime and wake up differences, sleep deficits, and social jetlag. The sleep deficit presented by girls was greater than that observed in boys of the same age. The difference between weekday and weekend waking times was also significantly greater in girls than in boys aged 13-18 years. Sleep deficit was significantly positively correlated with age and differences in wake up times, and significantly negatively correlated with MEQ scores, social jetlag, difference between weekday and weekend bedtimes, midpoint of sleep on weekends, and midpoint of sleep on weekends corrected for sleep deficit. A step-by-step multivariate logistic regression identified social jetlag, the difference between waking times on weekdays and weekends, and the midpoint of sleep on weekends as significant predictors of sleep deficit (Adjusted $R(2) = 0.95$; $F = 1606.87$; $p < 0.001$).

Conclusion: The results showed that school time influences the sleep parameters. The association of school schedules and physiological factors influence the sleep/wake cycle.

1. Introduction

As a consequence of social organization and the advent of electrical lights, human sleep patterns have changed significantly in the last century [1]. The extended presence in human-controlled environments has had an impact on physiology. As more time is spent under electrical light exposure in work places, daily exposure to darkness and total sleep durations have decreased [1]. As a result, the production of hormones such as melatonin is disturbed [2]. The impact of this metabolic alteration depends on the age, sex, and activity schedule (work, school, social interaction) of each individual. As a result, individual behavior patterns may vary as a function of the interaction between rhythmic psychobiological activities and the circadian timing system [3]. Social schedules may also affect circadian rhythmicity, although the extent of this impact depends on individual characteristics [4]. Variability in sleep patterns and activity schedules, combined with circadian preferences and adaptability related to a shift in circadian preference from morning type to evening type, may result in sleep deprivation or sleep deficits in children and adolescents. Such disturbances have severe health repercussions, including: changes in appetite-regulating hormones [5], obesity [6,7], increased cardiovascular risk [8], hypertension [9], behavioral problems in school-age children [10], and depression [11].

Social demands may mainly interfere in children and adolescents who have an evening chronotype as their sleep preference, which is defined as a preference for sleeping late and difficulty in waking in the morning. Evening types show the largest differences in sleep time between weekdays and weekends, leading to a sleep debt on weekdays, which tends to be compensated at weekends [12]. This misalignment of social and biological time refers not only to the duration of sleep time but also to the difference between the midpoint of sleep on weekdays and weekends, defined as social jetlag [12]. Social jetlag has been identified as a risk factor for psychological disorders [13] and obesity [14,15]. The influence of age-related sleep delay is particularly important in adolescents when the restricted school-night sleep had an increase impact being recognized as a public health issue [16,17]. In adulthood, a similar phenomenon may occur during attempts to recover weekday sleep debts (working days) by oversleeping on the weekend (days off).

Beyond early school-time, other factors can contribute to insufficient sleep, such as electronic media use and caffeine consumption [18]. These factors, in particular school time, could influence in sleep duration, circadian rhythm disruption, metabolic alterations, measures of alertness, mood, and health of children and adolescents [19,20,21]. In Brazil, most schools start at 7:30, but this does not take into account the recommendations for delaying school start times to provide an optimal level of sleep at this developmental stage [13,14]. The factors that may affect early school-time include economic background of the students, number of bus tiers, and school size [22].

In children and adolescents, weekend and weekdays sleep schedules differ due to school attendance [23]; thus, the times at which classes begin may contribute to sleep deprivation in this population [24]. In this epidemiological study, the impact of school-time on sleep parameters of Brazilian children and adolescents was evaluated.

2. Methods

2.1. Subject Selection

This cross-sectional study was conducted in the cities of Lajeado and Progresso, which are located in the Vale do Taquari region, Rio Grande do Sul, Brazil (Fig. 1), with Caucasian descendants. Despite of both cities being in the same region, 60 km in distance, Lajeado is more urbanized than Progresso. Most of the students living in Progresso came from farming families, and in Lajeado, most of the students came from industrial workers. The sample comprised 639 elementary (n= 283) and high school students (n= 356) (mean age 13.03 years, range: 8-18, 58.5% female) (Fig. 2). There were 538 morning-shift-students (7:30–12:00) and 101 afternoon shift students (13:30–17:30). The school at Lajeado has only morning shift option for this age. Participation was based on written parental consent, and the following exclusion criteria were applied: age >18 years, no school enrollment, and being in night school time. This study was performed according to international ethical guidelines (ethics committee approval number: 12–0386 GPPG/HCPA) [25].

2.2. Measures and Procedure

Over the course of the school year, students were invited to answer a set of questionnaires regarding meal times, sleep habits, and physical activity levels. Trained interviewers administered the questionnaires during school hours, in the presence of teachers, in a procedure lasting approximately 30 minutes. To ensure data consistency, parents were also administered questionnaires regarding their child's schedule. A collegial team proposed these two transcultural instruments [26]. During this time, all researchers were present and approved the final versions of the instruments [26]. The same proposal transcultural instrument was used, and it was translated into Portuguese by the Brazilian team and approved by the all authors. The parent's questions were used to confirm the children's answers. For this study, the following questions about sleep habits for weekdays and weekends were analyzed: "What time do you usually sleep?" and "What time do you usually wake up?". Therefore, it was possible to calculate the sleep duration of sleep and midpoint of sleep for weekdays and weekend.

Sleep deficit was the main outcome that was evaluated; it was defined as a difference in sleep duration from weekends to weekdays using self-reported schedules (sleep deficit = sleep duration at the weekends – sleep duration on weekdays). Sleep deficit was considered as a continuous variable for all analyzes.

Age, sex, body mass Index (BMI), school time, chronotype, and sleep parameters were evaluated as potential predictors of sleep deficit. Demographic variables were assessed using a questionnaire.

Chronotype was measured using the Morningness-Eveningness Questionnaire (MEQ), developed by Horne and Östberg [27]. The MEQ consists of 19 questions regarding subjective circadian preferences, yielding a total score ranging from 16 to 86 points. The highest scores indicate preference for the morning.

The sleep-wake difference, using self-reported schedules, was defined as the discrepancy between sleeping and waking times on the weekends and weekdays (sleep difference = sleep time at weekends – sleep time on weekdays; wake up difference = wake up time at weekends – wake up time on weekdays).

Midpoint of sleep was calculated using self-reported bedtimes and it was defined as an individual's sleeping period at the weekends and the weekdays (Midpoint of sleep on weekdays = sleep onset (SO) on weekdays plus sleep duration on weekdays divided by two: SO + SD/2; Midpoint of sleep on weekends = Sleep onset on weekends plus sleep duration on weekends divided by two: SO + SD/2;) [28].

Midpoint of sleep on weekends corrected for sleep deficit was calculated as follows: Midpoint of sleep on weekends - 0.5*(Sleep duration on weekends - (5*Sleep duration on weekdays + 2*Sleep duration on weekends)/7) [28].

Social jetlag, using self-reported schedules, was defined as the discrepancy between social and biological times, and calculated as the difference between the midpoint of sleep on weekends and on weekdays (social jetlag = midpoint of sleep on weekends – midpoint of sleep on weekdays) [12,14].

BMI was calculated as the ratio of weight in Kg to height in m^2 [29]. Weight and height were measured using a digital portable scale with a maximum load of 150 kg with a resolution of 100g (brand Plenna®, Brazil) for body weight, and a stadiometer (Wiso®, Brazil) fitted to a flat wall and no footer for height.

2.3. Statistical Analysis

The distribution of sleep variables by school time (morning or afternoon) was investigated using Student's t-test. The effect sizes were calculated by Hedges' g measure. The distribution of sleep variables and BMI was compared between sexes and age groups (children and adolescents) using Student's t-test for independent samples. A Chi-squared test was performed to analyze the distribution of categorical variables.

Pearson's correlation coefficients were used to analyze the relationship between sleep deficit, age, BMI, MEQ score, sleep/wake differences, midpoint of sleep on weekdays, midpoint of sleep on weekends, midpoint of sleep on weekends corrected for sleep deficit, and social jetlag. Variables, which showed a univariate association with sleep deficit, were included in a stepwise hierarchical regression model step-by-step controlling for confounding factors and potential collinearity. Age, sex, school time, and educational institution were included in the first step of the equation; MEQ scores were entered in the second; while sleep/wake differences, midpoint of sleep on weekends, and social jetlag were inserted in the third step of the model. In all analyzes, the sleep deficit was used as a continuous variable. The SPSS v.18 was used for all statistical analyses (SPSS Chicago, IL). Statistical significance was set at $p < 0.05$.

3. Results

Descriptive data comparing morning-shift and afternoon-shift students are displayed in Table 1. Sleep duration, midpoint of sleep on weekdays, and midpoint of sleep on weekends corrected for sleep deficit were significantly higher in the afternoon-school-time students compared to morning-school-time students. However, the morning-shift students presented significantly higher age, bedtime and wake up differences, sleep deficit, and social jet lag. Most students who went to school in the afternoon did not take a nap during weekdays (15.3%) and weekends (13.8%). On the weekdays, morning-shift students took a nap significantly more often than afternoon-shift students.

Descriptive statistics for the sample are presented in Table 2. The sleep deficit presented by girls aged ≤12 years and 13–18 years (1.19±1.37 and 1.52±1.31, respectively) was greater than that observed in boys of the same age (0.40±1.48 and 1.28±1.35, respectively). The difference between weekdays and weekend waking times was also significantly greater in girls (3.41±1.43) than in boys (3.13±1.57) aged 13–18 years. The midpoint of sleep on weekends corrected for sleep deficit was significantly lower in girls (3.57±1.88) compared with boys (4.17±2.19) aged ≤12 years.

The Pearson correlation was made to test the reliability of the answers about sleep in the questionnaires administered to schoolchildren and their parents. All sleep variables presented with a significant correlation when comparing schoolchildren's with parents' answers: wake up time ($r = 0.83$; $p < 0.001$), bedtime ($r = 0.52$; $p < 0.001$), and sleep duration at weekdays ($r = 0.38$; $p < 0.001$); wake up time ($r = 0.73$; $p < 0.001$), bedtime ($r = 0.65$; $p < 0.001$), and sleep duration at weekend ($r = 0.45$; $p < 0.001$).

The results of Pearson correlations between sleep deficit and age, BMI, MEQ score, and sleep variables are shown in Table 3. Sleep deficit was negatively correlated with MEQ scores ($r = -0.16$; $p < 0.001$), social jetlag ($r = -0.34$; $p < 0.001$), difference between weekdays and weekend bedtimes ($r = -0.34$; $p < 0.001$), midpoint of sleep on weekends ($r= -0.30$; $p < 0.001$) and midpoint of sleep on weekends corrected for sleep deficit ($r = -0.56$; $p < 0.001$). Age and difference in wake up times were positively correlated with sleep deficit ($r= 0.20$; $p < 0.001$; $r= 0.56$; $p < 0.001$), which, in turn, showed no correlation with BMI ($r= 0.01$; $p = 0.89$) and midpoint of sleep on weekdays ($r = 0.03$; $p = 0.41$).

The regression model step-by-step identified social jetlag, the difference between weekdays and weekend waking times, and midpoint of sleep on weekends as significant predictors of sleep deficit (Table 4; Adjusted $R^2 = 0.95$; $F = 1606.865$; p

< 0.001). The difference between bedtime on weekdays and the weekends was the only variable excluded from the model due to collinearity.

Fig. 3 shows the schedules of sleeping, waking, and sleep deficit to the morning and afternoon shift students during weekdays and weekends. Afternoon students slept ($p < 0.001$, 95% CI [-1.01, -0.57], Hedges's gs = -0.79) and woke up ($p < 0.001$, 95% CI [-3.90, -3.32], Hedges's gs = -3.61) significantly later than morning students on the weekdays. On weekends, morning students slept significantly later than afternoon students ($p = 0.020$, 95% CI [0.23, 0.65], Hedges's gs = 0.44), although the difference in waking times did not distinguish the two groups ($p = 0.13$, 95% CI [-0.75, -0.32], Hedges's gs = -0.54). The highest sleep deficits in the sample were observed among morning-shift students ($p < 0.001$, 95% CI [0.61, 1.04], Hedges's gs = 0.83).

4. Discussion

The present study assessed the influence of school time on the sleeping patterns (waking, bedtime, chronotype, and sleep deficit) of children and adolescents. The results also showed the influence of waking times, social jetlag and midpoint of sleep on weekends on sleep deficit.

The data showed that school time is an important determinant of sleeping and waking patterns during weekdays. Afternoon-shift students slept and awoke significantly later than morning-shift students, showing that school schedule plays an important role in the difference between sleep duration from weekends to weekdays. Morning classes may cause sleep deficit during weekdays in comparison with afternoon classes, which probably is partly compensated on weekends; thus, bedtime and wake up time are delayed. In a previous study, adolescents were found to show sleep disturbances during the weekends [30]. Insufficient sleep in adolescents can be considered a major public health concern [20]. Sleep disturbances and sleep-related health problems have been found to be more prevalent in adolescents who start school earlier in the morning [31]. In Brazilian children from the city of São Paulo, school time has been found to influence sleep habits. The morning-shift students showed a reduced total in the sleep duration, slept earlier, and napped more often than afternoon students [32]. In addition to disturbing circadian rhythmicity, earlier school times have been found to be significant contributors to insufficient sleep [20,24]. In the present study, morning students also slept earlier than afternoon students on weekdays.

Circadian preference starts to shift toward ‘eveningness’ at the age of 13 years. Although individual differences in chronotype tend to persist throughout life, biological and social synchronizers lead to more ‘morningness’ in early development, a shift toward eveningness in adolescence, and a return to the morningness with aging [33]. School schedules can be considered one of these synchronizers [34]. Wittmann et al. (2006) [12] demonstrated that the correlation between late chronotype, wellbeing, and stimulant use might be a consequence of social jetlag, attributable to the discrepancy between social and biological times in weekdays *vs.* the weekend. In adults, a social jetlag ≥2 hours has been found to be associated with depression [13]. In children without psychiatric disorders, no correlations have been identified between a social jetlag of ≥2 hours and depression levels [11]. In the present study, it was shown that social jetlag, weekend/weekdays differences in waking times and midpoint of sleep on weekends are significant predictors of sleep deficit. These results suggest that social jetlag may have a chronic influence on sleep deficit, which, in turn, contributes to the development of depression in adulthood.

Social jetlag can be transient [16], and cause temporary symptoms such as changes in mood, sleep, and appetite, as part of the physiological adaptation to a sudden change of schedules. However, the chronic nature of the sleep disturbances experienced by children and adolescents is a cause for concern. Problems such as depression [13] and obesity [14,15] may both occur as a consequence of this chronic desynchronization. Sleep education programs at schools have been found to increase weekend sleep duration in adolescents in the short term [35]. Sleep recommendations [36] may therefore be an important tool to improve sleep quality and prevent the consequences of sleep deficits in children and adolescents.

In the present study, sleep deficit was assessed using a self-report questionnaire, which may have been vulnerable to response bias. However, the questionnaires administered to children and adolescents were also answered by parents, which increased the reliability of the current findings. Furthermore, it will be important to replicate these results in future research, using multiple informants relating to the symptoms of sleep disorders, and lifestyle habits, such as academic performance, electronic media use, substance use, and mental impairments, which were not considered, and they may affect sleep pattern. Future studies may overcome this limitation by using objective measures of sleep and waking times, and maybe investigate all areas of interest.

These findings reinforce the evidence that school time has been showed to influence the sleep deficit experienced by children and adolescents. Also, school time showed to be a confounding variable, since not all students adapted according to the circadian preference. In the regression model, the influence of waking times, social jetlag and midpoint of sleep on weekends was observed on sleep deficit.

In conclusion, the combination of school time and physiological factors was found to influence the sleep/wake cycle and contribute to the sleep disturbances observed in this population.

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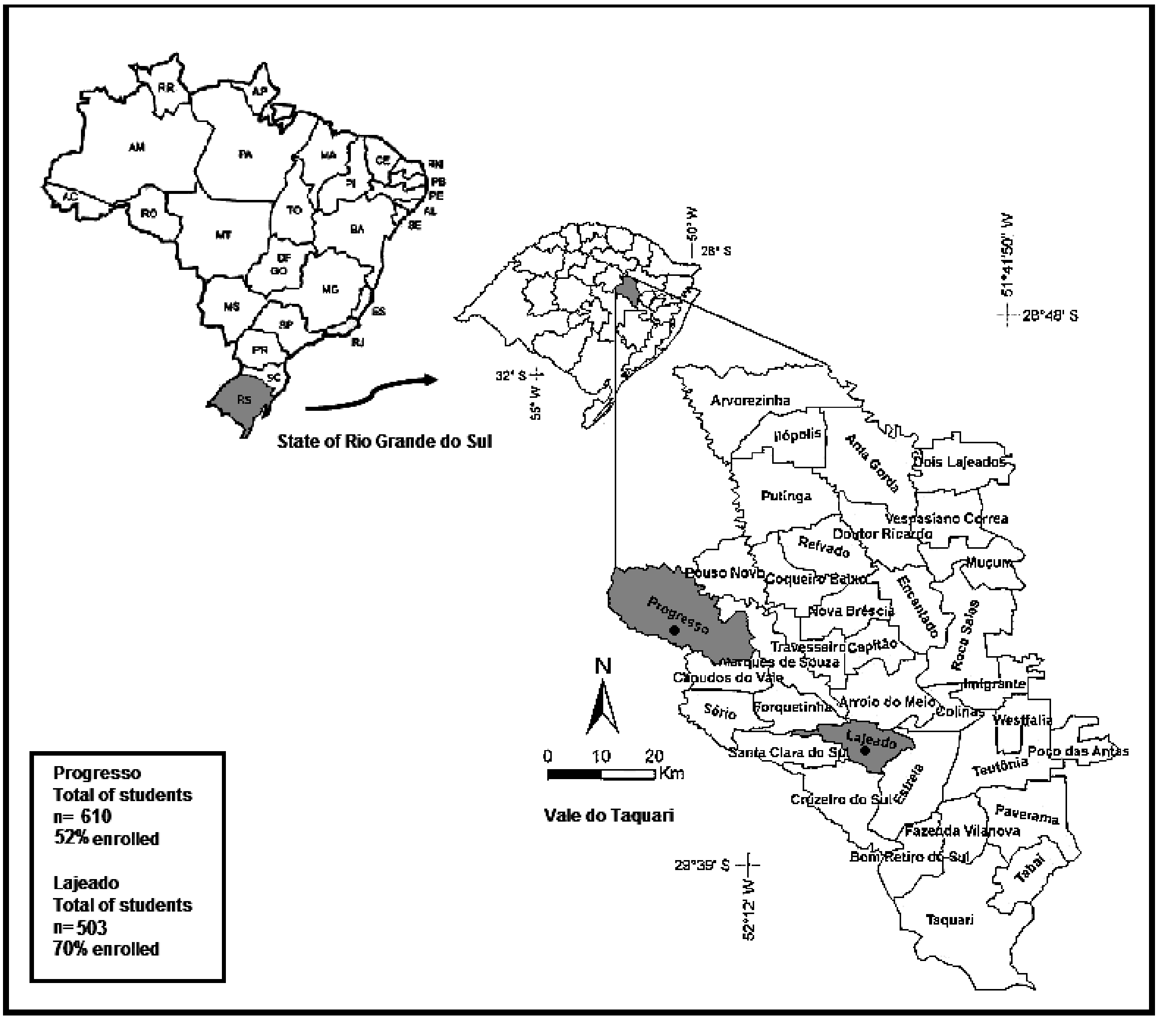

Fig. 1. Geographic coordinates and sample size surveyed in the Vale do Taquari, in southern Brazil.

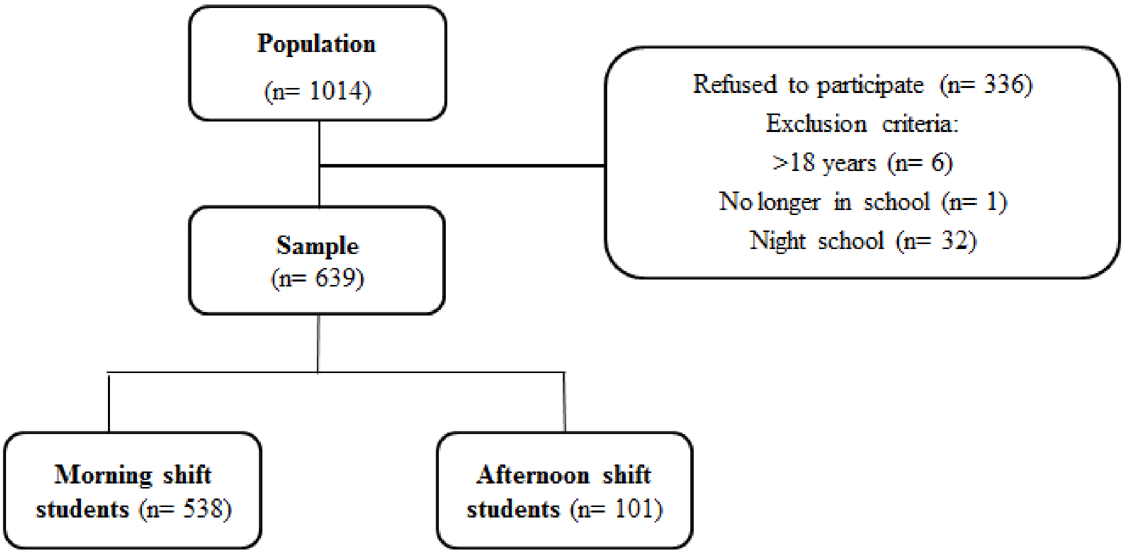

Fig. 2. Flowchart of the study.

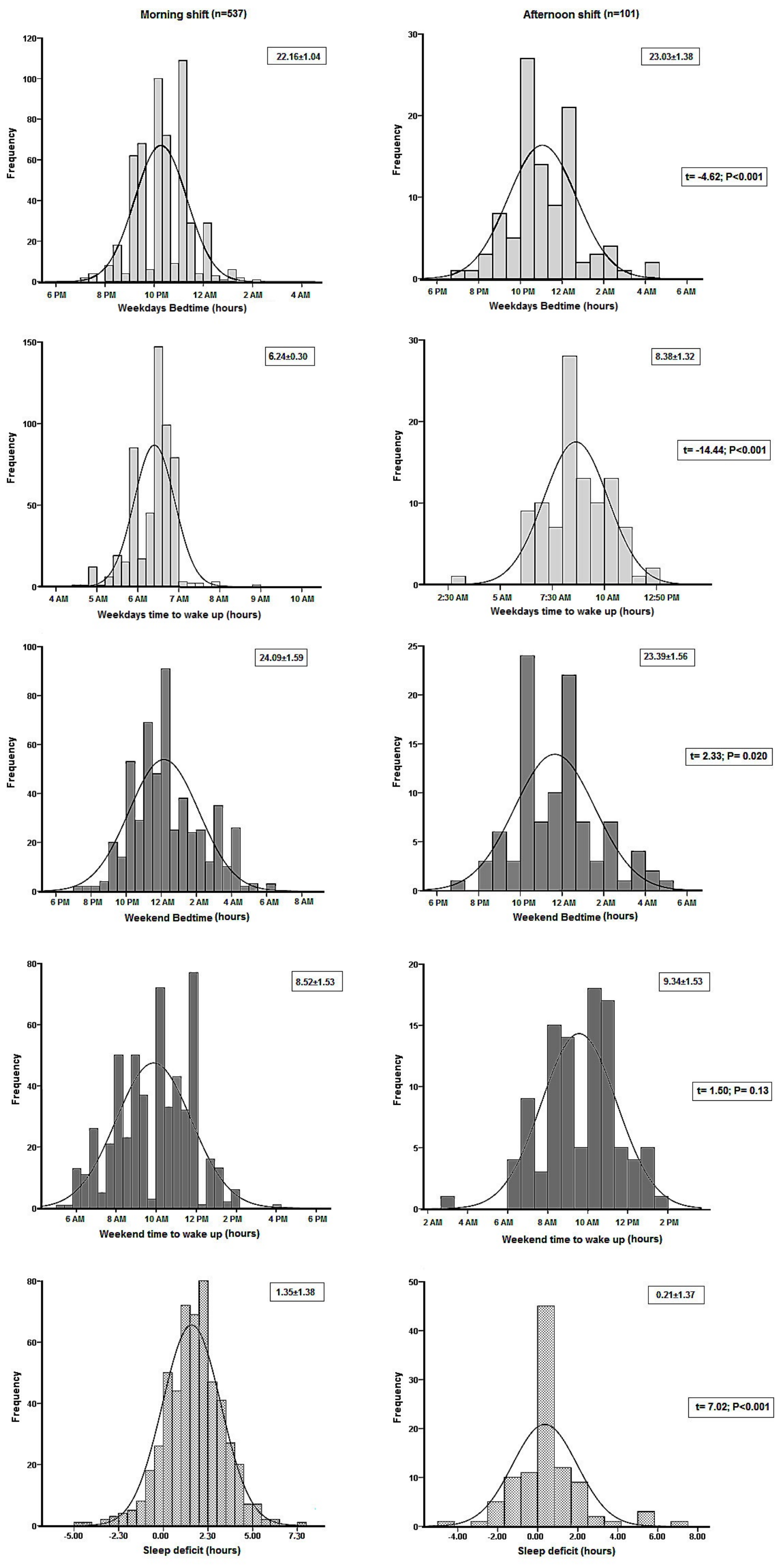

Fig. 3. Bedtime, waking time, and sleep deficit of morning and afternoon shift students on weekdays and on weekends. Level of significance: $p < 0.05$*.

Table 1.
Descriptive statistics for school time, sex, age, weight status, and sleep.

	Morning (n= 538)	Afternoon (n= 101)	p
Sex, n (%)#			0.08
Male	215 (33.6%)	50 (7.8%)	
Female	323 (50.5%)	51 (8%)	
Age£	13.35±2.60	11.35±1.98	< 0.001*
Body mass index (SD)£	20.25±3.58	19.66±4.12	0.60
Sleep duration (hours)£			
Weekdays	8.06±0.59	9.35±1.36	< 0.001*
Weekend	9.43±1.33	9.56±1.50	0.20
MEQ total (SD)£	49.08±8.52	51.28±10.84	0.06
Bedtime difference (hours)£	1.54±1.39	0.36±1.28	< 0.001*
Wake up difference (hours)£	3.31±1.43	0.56±1.26	< 0.001*
Sleep deficit (hours)£	1.37±1.36	0.22±1.37	< 0.001*
Midpoint of sleep on weekdays (hours)£	2.20±0.39	3.53±1.17	< 0.001*
Midpoint of sleep on weekends (hours)£	4.14±1.47	4.29±1.41	0.18
Midpoint of sleep on weekends corrected for sleep deficit (hours)£	3.67±2.03	4.36±1.98	0.002*
Social jetlag (hours)£	1.54±1.37	0.36±1.28	< 0.001*
Nap, n (%)#			
Weekdays			< 0.001*
Yes	199 (31.1%)	3 (0.5%)	
No	339 (53.1%)	98 (15.3%)	
Weekend			0.01*
Yes	129 (20.2%)	13 (2.0%)	
No	408 (63.9%)	88 (13.8%)	
Nap, yes (hours)£			
Weekdays	1.43±1.20	0.30±0.00	< 0.001*
Weekend	1.44±0.56	1.28±0.43	0.31

Weekend/weekday differences in bedtime and waking time; Sleep deficit, weekend/weekday differences in sleep duration; MEQ, Morningness-Eveningness Questionnaire.
£Student's t-test;
#Chi-square test; *Statistically significant differences ($p < 0.05$).

Table 2.

Descriptive statistics for age, weight status, school time and sleep.

	Children (age ≤12 years)			Adolescents (13-18 years)		
	Boys (n= 122)	Girls (n= 161)	p	Boys (n= 143)	Girls (n= 213)	p
Age[£]	10.50±1.21	10.53±1.31	0.85	15.06±1.53	15.02±1.32	0.81
Body mass index (SD) [£]	19.28±3.55	18.71±3.24	0.16	20.84±3.82	21.31±3.47	0.23
MEQ total (SD)[£]	50.63±9.39	49.92±8.75	0.51	49.42±8.77	48.38±8.91	0.28
Bedtime difference (hours)[£]	1.50±1.53	1.26±1.39	0.06	1.42±1.41	1.47±1.35	0.61
Wake up difference (hours)[£]	2.25±2.05	2.45±1.49	0.15	3.13±1.57	3.41±1.43	0.026*
Sleep deficit (hours)[£]	0.40±1.48	1.19±1.37	0.002*	1.28±1.35	1.52±1.31	0.017*
Social Jet Lag (hours)[£]	1.50±1.53	1.26±1.39	0.07	1.42±1.41	1.47±1.31	0.59
Midpoint of sleep on weekdays (hours)[£]	2.34±1.01	2.59±1.01	0.82	2.44±1.04	2.30±0.49	0.24
Midpoint of sleep on weekends (hours)[£]	4.23±1.50	4.02±1.33	0.079	4.23±1.51	4.17±1.50	0.091
Midpoint of sleep on weekends corrected for sleep deficit (hours)[£]	4.17±2.19	3.57±1.88	0.015*	3.91±2.01	3.62±2.05	0.20
School time, n (%)[#]			0.59			0.042*
Morning	88 (31%)	121 (43%)		127 (36%)	202 (57%)	
Afternoon	34 (12%)	40 (14%)		16 (5%)	11 (3%)	

Abbreviations: Weekend/weekdays difference in bedtime and waking time; Sleep deficit, weekend/weekdays difference in sleep duration; MEQ, Morningness-Eveningness Questionnaire.

[£]Student's t-test;

[#]Chi-square test; *Statistically significant differences ($p < 0.05$)

Table 3.

Results of univariate Pearson correlations between sleep deficit and age, body mass index, sleep parameters, and chronotype.

	Sleep deficit	
Variable	Pearson correlation (r)	p
Age	0.197	<0.001
Body mass index	0.005	0.89
MEQ	-0.161	<0.001
Bedtime difference	-0.342	<0.001
Wake up difference	0.561	<0.001
Midpoint of sleep on weekdays	-0.033	0.41
Midpoint of sleep on weekends	-0.304	<0.001
Midpoint of sleep on weekends corrected for sleep deficit	-0.557	<0.001
Social jetlag	-0.342	<0.001

Weekend/weekday difference in bedtime and waking time; Sleep deficit, weekend/weekdays difference in sleep duration.

MEQ, Morningness-Eveningness Questionnaire.

Table 4.

Stepwise univariate linear regression model of sleep deficit.

Variables	Multivariate B (Std Error)	Beta	Multivariate t
Step 1 Adjusted R^2= 0.12			
Age	0.087 (0.03)*	0.137	3.477
Sex	0.476 (0.13)**	0.141	3.725
School time	-0.791 (0.21)**	-0.174	-3.861
Educational institution	0.368 (0.15)*	0.110	2.533
Step 2 Adjusted R^2= 0.12			
Age	0.079 (0.03)*	0.124	3.135
Sex	0.462 (0.13)**	0.137	3.635
School time	-0.840 (0.21)**	-0.185	-4.103
Educational institution	0.255 (0.15)	0.076	1.690
MEQ	-0.019 (0.07)*	-0.101	-2.551
Step 3 Adjusted R^2= 0.95			
Age	0.004 (0.01)	0.006	0.602
Sex	0.003 (0.03)	0.001	0.099
School time	0.099 (0.07)	0.022	-1.513
Educational institution	0.017 (0.02)	0.009	0.811
MEQ	-0.003 (0.00)	-0.017	-1.533
Wake up difference	0.968 (0.01)**	1.106	83.164
Social jetlag	-0.915 (0.02)**	-0.916	-40.523
Midpoint of sleep on weekends	-0.061 (0.02)*	-0.065	-2.642

Weekend/weekday difference in waking time; MEQ, Morningness-Eveningness Questionnaire.

Weekend/weekday difference in bedtime was excluded from the model due to collinearity; Significant at $p< 0.05$*, $p< 0.001$**.

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7. ARTIGO 2

School start time influences melatonin and cortisol levels in children and adolescents – a community-based study

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School start time influences melatonin and cortisol levels in children and adolescents – a community-based study

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Abstract

School start time influences sleep parameters. Differences between circadian sleep parameters on weekends and weekdays have been associated with obesity, sleep and psychiatric disorders. Moreover, circadian rhythm dysregulation affects the secretion of some hormones, such as melatonin and cortisol. In the current study, we investigate the effect of school start time on cortisol and melatonin levels in a community sample of Brazilian children and adolescents. This was a cross-sectional study of 454 students (mean age, 12.81±2.56 years; 58.6% female). From this sample, 80 participants were randomly selected for saliva collection to analyze melatonin and cortisol. Circadian sleep parameters were assessed by self-reported sleep and wake up schedules and the Morningness-Eveningness Questionnaire. The outcomes, salivary melatonin and cortisol levels, were measured in morning, afternoon, and night saliva samples, and behavior problems were assessed using the Child Behavior Checklist (CBCL). The main results revealed that morning school start time decrease the secretion of melatonin. Morning melatonin levels were significantly positively correlated with sleep midpoint on weekdays and on weekends. Afternoon melatonin levels were positively correlated with sleep midpoint on weekends in the morning school students. Conversely, in the afternoon school students, night melatonin levels were negatively correlated with sleep midpoint on weekdays. Cortisol secretion did not correlate with circadian sleep parameters in any of the school time groups. In conclusion, school start time influences melatonin secretion, which correlated with circadian sleep parameters. This correlation depends of the presence of psychiatric symptoms. Our findings emphasize the importance of drawing attention to the influence of school start time on the circadian rhythm of children and adolescents.

Keywords: Circadian rhythm; school start time; behavior problems; Child Behavior Check List; hormones

Introduction

Our body receives environmental cues (*zeitgebers*, German for ‘time givers’) that oscillate with a circa-24-h rhythm. Light is the prominent *zeitgeber* for most mammals (Roenneberg et al., 2013), but some human social cues also act as a strong *zeitgeber*, such as work schedule. Especially in children and adolescents, school start time influences sleep parameters (Carissimi et al., 2016). According to the American Academy of Pediatrics policy statement (Adolescent Sleep Working Group, 2014), one of the most important factors influencing insufficient sleep in children and adolescents is school start time. Delaying school start time may have a beneficial effect on satisfaction with sleep and improved motivation, alertness, mood, and health (Owens et al., 2010). In a previous study, we found that school time also had an influence on sleep deficit (Carissimi et al., 2016).

Adverse consequences have been observed by comparing sleep-wake patterns of adolescents with early vs later school start times, including increased sleepiness, absenteeism, poor academic performance, insufficient sleep, and circadian rhythm disruption (Adolescent Sleep Working Group, 2014; Boergers et al., 2014; Minges et al., 2015). Moreover, differences between sleep patterns on weekends and weekdays have been associated with increased body mass index (Roenneberg et al., 2012; Sivertsen et al., 2014) sleep disorders (Hysing et al., 2013), and depressive symptoms (de Souza & Hidalgo, 2014), probably through circadian rhythm dysregulation.

The dysregulation of circadian rhythms may alter melatonin secretion (Kim et al., 2015). Melatonin is produced predominantly by the pineal gland and regulated by the environmental light-dark cycle via the suprachiasmatic nucleus, which is responsible for the circadian rhythm of its secretion (Axelrod., 1974; Brainard et al., 2001). Plasma melatonin levels are high at night and low during daylight hours (Zawilska et al., 2009).

Melatonin plays a role in regulating the circadian sleep-wake cycle. Furthermore, melatonin could be important in slowing the processes of ageing by acting as an antioxidant (Cagnacci, 1996) and has the potential to influence the regulation of the reproductive, cardiovascular, and immune systems (Macchi & Bruce, 2004).

Some hormones, such as cortisol, are regulated by the circadian system. Cortisol is produced in the hypothalamic-pituitary-adrenal axis (Chrousos, 2009) and has its peak close to habitual wake time (Czeisler & Klerman, 1999), declining throughout the day and remaining low until the later hours of sleep (Clow et al., 2004). In adolescents, the peak of cortisol secretion occurs approximately 30-45 min after awakening (Oskis et al., 2009). Diurnal cortisol secretion may change after exposure to a prolonged psychosocial stressor (Lenaert et al., 2016) and differ according to the presence of mental disorders. In depression, the disruption of circadian rhythms and homeostatic processes leads to changes, for instance, in body temperature and hormone secretion, such as cortisol, growth hormone, and melatonin. This disruption has been associated with sleep disorders, loss of appetite, daytime sleepiness, and mood changes (Nechita et al., 2015).

The present epidemiological study was designed to evaluate the effect of school start time on cortisol and melatonin levels in a community sample of Brazilian children and adolescents. We hypothesized that school start time would influence melatonin and cortisol secretion, causing sleep dysregulation, and that the correlation between hormones and sleep/circadian variables would differ depending on the child's mental condition.

Methods

Subject Selection

This cross-sectional study was conducted in Lajeado and Progresso, two cities located in the Vale do Taquari, Rio Grande do Sul, the southernmost state of Brazil (Carissimi et al., 2016). The study was conducted in two phases: in the first phase, questionnaires were administered to 454 students enrolled in elementary, middle, and high schools (mean age, 12.81±2.56 years; 58.6% female); in the second phase, 80 participants were randomly selected for saliva collection. Saliva samples were collected in the morning, afternoon and at night, for a total of 240 samples. Seven cortisol and 14 melatonin samples were excluded because they were outside the detection range of the assay. The school schedules were 07:30–12:00 for morning school students and 13:30–17:30 for afternoon school start time students. Participants were included only if both the student and his/her parents signed the informed consent form. Exclusion criteria were age >18 years and students not regularly enrolled in school or attending night school. A flowchart of the inclusion procedure is shown in Figure 1.

The study was conducted in accordance with the provisions of the Declaration of Helsinki and approved by the institutional ethics committee (approval number: 12–0386 GPPG/HCPA) (World Medical Association, 2013).

Measurements and Procedures

Students were invited to complete a set of questionnaires aimed at gathering data on timing of food intake, physical activity, sleep habits, and chronotype. Trained interviewers administered the questionnaires during school time (approximately 30 min) in the presence of the teacher. Parents also answered questions regarding the student's sleep habits to check data consistency. The protocol has been previously described (Carissimi et al., 2016).

Circadian sleep parameters

The circadian sleep parameters (sleep duration on weekdays and on weekends, bedtime and wake up time differences, sleep deficit, midpoint of sleep on weekdays and weekends and social jetlag) were calculated by self-reported schedules, using the following questions: "What time do you usually sleep?" and "What time do you usually wake up?'.

The bedtime and wake up time differences were defined as the discrepancy between sleep and wake up times on the weekends and weekdays (bedtime difference= sleep time at weekends − sleep time on weekdays; wake up difference= wake up time at weekends − wake up time on weekdays).

Sleep deficit was defined as a difference in amount of sleep from weekends to weekdays (sleep deficit= sleep duration at the weekends − sleep duration on weekdays).

The Midpoint of sleep was calculated as the halfway point between bedtime and wake up time [Midpoint of sleep on weekdays= sleep onset (SO) on weekdays plus sleep duration (SD) on weekdays divided by two (SD/2): SO+SD/2; Midpoint of sleep on weekends= sleep onset on weekends plus sleep duration on weekends divided by two: SO+SD/2] (Roenneberg et al., 2004).

Social jetlag was calculated as the difference between midpoint of sleep on weekends and on weekdays (social jetlag= midpoint of sleep on weekends − midpoint of sleep on weekdays) (Wittmann et al., 2006; Roenneberg et al., 2012).

Morningness-Eveningness Questionnaire

The Morningness-Eveningness Questionnaire (MEQ), developed by Horne and Östberg (1976) (Horne & Ostberg, 1976*)*, was used to assess chronotype. The MEQ consists of 19 questions regarding subjective circadian preferences, yielding a total score ranging from 16 to 86 points. Higher scores indicate a morning preference. MEQ presented high levels of reliability (>0.80) (Di Milia et al., 2013).

Child Behavior Checklist

The Portuguese version of the Child Behavior Checklist (CBCL) for ages 4-18 years was used in the study (Bordin et al., 1995; Achenbach, 1991). The CBCL is completed by the parents and consists of 138 questions to assess behavior problems. Each question is scored from 0 to 2: 0 (not true), 1 (somewhat or sometimes true), and 2 (very true or often true). The instrument assesses 11 different categories: Withdrawn, Somatic Complaints, Anxious/Depressed, Social Problems, Thought Problems, Attention Problems, Rule-breaking Behavior, Aggressive Behavior, and Other Problems. These problems are divided into Internalizing and Externalizing Problems. Internalizing problems include Emotionally Reactive, Anxious/Depressed, Somatic Complaints, and Withdrawn syndromes, while externalizing problems refer to Aggressive Behavior and Attention Problems syndromes. The Achenbach System of Empirically Based Assessment (ASEBA) Windows software of CBCL also provides a total problem score, based on which the child's behavior was classified as non-clinical, borderline, or clinical groups. CBCL presented a sensitivity of 87% to detect psychiatric diagnoses when compared with International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) (Bordin et al., 1995).

Saliva Collection

Salivary melatonin and cortisol levels were measured in samples collected at three different time points during the day: in the morning (8-9 AM), afternoon (4-5 PM) and at night (10-11 PM). For saliva collection, Eppendorf tubes were previously identified with each student's code and time of the day. Students were instructed to carry out thorough cleaning of the mouth before collection, collect saliva samples at the predetermined times before meals and store them in the refrigerator for subsequent delivery to the researchers.

Molecular Analysis

Saliva samples were stored at −70°C until analysis. Salivary cortisol levels (ng/mL) (DBC– Diagnostics Biochem Canada Inc, Ontario, Canada) and salivary melatonin levels (pg/mL) (IBL International GmbH, Hamburg, Germany) were determined by enzyme-linked immunosorbent assay (ELISA). During the assay, a microplate washer (Atlantis; Asys, Eugendorf, Austria), a rotary shaker (Certomat BS-1; B. Braun Biotech International, Melsugen, Germany) and a microplate reader (SpectraMax M3; Molecular Devices, Sunnyvale, CA, USA) were used. Results were obtained with a computerized method (My Assays) using a 4-parameter curve fit.

Statistical Analysis

Data were expressed as mean and standard deviation (SD) or mean and standard error (SE) for continuous variables and as frequencies or percentages for categorical variables. Cortisol and melatonin levels were log-transformed before analysis. Chi-square test was used to compare sex and Child Behavior Checklist classification by school start time. Student's t test was used to compare demographic variables, school start time, and circadian sleep parameters between school start times groups; to compare mean differences of cortisol and melatonin levels between morning and afternoon school students and between non-clinical and clinical CBCL groups; to compare circadian sleep parameters between morning and afternoon school students; and to compare school start times and circadian sleep parameters, separately by non-clinical and clinical groups. The mean difference in cortisol and melatonin levels between morning, afternoon and night times was analyzed using one-way analysis of variance (ANOVA) followed by Tukey's multiple comparison test.

Univariate Pearson's correlation coefficients were calculated to analyze the relationship between morning melatonin levels and circadian sleep parameters for all sample; and hormone levels and circadian sleep parameters in non-clinical and clinical CBCL groups. All statistical analyses were performed using SPSS v.18 (SPSS Inc., Chicago, IL, USA). Statistical significance was set at $P < 0.05$.

Results

Comparisons for age, sex, body mass index, CBCL classification, and circadian sleep parameters between school start times are shown in Table 1. The morning school start time students group had significantly higher age, lower sleep duration on weekdays, higher bedtime and wake up time differences, higher sleep deficit, earlier midpoint of sleep on weekdays and on weekends, and higher social jetlag than afternoon school start time students.

The comparison of cortisol and melatonin levels between morning and afternoon school students is shown in Figure 2. Cortisol levels were similar between morning and afternoon school students. Afternoon school students had significantly higher melatonin levels in the morning and a statistical trend toward higher melatonin levels in the afternoon (t=-1.91; P=0.06).

Morning melatonin levels were significantly positively correlated with midpoint of sleep on weekdays (r=0.30; P=0.023) and on weekends (r=0.28; P=0.031). Morning melatonin levels were no correlated with others sleep parameters, such as sleep duration, bedtime and wake up time differences, sleep deficit, social jetlag and MEQ scores.

When the correlation between melatonin secretion and circadian sleep parameters was analyzed according to school start time, afternoon melatonin levels were positively correlated with midpoint of sleep on weekends in the morning school students (r=0.313; P=0.049). Conversely, in the afternoon school students, night melatonin levels were negatively correlated with midpoint of sleep on weekdays (r=-0.48; P=0.012). Cortisol secretion did not correlate with circadian sleep parameters in any of the school time groups.

Non-clinical and clinical CBCL groups had similar cortisol levels in the morning (t=0.93; P=0.35), afternoon (t=0.79; P=0.43), and at night (t=-1.35; P=0.18), as well as similar melatonin levels in the morning (t=0.48; P=0.63), afternoon (t=-1.20; P=0.24), and at night (t=-1.35; P=0.18).

However, clinical and non-clinical CBCL groups differed in the correlation between circadian sleep parameters and cortisol and melatonin secretion. Night melatonin levels were negatively correlated with midpoint of sleep on weekdays and on weekends, in non-clinical group. In addition, clinical group showed an opposite correlation between melatonin levels and circadian sleep parameters compared to the non-clinical CBCL group (Figure 3). No correlation was found between cortisol levels and circadian sleep parameters, in non-clinical group. Otherwise, night cortisol levels were positively correlated with morningness in the clinical CBCL group (r=0.39; P=0.029).

When compared school start times and circadian sleep parameters, separately by non-clinical and clinical groups (Figure 4), students classified as non-clinical group and studying in morning school start time presented lower sleep duration on weekdays and on weekends, higher sleep deficit, and earlier midpoint of sleep on weekdays and on weekends than afternoon school start time students. Students classified as clinical group and studying in morning school start time reported significantly earlier midpoint of sleep on weekdays than afternoon school start time students.

Discussion

The current study investigated the influence of school start time on melatonin and cortisol levels. We found that school start time influences the secretion of melatonin, which showed significantly lower levels in morning school students. Otherwise, cortisol presents similar levels on both school start times.

In this study, morning melatonin levels were significantly positively correlated with midpoint of sleep on weekdays and on weekends. Melatonin secretion is stimulated by darkness, controlling circadian rhythmicity. The dysregulation of pineal melatonin secretion can be associated with sleep-wake disruption (Hickie et al., 2013). We found that the secretion of morning melatonin was influenced by sleep phase, which is more interrupted if the children and adolescents studying in morning school start time. In adults, both sleep and sleep deprivation have an impact on melatonin amplitude, and this effect appears to be age-dependent (Zeitzer et al., 2007).

In this study, non-clinical group presented lower melatonin levels correlated with greater sleep deficit and later midpoint of sleep, as expected (Simpkin et al., 2014). These correlations disappear in clinical group, may be because the children and adolescent with mental problems presented impairment in their temporal system, consequently decreasing the adaptability to sleep routines. Altered melatonin secretion may predispose individuals to diseases, add to the severity of symptoms, or modify the course of the disease (Claustrat & Leston, 2015). Studies have demonstrated that changes in melatonin levels are associated with depression (Beck-Friis et al., 1985; Srinivasan Vet al., 2009), cancer (Mazzoccoli et al., 2012; Kochan & Kovalchuk, 2015), inflammatory response (Fernandes et al., 2006), and obesity (Cipolla-Neto et al., 2014), and beneficial effects of melatonin replacement therapy have been suggested (Mendes et al., 2013). Administration of low doses of melatonin in the afternoon to adolescent students could advance the sleep timing, decrease daytime sleepiness, and increase evening sleepiness (Eckerberg et al., 2012).

Our results showed that non-clinical group presented significantly differences in many sleep parameters when compared students of morning and afternoon school start times. On the other hand, when we made these comparisons for students classified as clinical group, only midpoint of sleep on weekdays was significantly different between morning and afternoon school start times. For both CBCL groups, morning students reported the most disrupted sleep parameters. In children, late sleep-wake schedules were associated with behavior problems (Wada et al., 2013). In adolescents, sleep difficulties were associated with a higher frequency of health problems such as headaches, fatigue, irritability, and nervousness (Paiva et al., 2015). If the sleep deficit becomes chronic, it is unlikely that the body will recover physiologically, which may explain why, in adults, a positive correlation has been found between circadian behavior and psychiatric disorders, such as depression.

This study has some limitations. Sleep parameters were obtained from questionnaires. However, a review of the literature suggests that subjective sleep reports are valid for screening as compared to objective measures (Bauer et al., 2008). In the same vein, psychiatric problems in children were assessed by parents' reports on the CBCL, which may express possible misperception of symptoms. However, this instrument is a valid measure for screening psychiatric problems (Bordin et al., 2013).Further longitudinal studies are needed to clarify the direction of the causality between circadian sleep parameters and morbidities, specifically psychiatric symptoms in the long term (Gregory & Sadeh, 2016).

In our previous study, there was evidence that school time influenced sleep deficit in a sample of Brazilian children and adolescents (Carissimi et al., 2016). In the present study, we demonstrated that school start time influences melatonin secretion, which correlated with circadian variables (circadian sleep parameters) differently for children who have behavior problems. Studies have shown that school start time influences students' satisfaction with sleep, motivation, daytime sleepiness, fatigue, and depressed mood (Owens et al., 2010). Adolescents with a 25-min delay in school start time showed an increase in sleep duration on weekday nights and improvements in daytime sleepiness, mood, and caffeine use (Boergers et al., 2014). School start time might affect morning and evening students in a different way, i.e. evening-type students could benefit from attending classes in the afternoon. Thus, it is important to revise the school start time, since it has been associated with impairment in the physiology of children and adolescents. To consider psychiatric symptoms becomes imperative in the adjustment of school schedules.

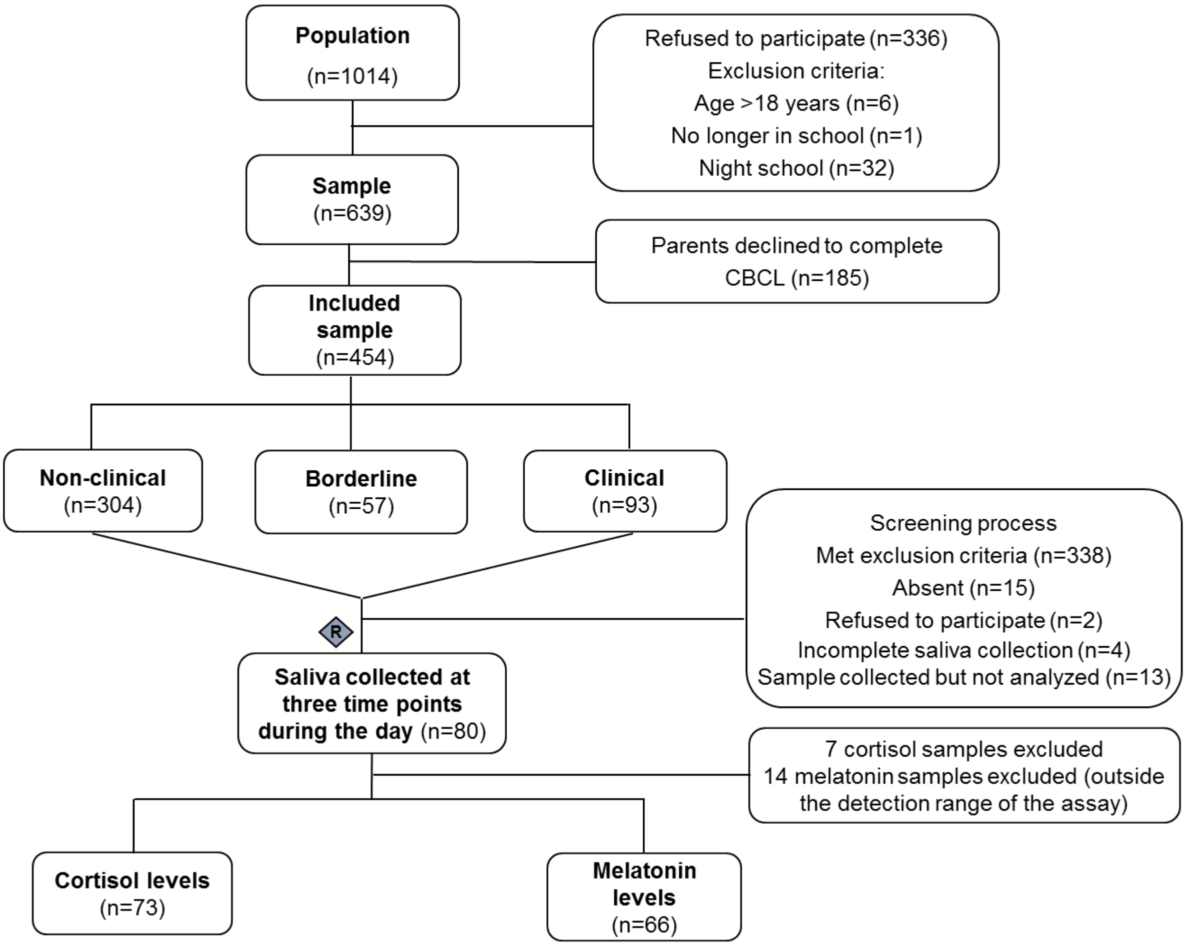

Figure 1. Flowchart of the inclusion procedure.

Table 1. Comparisons for age, sex, body mass index, Child Behavior Checklist classification, and circadian sleep parameters between school start times groups.

	Morning (n=50)	Afternoon (n=30)	P value
Age, mean (SD), yrs#	13.26±2.72	10.67±1.58	<0.001*
Sex, n (%)£			0.10
Male	15 (30)	14 (47)	
Female	35 (70)	16 (53)	
Body mass index, mean (SD)#	19.69±3.80	19.34±5.24	0.73
Child Behavior Checklist, n (%)£			0.09
Non-clinical	26 (52)	21 (70)	
Clinical	24 (48)	9 (30)	
Circadian sleep parameters#			
Sleep duration (hours)			
Weekdays	8.03±1.04	9.41±1.37	<0.001*
Weekends	9.42±1.26	10.20±1.43	0.08
Bedtime difference (hours)	0.53±0.52	0.18±0.58	0.007*
Wake up time difference (hours)	2.31±1.24	0.54±1.17	<0.001*
Sleep deficit (hours)	1.44±1.20	0.39±1.16	0.001*
Midpoint of sleep (hours)			
Weekdays	2.06±0.40	3.44±1.28	<0.001*
Weekends	2.59±0.47	4.02±1.38	0.002*
Social jetlag (hours)	0.52±0.52	0.18±0.58	0.008*
MEQ score, mean (SD)	50.41±7.45	51.12±11.45	0.83

Note: Weekend/weekday differences in bedtime and wake up time; Sleep deficit, weekend/weekday differences in sleep duration; MEQ, Morningness-Eveningness Questionnaire. £Chi-Square Test; #Student's t Test. Statistically significant differences, P<0.05*

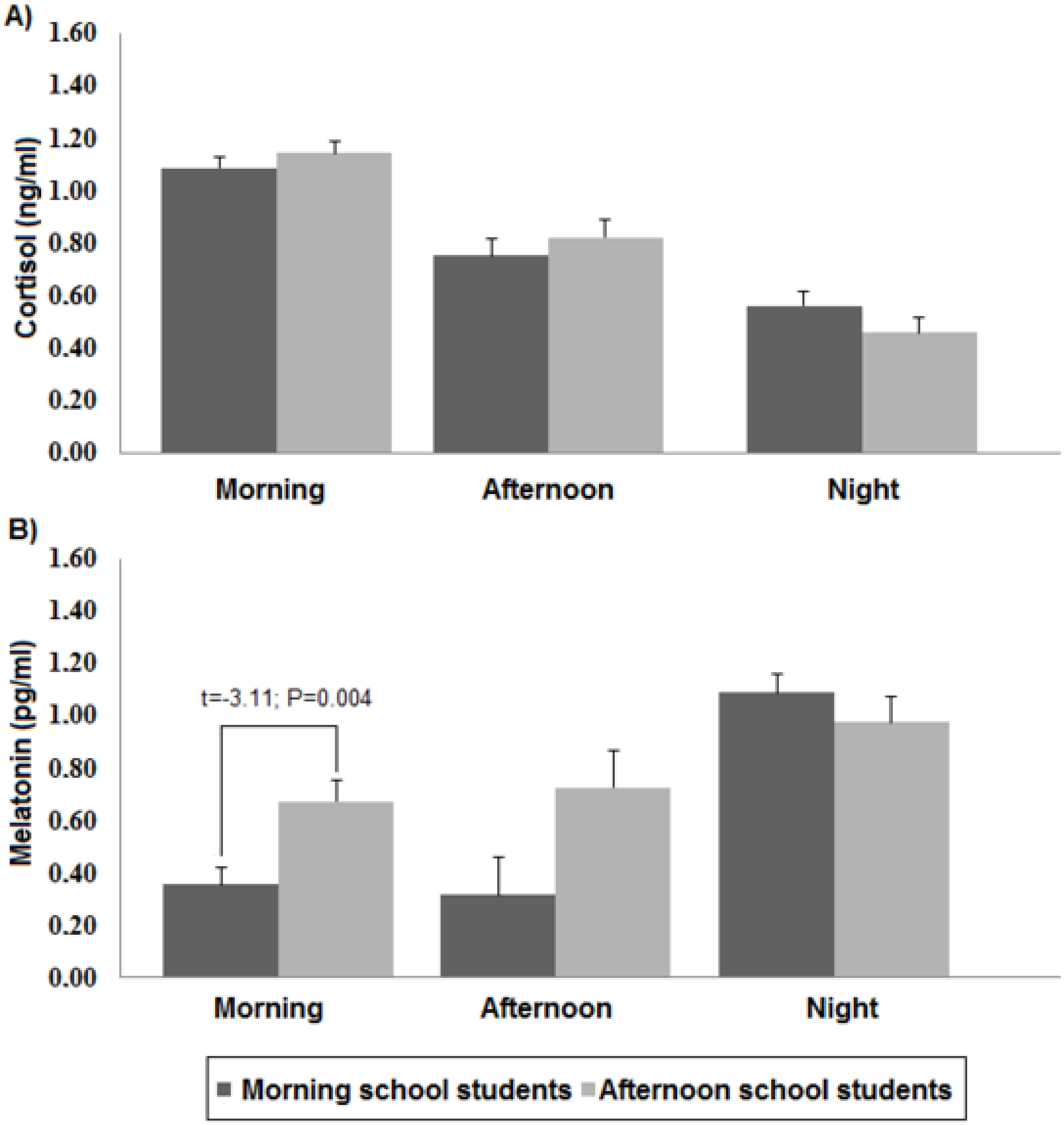

Figure 2. Comparison between A) cortisol and B) melatonin levels in morning vs afternoon school students at three time points (morning, afternoon, and night) by Student's t test. Data are presented as mean and standard error. Statistically significant differences (P<0.05).

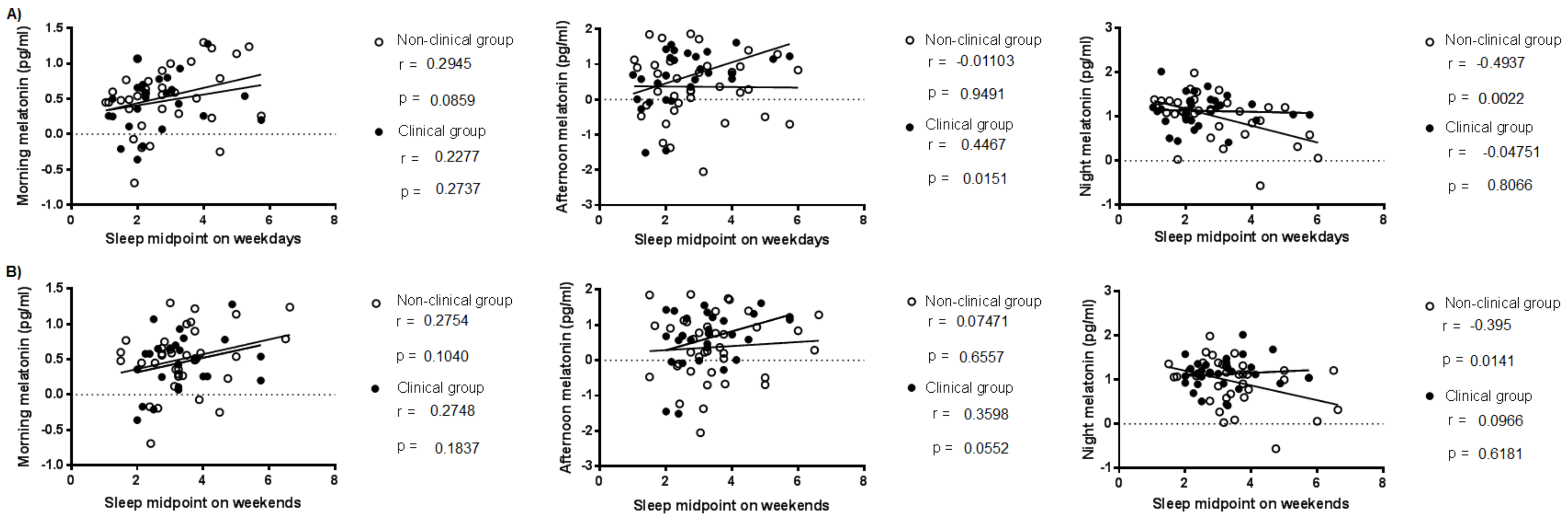

Figure 3. Scatterplot of melatonin levels at three time points (morning, afternoon, and night) and A) sleep midpoint on weekdays, and B) sleep midpoint on weekends in non-clinical and clinical groups evaluated by Child Behavior Checklist. Statistically significant differences (P<0.05).

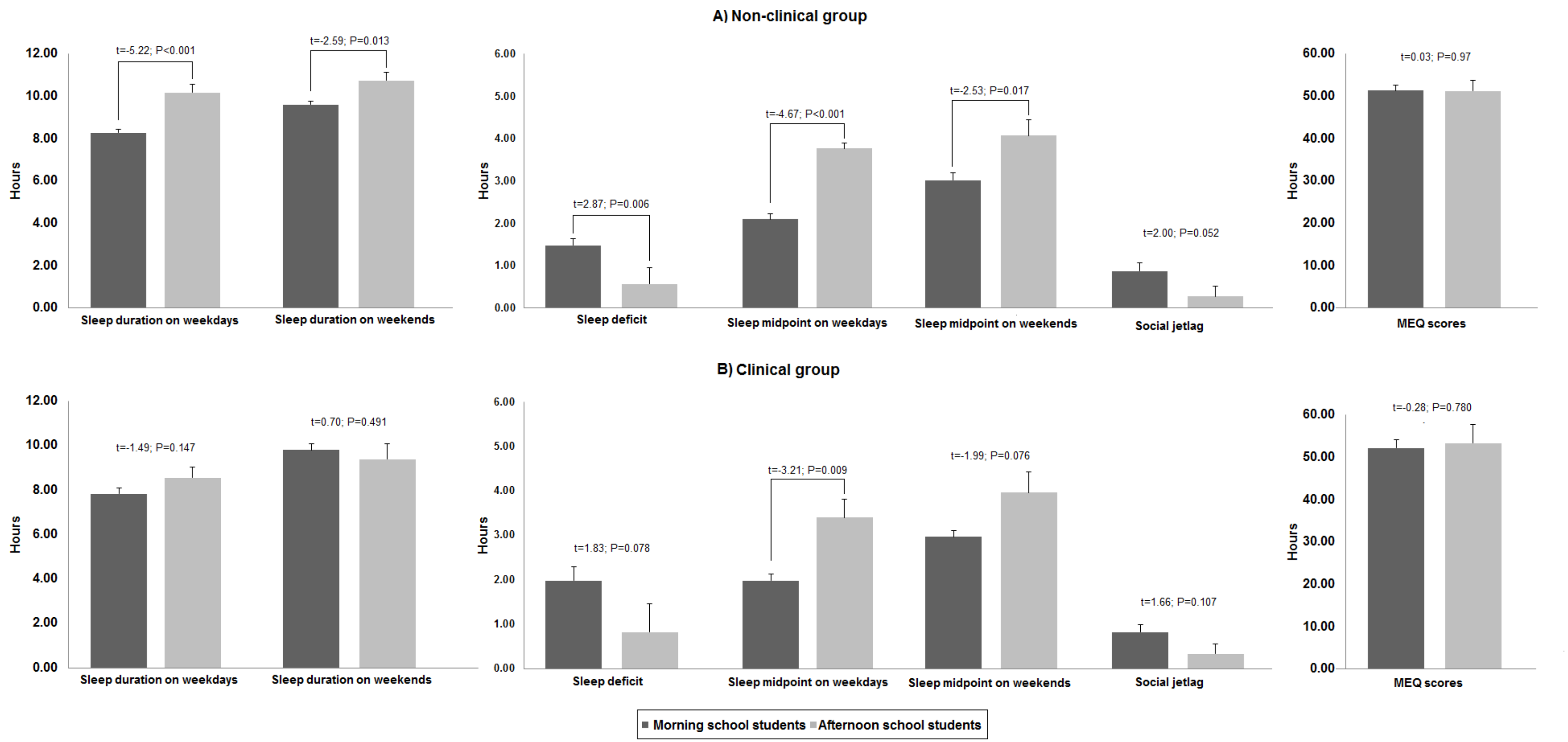

Figure 4. Comparison between school start times and circadian sleep parameters, separately by A) non-clinical and B) clinical groups evaluated by Child Behavior Checklist. Statistically significant differences (P<0.05).

Declaration of Interest statement

Authors have reported no financial conflicts of interest regarding the subject of the present study.

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8. ARTIGO 3

Influence of circadian sleep pattern on psychiatric symptoms in children and adolescents: a community study

O artigo será submetido para a revista *Acta Psychiatrica Scandinavica.*

Influence of circadian sleep pattern on psychiatric symptoms in children and adolescents: a community study

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Abstract

Objective: To investigate the influence of circadian sleep patterns on psychiatric symptoms in a large community sample of Brazilian children and adolescents.

Method: This was a cross-sectional study of 454 school-aged children and adolescents (mean age 12.81±2.56 years; 58.6% female). Circadian sleep parameters were assessed by self-reported sleep duration, bedtime and wake up time differences, sleep deficit, midpoint of sleep on weekdays and weekend, social jetlag, and the Morningness-Eveningness Questionnaire. The Child Behavior Checklist classified behavior problems as Clinical, Borderline, and Non-clinical.

Results: In morning school start time, bedtime and wake up difference, midpoint of sleep, and social jetlag were significantly lower in the Clinical group than Non-clinical group. Students starting school in the afternoon and classified as Non-clinical group demonstrated higher sleep duration on weekdays than those in the Clinical group, and higher sleep duration on weekends compared to the borderline group. In a binary logistic regression model, the variables that predicted psychiatric symptoms were older age, earlier midpoint of sleep on weekdays, shorter sleep duration on weekdays, and earlier school start time.

Conclusion: These findings emphasize the importance of circadian sleep patterns and the effects of school start time on psychiatric symptoms in children and adolescents.

Keywords: psychiatric disorders, sleep, circadian rhythm, behavior problems, chronobiology.

Significant Outcomes

- We identified age, school start time, midpoint of sleep on weekdays, and sleep duration on weekdays as predictors of psychiatric symptoms.
- Students with a morning school start time whose chronotype was classified as evening had shorter sleep duration on weekdays and higher social jetlag than morning-type participants.
- Students with a morning school start time and psychiatric symptoms had shorter duration of sleep and earlier circadian sleep patterns.

Limitations

- The cross-sectional design of this study precludes determination of causal relationships.
- Sleep parameters were obtained from self-administered questionnaires, a subjective measure of sleep and other covariates. However, subjective sleep reports are an inexpensive method for use in epidemiological studies.
- Internalizing psychiatric symptoms were assessed by parental reports, which could express misperception of children and adolescents' symptoms.
- Although we included a representative sample, interpretation of our findings may lack external validity for other countries and cultures (for example, industrialized communities).

Introduction

During adolescence and into emerging adulthood, 38% of individuals experience the onset of a psychiatric disorder.[1] In a recent meta-analysis, the prevalence of mental disorders was 13.4% in children and adolescents worldwide.[2] One of the many factors associated with clinical diseases and mental disorders is sleep problems. In children, late sleep and wake schedules have been associated with behavioral problems.[3] Sleep variability and irregular sleep patterns during weekdays and weekends are common in adolescence.[4] Moreover, the difference between sleep patterns on weekends and on weekdays has been associated with increases in body mass index,[5,6] sleep disorders[7], and psychiatric symptoms,[8,9] probably through circadian rhythm dysregulation.

Sleep disturbances demonstrate a bidirectional relationship with psychiatric disorders, including mood disorders.[10,11,12] Children with psychiatric disorders commonly report sleep disorders such as long sleep latency, short sleep duration, frequent nocturnal awakenings, and restless sleep.[13] Paiva et al. (2015)[14] found that 19% of students in a sample had sleep deprivation (difference of 3 hours or more from weekends to weeknights), and that adolescents with sleep difficulties had higher rates of health problems such as headaches, fatigue, irritability, and nervousness. In medical students, a hazard ratio of 5.47 for minor psychiatric disorders was found in subjects who slept 7 hours or less.[15]

The misalignment between individual endogenous circadian rhythmicity and the external environment is known as circadian disruption. Chronobiology studies indicate that disruption of the circadian system has a negative impact on physical and mental health in adults,[16] affecting symptoms of depression, anxiety, and bipolar disorder.[17,18,19,20] The literature on chronobiological variables in children is lacking. Most studies have focused in the effects of sleep duration on emotional symptoms,[21,22] and few have evaluated individual characteristics, such as chronotype and psychiatric symptoms,[23] as well as the relationship between chronotype and different school start times.[24] To the best of our knowledge, this is the first study to investigate the influence of school start time and circadian sleep pattern on psychiatric symptoms.

Aims of the study

This epidemiological study was designed to investigate the influence of circadian sleep pattern on psychiatric symptoms in Brazilian children and adolescents from a large community sample. We hypothesized that circadian pattern (chronotype, midpoint of sleep, social jetlag, and morning school start time) would be associated with psychiatric symptoms.

Methods

2.1 Subject selection

Students (n=1,014) from grades 3–12 attending the school systems of Lajeado and Progresso, two municipalities located in the Vale do Taquari region, state of Rio Grande do Sul, Brazil[25], were invited to participate in the study. Subjects were included only if parents provided written informed consent. Of the 1,014 invited, 454 (mean age 12.81±2.56 years; 58.6% female) were included in the final sample. The school schedules were from 07:30 to 12:00 (morning) and from 13:30 to 17:30 (afternoon). The exclusion criteria were: age >18 years, children or adolescents not enrolled in school, and night school start time. The students included and their parents participated by answering a set of questionnaires. The process of sample selection is shown in Fig. 1. This study was performed in accordance with the Declaration of Helsinki[26] (ethics committee approval number: 12–0386 GPPG/HCPA).

2.2 Measures and procedure

Students answered questionnaires on sleep habits and circadian preferences (as measured by the Morningness-Eveningness Questionnaire, MEQ) during the school year. The questionnaires were applied by trained interviewers during school hours, in the presence of a teacher. In addition, parents completed questionnaires about children’s and adolescents’ psychiatric symptoms (Child Behavior Checklist) and about sleep habits, to allow data consistency checks.

2.3 Sleep habits

The questions used to assess sleep habits on weekdays and weekends were “What time do you usually sleep?” and “What time do you usually wake up?”. Based on the responses to these questions, the duration of sleep, sleep deficit, bedtime and wake up time differences, midpoint of sleep for weekdays and weekends, and social jetlag were calculated using self-reported schedules.

Sleep deficit was defined as a difference in sleep duration from weekends to weekdays (sleep deficit = sleep duration on weekends − sleep duration on weekdays).

The sleep-wake difference was defined as the discrepancy between sleeping and waking times on the weekends and weekdays (sleep difference = sleep time on weekends − sleep time on weekdays; wake up time difference = wake up time on weekends − wake up time on weekdays).

Midpoint of sleep was defined by each participant’s sleeping period on weekends and weekdays, as follows: midpoint of sleep on weekdays = sleep onset (SO) on weekdays plus sleep duration (SD) on weekdays divided by two (SD/2), i.e., SO+SD/2; midpoint of sleep on weekends = sleep onset on weekends plus sleep duration on weekends divided by two, i.e., SO+SD/2.[27]

Social jetlag was defined as the discrepancy between social and biological times, and calculated as the difference between the midpoint of sleep on weekends and on weekdays (social jetlag = midpoint of sleep on weekends − midpoint of sleep on weekdays).[28]

2.4 Morningness-Eveningness Questionnaire

The MEQ is a self-assessment questionnaire developed by Horne and Östberg[29] to determine chronotype. It consists of 19 items, which, in turn, are composed of five categories: definitely morning (scores ranges from 70 to 86), moderately morning (59-69), intermediate (42-58), moderately evening (31-41), and definitely evening type (16-30). In this study, chronotype was categorized into three classifications: morning (59-86), intermediate (42-58), and evening type (16-41).

2.5 Child Behavior Checklist

Parents completed the Portuguese version[30] of the Child Behavior Checklist (CBCL) for ages 4-18 years, an 138-item instrument designed to assess behavioral problems.[31] Each question is scored from 0 to 2 (0, not true;

1, somewhat or sometimes true; 2, very true or often true). The scores for each question compose 11 scores of symptom/behavior clusters, which are divided into Internalizing and Externalizing problems. Internalizing problems include Emotionally Reactive, Anxious/Depressed, Somatic Complaints, and Withdrawn syndromes, while externalizing problems refer to Aggressive Behavior and Attention Problems syndromes. The CBCL also generates a total problem score, which is used to classify the child's overall behavior as Non-clinical, Borderline, or Clinical.

2.6 Statistical analysis

To test for association between age and circadian sleep patterns among Child Behavior Checklist groups (Non-Clinical, Borderline and Clinical) for the morning and afternoon school start time groups, we used one-way analysis of variance (ANOVA) with Tukey post-hoc comparisons. To analyze the association between sex distribution and CBCL classification, a chi-square test was performed. To compare circadian sleep pattern and CBCL scores between the morning and afternoon school start time groups, separately by MEQ classification (morning, intermediate, and evening chronotypes), we used Student's t-test. A step-by-step binary logistic regression model was used to predict Clinical and Non-clinical classification on the CBCL. All variables were included in the regression model to control for confounding factors and potential collinearity. Age, sex, and school start time were included in the first step of the equation; MEQ scores were entered in the second; circadian sleep pattern parameters were inserted in the third; and sleep duration was included in the fourth step of the model. PASW Statistics Version 18 was used for all statistical analyses (SPSS Inc., Chicago, IL). Statistical significance was accepted at $P<0.05$.

Results

Of 454 students, 67% were classified as Non-clinical, 13% as Borderline and 20% as Clinical, evaluated by Child Behavior Checklist. A higher percentage of morning school start time were Borderline (74%) or Clinical (82%) than afternoon school start time group ($\chi^2_{(2,454)}= 5.833$; $P=0.054$).

In summary, in morning school start time students, bedtime difference, wake up time difference, midpoint of sleep on weekdays and on weekends, and social jetlag were significantly lower/earlier in the Clinical group compared to the Non-clinical group. On the other hand, students with an afternoon school start time classified as Non-clinical reported longer sleep duration on weekdays compared to the Clinical group, and longer sleep duration on weekends compared to the Borderline group (see Table 1).

According with MEQ, 14% of students were classified as having a morning chronotype, 70% were classified as intermediate, and 16% were classified as having an evening chronotype. Circadian sleep pattern comparisons between the morning and afternoon school start time groups, stratified by MEQ classification, are shown in Figure 2. Students classified as morning, intermediate, and evening types who had an afternoon school start time reported significantly longer sleep duration on weekdays and midpoint of sleep on weekdays, as well as less bedtime difference, wake up time difference, sleep deficit, and social jetlag compared to those with a morning school start time. When compared CBCL scores between the morning and afternoon school start time groups, stratified by MEQ classification, the intermediate chronotype group of afternoon school start time presented higher CBCL scores and External scores than the corresponding group in the morning school start time group, although that result only reached a statistical trend toward statistical significance ($t=-1.89$; $P=0.064$ and $t=-1.79$; $P=0.079$, respectively).

Table 2 shows the binary logistic regression model used to predict Clinical and Non-clinical classification according to the CBCL. This analysis identified older age ($\beta=0.100$; $P=0.033$), earlier school start time ($\beta=-1.834$; $P<0.001$), earlier midpoint of sleep on weekdays ($\beta=-0.607$; $P=0.001$), and shorter sleep duration on weekdays ($\beta=-0.481$; $P<0.001$) as significant predictors of psychiatric symptoms (Nagelkerke $R^2=0.152$).

Discussion

The present study investigated the influence of circadian sleep pattern on psychiatric symptoms in a large community sample of school-aged children and adolescents. Psychiatric symptoms were predicted by older age, earlier midpoint of sleep on weekdays, shorter sleep duration on weekdays, and earlier school start time.

Our results demonstrated that older age was associated with an increase in psychiatric symptoms. It is known that the normative transition to adulthood faced by adolescents is a stressful period, due to the massive biological, cognitive, emotional, and social changes experienced.[32] Based on our data, we cannot infer whether the symptoms we detected represent a temporary dysfunction of adaptive mechanisms or the onset of mental disorders. Additionally, circadian rhythm disruption occurring at this age may be due to epigenetic influences (interaction between genes and environmental lighting conditions, for example). We can state that sleep pattern effects have a potential impact on health (in this case, psychiatric symptoms).[16]

We observed that psychiatric symptoms were associated with the sleep-wake rhythm on weekdays, explained by earlier midpoint of sleep and shorter sleep duration on weekdays, independently of school start time. One possible explanation is due to the fact that the students composing the sample reside in a rural community, and the main source of livelihood is agriculture, being most of the children and adolescents involved with the family work, waking up earlier regardless of school days. The earlier midpoint of sleep was significantly earlier for students classified as Clinical group than Non-clinical group in the morning school start time, indicating that students classified as morning chronotype experienced more behavior problems. A significant association between midpoint of sleep on weekdays and depression has also been described by others.[9] In children and adolescents, the midpoint of sleep on weekdays reflects the expression of individual chronotype under the influence of school routine; therefore, the difference between sleep midpoint on weekends and weekdays could be a useful marker to measure physiological stress.

In addition, shorter sleep duration was also associated with psychiatric symptoms, as students in the afternoon school start time group with psychiatric symptoms had a shorter sleep duration (mean of 8.5 hours) than students without psychiatric symptoms (mean of 10.1 hours). Although students in the morning school start time group slept less than students in the afternoon group, there were no differences in CBCL scores for this group. Increased sleep duration during the weekend provides an opportunity to recover from the sleep deficit experienced during the week, which may be related to lifestyle. When this deficit becomes chronic, the body may no longer be able to recover physiologically, which can explain why a positive correlation has been established between circadian sleep pattern and psychiatric disorders, such as depression, in adults.[17] In our study, we found that students in the afternoon school start time group classified as the intermediate chronotype presented a statistical trend toward significantly more psychiatric symptoms than those in the morning school start time group. Our findings reinforce the importance of adjusting school schedules to circadian typology preference.

Furthermore, it is important to emphasize the impact of school start time on sleep deficit in children and adolescents.[25] Studies have shown that, in students of grades 9–10, delayed school start times reduced depressed mood, daytime sleepiness, and caffeine use.[33] According to the American Academy of Pediatrics policy statement[34], a recommendation for delayed school start times can provide the opportunity for sleep duration of 8.5 to 9.5 hours and help reduce the risk of obesity, mental disorders, low academic performance, and poor quality of life. Although these studies assessed the relationship between sleep and school start time, there is a lack of research into chronobiological variables and school start time and their respective impacts on psychiatric symptoms.

To understand our data, it is also necessary to differentiate lifestyles and symptoms of circadian sleep problems, because the latter may be indicative of mental illness in childhood and adolescence. For example, individual characteristics of sleep and wake up time according to physiological predisposition (morningness and eveningness) are simply a sleep pattern.[35] Conflicts between changing social demands and the physiological clock can constitute a risk factor for mental illness, especially in adolescence. For example, in children and adolescents, unsupervised and uncontrolled use of electronic devices has been considered a negative factor predisposing to an unhealthy lifestyle, especially regarding sleep. Delayed bedtime and shorter total sleep time have been reported in association.[36]

Some limitations of the present study must be considered. Due to the cross-sectional design, we were unable to assess causality. Sleep parameters were obtained from self-administered questionnaires, which are a subjective measure of sleep and other covariates. Nevertheless, subjective sleep reports can be considered an inexpensive method for use in epidemiological studies. Likewise, psychiatric symptoms were assessed by parental reports, which can express misperceptions of children and adolescents' internalizing symptoms.

To conclude, schoolchildren with a morning school start time and psychiatric symptoms presented shorter duration of sleep and earlier circadian sleep patterns. Furthermore, controlling for potential confounders, age, school start time, midpoint of sleep on weekdays, and sleep duration on weekdays were predictors of psychiatric symptoms, as evaluated by the Child Behavior Checklist. Since mental disorders are considered as one of the most important cause of mortality and disability in the period of 1990–2020[37,38], polices statements should consider school schedules to reduce the effects of dysregulation of circadian rhythms and, therefore, the risk of psychiatric symptoms in children and adolescent.

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Declaration of Interest

None reported.

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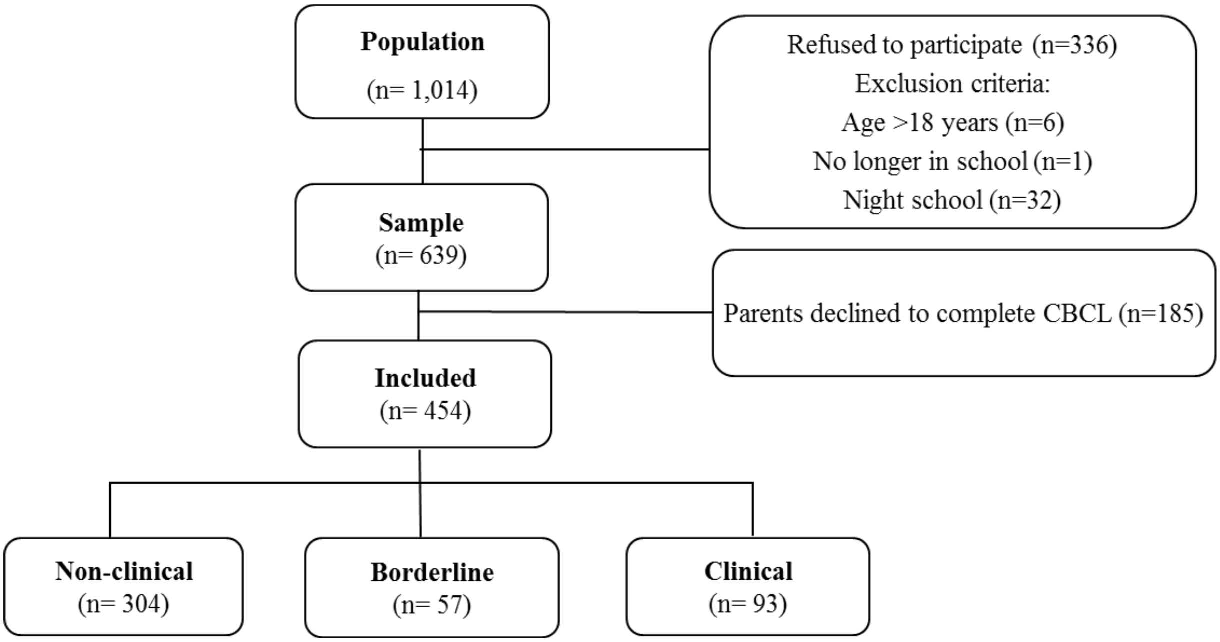

Fig. 1. Flowchart of inclusion procedure.

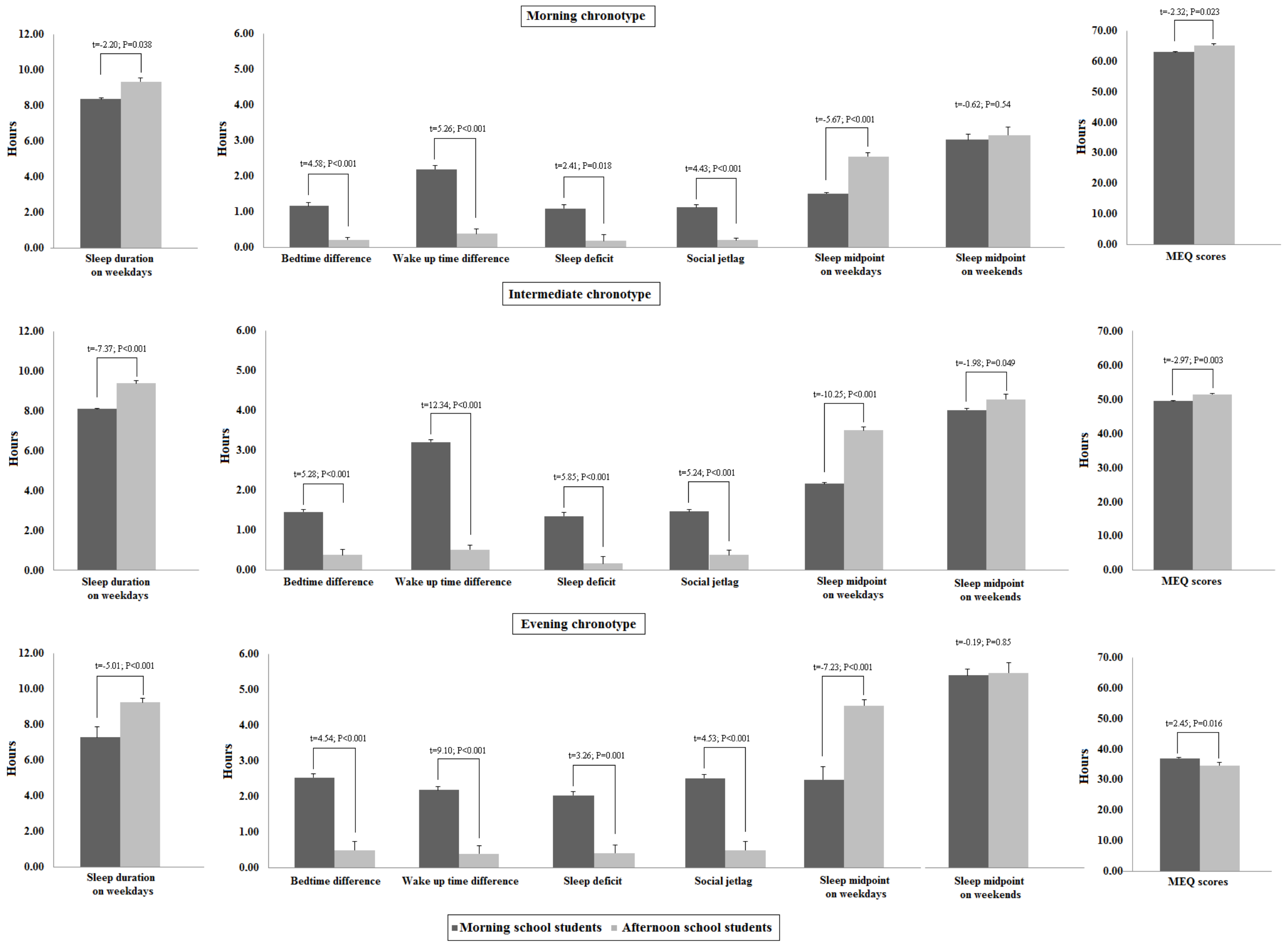

Fig. 2. Circadian sleep pattern comparisons between morning and afternoon school start times, stratified by Morningness-Eveningness Questionnaire classification (Morning, Intermediate, and Evening chronotypes).

Table 1. Results of age, sex, and circadian sleep pattern comparisons among groups as classified by Child Behavior Checklist (Non-Clinical, Borderline and Clinical) for morning and afternoon school start times

	Morning school start time			
	Non-Clinical n=262	Borderline n=42	Clinical n=76	P-value
Age, mean (SD), yrs*	12.86±2.60[a]	13.79±2.37[ab]	13.63±2.39[b]	**0.014**
Sex, n (%)£				**0.043**
Male	112 (29.6%)	20 (5.3%)	21 (5.5%)	
Female	150 (39.6%)	22 (5.8%)	54 (14.2%)	
Sleep duration, weekdays (hours)*	8.13±0.58	8.07±0.53	8.00±1.04	0.24
Sleep duration, weekends (hours)*	9.49±1.37	9.17±1.32	9.47±1.22	0.12
Bedtime difference (hours)*	1.59±1.37[a]	1.43±1.31[ab]	1.12±1.28[b]	**0.001**
Wake up time difference (hours)*	3.35±1.37[a]	2.53±1.53[b]	2.59±1.39[b]	**0.002**
Sleep deficit (hours)*	1.37±1.37	1.10±1.29	1.47±1.23	0.13
Midpoint of sleep, weekdays (hours)*	2.20±0.38[a]	2.13±0.42[ab]	2.06±0.42[b]	**0.016**
Midpoint of sleep, weekends (hours)*	4.17±1.46[a]	3.56±1.44[ab]	3.23±1.41[b]	**0.001**
Social jetlag (hours)*	1.59±1.37[a]	1.43±1.31[ab]	1.16±1.25[b]	**0.003**
MEQ score, mean (SD)*	49.35±7.90	50.86±8.54	49.64±8.69	0.53
	Afternoon school start time			
	Non-Clinical n=42	Borderline n=15	Clinical n=17	P-value
Age, mean (SD), yrs*	11.19±2.02	10.93±1.71	11.53±1.81	0.68
Sex, n (%)£				0.23
Male	23 (31.5%)	6 (8.2%)	5 (6.8%)	
Female	19 (26%)	9 (12.3%)	11 (15.1%)	

Sleep duration, weekdays (hours)*	10.06±1.17[a]	9.08±1.02[ab]	8.49±1.48[b]	**0.003**
Sleep duration, weekends (hours)*	10.29±1.44[a]	9.20±1.10[b]	9.35±1.54[ab]	**0.035**
Bedtime difference (hours)*	0.30±1.01	0.33±1.04	0.24±2.06	0.95
Wake up time difference (hours)*	0.52±1.36	0.44±1.05	1.10±1.24	0.69
Sleep deficit (hours)*	0.23±1.28	0.11±0.54	0.46±2.14	0.58
Midpoint of sleep on weekdays (hours)*	3.59±1.18	3.34±0.56	4.12±1.20	0.36
Midpoint of sleep on weekends (hours)*	4.29±1.41	4.07±1.31	4.35±1.59	0.72
Social jetlag (hours)*	0.30±1.01	0.33±1.04	0.24±2.06	0.95
MEQ score, mean (SD)*	50.26±10.99	54.87±9.43	48.50±10.21	0.26

Abbreviations: Weekend/weekday difference in bedtime and wake time; Sleep deficit, weekend/weekday difference in sleep duration; MEQ, Morningness-Eveningness Questionnaire. [a,b]Mean difference significant at the 0.05 on post-hoc comparison; *One-way analysis of variance; [£]Chi-square. Statistically significant differences (P<0.05) are set in bold type.

Table 2. Step-by-step binary logistic regression model of Clinical and Non-clinical groups assessed by CBCL

Variables	Multivariate B (standard error)	Wald
Step 1 – Demographic characteristics		
Nagelkerke R^2= 0.048		
Age	0.119 (0.043)*	7.819
Sex	-0.412 (0.210)	3.855
School start time	-0.799 (0.540)*	8.211
Step 2 – Morningness-Eveningness Questionnaire		
Nagelkerke R^2= 0.053		
Age	0.124 (0.043)*	8.392
Sex	-0.417 (0.211)*	3.913
School start time	-0.793 (0.279)*	8.072
MEQ	0.015 (0.012)	1.685
Step 3 – Circadian sleep pattern		
Nagelkerke R^2= 0.107		
Age	0.149 (0.045)*	11.095
Sex	-0.301 (0.221)	1.845
School start time	-0.995 (0.437)*	5.176
MEQ	-0.021 (0.016)	1.783
Bedtime difference	-0.834 (0.725)	1.321
Wake up time difference	0.534 (0.723)	0.545
Sleep deficit	-0.680 (0.722)	0.888
Midpoint of sleep on weekdays	-0.380 (0.164)*	5.412
Step 4 – Sleep duration		
Nagelkerke R^2= 0.152		
Age	0.100 (0.047)*	4.528
Sex	-0.340 (0.227)	2.250
School start time	-1.834 (0.501)**	13.415

MEQ	-0.020 (0.016)	1.468
Bedtime difference	-0.979 (0.824)	1.414
Wake up time difference	0.671 (0.823)	0.666
Sleep deficit	-0.907 (0.823)	1.214
Midpoint of sleep on weekdays	-0.607 (0.180)*	11.419
Sleep duration on weekdays	-0.481 (0.125)**	14.773

Abbreviations: CBCL, Child Behavior Checklist; MEQ, Morningness-Eveningness Questionnaire. Weekend/weekday difference in waking time; Weekend/weekday difference in bedtime. Variables excluded from the model due to collinearity: Step 3, Midpoint of sleep on weekends and Social jetlag; Step 4, Midpoint of sleep on weekends, Social jetlag, and Sleep duration on weekends. Significant at $P<0.05$*, $P<0.001$**.

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9. CONCLUSÕES E CONSIDERAÇÕES FINAIS

De acordo com os resultados apresentados, os achados sinalizam que:

- Horários escolares influenciam no déficit de sono de crianças e adolescentes;
- Verificou-se maior déficit de sono em estudantes do turno da manhã;
- Observou-se maior déficit de sono em meninas comparando com meninos;
- Preditores de déficit de sono foram: jetlag social, diferenças entre os horários de acordar e ponto médio do sono nos fins de semana;
- Horários escolares influenciam a secreção de melatonina;
- Os níveis de melatonina foram positivamente correlacionados com ponto médio do sono em estudantes do turno da manhã, e negativamente correlacionados com ponto médio do sono em estudantes do turno da tarde;
- Níveis de cortisol durante à noite foram correlacionados com matutinidade no grupo com sintomas psiquiátricos;
- Identificou-se idade, horário de início da escola, ponto médio de sono e duração do sono nos dias de semana como preditores de sintomas psiquiátricos, avaliados pela Lista de verificação comportamental para crianças e adolescentes;
- Os estudantes do turno da manhã, classificados como cronotipo do tipo vespertino, apresentaram menor duração do sono durante a semana e maior jetlag social do que estudantes do tipo matutino;
- Os alunos do turno da manhã com sintomas psiquiátricos apresentaram menor duração do sono e padrão circadiano de sono mais cedo.

Por fim, o presente estudo fornece evidências de que os horários escolares influenciam os componentes circadianos do sono, tendo relação com o déficit de sono e com a disrupção/ruptura do ritmo circadiano. Além disso, os horários de início da escola influenciam a secreção de hormônios, como melatonina. Portanto, é importante redirecionar as crianças e adolescentes para um turno escolar que contemple as preferências individuais de sono. Estas medidas podem auxiliar na regulação da secreção de melatonina e de cortisol, bem como dos componentes circadianos do sono, prevenindo o desenvolvimento de sintomas psiquiátricos.

10. MATERIAL SUPLEMENTAR

Artigos científicos (ANEXO 1)

24-h actigraphic monitoring of motor activity, sleeping and eating behaviors in underweight, normal weight, overweight and obese children

Artigo realizado em colaboração com pesquisadores da Universidade de Bologna, na Itália. Os dados foram coletados durante o período de doutorado sanduíche na Universidade de Bologna. Neste estudo, objetivou-se descrever o ciclo sono-vigília de 24 horas, atividade motora e padrões de consumo alimentar em diferentes categorias de índice de massa corporal (IMC) de crianças através de sete dias de registro actigráfico. Link para o artigo: http://link.springer.com/article/10.1007%2Fs40519-016-0281-9

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24-h actigraphic monitoring of motor activity, sleeping and eating behaviors in underweight, normal weight, overweight and obese children

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Abstract

Purpose: Within a chronobiological perspective, the pre-sent study aimed to describe 24 h of sleep–wake cycle, motor activity, and food intake patterns in different body mass index (BMI) categories of children through 7 days of actigraphic recording.

Methods: Height and weight were objectively measured for BMI calculation in a sample of 115 Italian primary schoolchildren (10.21 ± 0.48 years, 62.61 % females). According to BMI values, 2.60 % were underweight, 61.70 % were of normal weight, 29.60 % were overweight and 6.10 % were obese. Participants wore a wrist actigraph continuously for 7 days to record motor activity and describe sleep–wake patterns. In addition, participants were requested to push the event-marker button of the actigraph each time they consumed food to describe their circadian eating patterns.

Results: BMI group differences were found for sleep quantity (i.e. midpoint of sleep and amplitude), while sleep quality, 24-h motor activity and food intake patterns were similar between groups. Regression analyses showed that BMI was negatively predicted by sleep duration on schooldays. BMI was also predicted by motor activity and by food intake frequencies recorded at particular times of day during schooldays and at the weekend.

Conclusions: The circadian perspective seems to provide promising insight into childhood obesity, but this aspect needs to be further explored.

Keywords: Motor activity; Sleep; Eating behavior; Body mass index; Children; Actigraphy

Introduction

The World Health Organization has considered childhood obesity to be one of the most serious global public health challenges for the twenty-first century [1]. Obese children and adolescents are at an increased risk of developing diverse health problems [2], and they are more likely to become obese adults. It is therefore important to plan strategies against weight gain and obesity starting from an early age [3,4].

The detection of all supposed factors associated with weight gain is fundamental to offer novel avenues for prevention and intervention. Among these factors, recent indications from animal studies have suggested that the time of food intake itself influences weight regulation. For example, in an experiment comparing two groups of mice, one that fed only during the light phase (usual rest period for mice), and one that fed only during the dark phase (usual active period for mice), despite an equivalent amount of calories being consumed by the two groups, a greater weight gain was reported in the first group, that is, the group in which the mice fed at times of day that were different from their usual feeding habits [5]. In humans, Garaulet and Gómez-Abellán [6] described that during a 20-week dietary intervention, the timing of the main meal, such as early or late lunchtime, played a significant role in weight-loss success: independently of energy intake, late lunch eaters exhibited a slower weight-loss rate and lost less weight compared to early eaters. In addition, evidence from shift-work studies showed that irregular meal times due to shift work could contribute to the range of metabolic diseases commonly found in shift workers [7].

The studies mentioned above show the importance of when we eat, and not only of what we eat. Since almost all physiological and behavioral functions of the body exhibit oscillations during different time periods, mainly in cycles of 24 h [8], we decided to investigate body mass index (BMI) variations adopting a chronobiological approach, in which the focus is on time-dependent variations of bio-logical functions. To this end we chose to use the actigraph, given that this tool allows for a continuous collection of data within the 24-h period in an ecological way.

In pediatric research, the use of the actigraph has become common because actigraphy allows researchers to obtain objective sleep measure for extended periods of time, in natural environment [9]. As regards sleep, an increasing amount of research has shown that, in addition to the ‘‘traditional’’ factors associated with weight gain (see [10] for a review), shorter sleep durations seem to contribute to childhood obesity. Cappuccio et al. [11], for example, reported a strict relationship between the reported number of sleep hours and BMI, that is, short sleepers had higher BMI values than longer sleepers. Actigraphy provides measures of several other sleep parameters, besides sleep duration, that are potentially associated with BMI. For instance, Wirth et al. [12] showed that, besides a short sleep duration, higher BMI values were predicted by an actigraphic lower sleep efficiency (the ratio of the total sleep time to time in bed multiplied by 100), higher wake after sleep onset, later wake times and longer sleep latency. Van den Berg et al. [13] found a relationship between the increase in sleep frag-mentation and an increase in BMI. Thus, BMI seems to be related to actigraphic sleep quantity and quality.

The accelerometer of the actigraph has also been widely used to estimate the amount of daily physical activity [14]. Generally, these studies indicated that childhood obesity was predicted by less moderate-to-vigorous physical activity; however, these data were questioned because of the availability of various accelerometer cut-off points that reduced the possibility of comparison between studies and generated differing results [15]. Within a circadian perspective, and in line with a recent meta-analysis [16], we decided to analyze the actigraphic motor activity during a 24-h span to describe the circadian pattern of this actigraphic activity in an ecological setting [17].

In previous studies, actigraphy was also used to measure the frequency of behaviors other than the sleep–wake cycle, such as the occurrence of yawning [18] and prospective memory [19]. In the two studies cited, participants were instructed to push the event-marker button of the actigraph each time a particular behavior occurred; in the present study, we instructed participants to push the event-marker button of the actigraph each time they consumed food. In so doing, in this study we collected data regarding not only the frequency of food intake during the 24-h period, but also the time of day when participants consumed food.

The aim of the present study was therefore to investigate 24 h of sleep–wake cycle, motor activity and food intake patterns in different BMI groups using a single tool.

Although this study was an exploratory study, some predictions could be advanced. First, as far as sleep quality and quantity were concerned, we expected to see lower values in overweight and obese children than in normal weight children. As regards motor activity, we expected normal weight children to have higher values during the 24-h period compared to the other weight groups. Finally, regarding eating patterns, we expected BMI groups to show different times of day for food intake.

Finally, we predicted differences between weekdays and weekends in all variables considered, given that school schedules, which provide an important environmental cue, could have a synchronizing effect on the circadian system. During schooldays, for example, school starting time influences both bedtime and getting-up time [20].

Methods

Participants

The sample comprised 115 schoolchildren (72 females) (mean age ± SD, 10.21 ± 0.48 years), who were attending the last 2 years of the Italian Primary School System. Participants did not differ for age ($t(113) = 1.64$, $p = 0.10$). Participants attended classes from Monday to Friday from 8:30 to 16:30. Exclusion criteria included sleep disorders, serious or acute illness, psychopharmaceutical drug use, and disabilities that would interfere with or restrict mobility.

Children were enrolled only if parents signed the informed consent form.

Measures and procedure

Circadian preference

Since one of the most important inter-individual differences in the expression of circadian rhythms is circadian preference [21], we evaluated participants' chronotype using the Italian version [22,23] of the reduced version of the Morningness–Eveningness Questionnaire (rMEQ) [24], adapting the content of the items to scholastic rather than working activities. The rMEQ is a self-assessment questionnaire, consisting of five items: three items ask the time at which participants go to bed, the time they get up and the hour of the day when peak personal efficiency is at its maximum, one item requests participants to assess their degree of tiredness during the first half hour after awakening, and the last item asks participants to indicate which circadian type they think they belong to. The rMEQ score ranges from 4 to 25, with higher scores indicating a morningness preference.

Anthropometric measures

Children were measured barefoot and without outerwear. Weight was measured using a digital scale, with an accuracy of 0.1 kg. Height was measured using a portable stadiometer, with an accuracy of 0.1 cm. BMI was calculated as weight in kilograms divided by height in meters, squared (kg/m2). According to age- and gender-specific BMI cut-off values [25,26], children were assigned to one of the following groups: underweight, normal weight, overweight and obese.

Actigraphic measurements

The actigraph is a small device that records and stores movement to estimate sleep–wake patterns from activity level; it is habitually worn around the non-dominant-wrist.

In the present study we used the Actiwatch actigraph (AW64, Cambridge Neurotechnology Ltd, UK). The hardware consists of a piezoelectric accelerometer with a sensitivity of 0.05 g and a sampling rate of 32 Hz. Devices were initialized to collect data in 1-min epochs. Data were analyzed by Actiwatch Activity and Sleep Analysis (AASA) 5.32 software. AASA software calculates sleep onset regardless of the sleep–wake discrimination, searching for the first 10-min immobility block in which there is measured activity in no more than one epoch. The software then estimates that the first minute of this 10-min immobility block is the time of sleep start. After the sleep onset time, identification of each epoch as sleep or wake was based on the mathematical model developed and validated by Oakley [27]. Sleep was scored when the total activity count (AC) was equal to or less than the activity threshold setting (low sensitivity = 80; [28]) according to the following formula: AC = an2(1/25) + an1(1/5) + α + α1(1/5) + α2(1/25), where an2 and an1 were the activity counts from the prior 2 min, and a1 and a2 were from the following 2 min.

The sleep parameters considered in the present study were: bedtime (BT: the clock time when the participant went to bed and switched off the light) and get-up time (GUT: the clock time when the participant last woke up in the morning); time in bed (TIB: the interval, in minutes, between BT and GUT); total sleep time (TST: the sum, in minutes, of all the epochs scored as sleep between sleep onset and GUT); sleep onset latency (SOL: the interval, in minutes, between bedtime and sleep start); wake after sleep onset (WASO: the sum, in minutes, of all wake epochs between sleep onset and sleep end); sleep efficiency (SE %: the ratio of the total sleep time to time in bed multiplied by 100); midpoint of sleep (MS: expressed in hours and minutes, the clock time which splits the TIB in half); fragmentation index (FI: the sum of the percentage of moving epochs within the sleep period and the percentage of immobility phases of 1 min out of all immobility phases). All the above sleep parameters were calculated for schooldays and for weekend days (i.e., the weekend started on the Friday evening and finished on Sunday afternoon).

In addition, for all children, we calculated the mean motor activity for each hour, with the precaution of separating mean motor activity on schooldays from mean motor activity on weekend days. Actigraphic indices of the 24-h activity pattern (interdaily stability, intradaily variability and amplitude) were also calculated [29]. The interdaily stability (IS) is the predictability of 24-h rest-activity pat-tern, the intradaily variability (IV) reflects the fragmentation of the activity rhythm into brief periods of rest and activity, and the relative amplitude (RA) gives an indication of the amplitude of the rest–activity rhythm. For each index we calculated a single value (i.e. without differentiating between schooldays and weekend days).

Finally, participants were instructed to press the event-marker button each time they consumed food. For each child we calculated the percentage of times the event-marker button was pressed within the 24-h period during schooldays [number of times the event-marker button was pressed/5 (i.e. number of days) x 100] and at the weekend [number of times the event-marker button was pressed/2 (i.e. number of days) x 100]. These calculations were performed for each hour.

Procedure

Before starting the actigraphic monitoring participants completed the rMEQ and they were individually height-and weight-measured during school hours, in a private setting. Verbal and written instructions were given to participants: children were requested to wear the actigraph on their non-dominant wrist for seven consecutive days, including five weekdays and two weekend days. Participants were instructed to push the event-marker button on the actigraph to signal their bedtime and get-up time. They also filled in a sleep log each day within 30 min after morning awakening, reporting the time of getting into bed and the time of getting out of bed, the time of having breakfast and dinner. When participants forgot to push the event-marker button, the bedtime and get-up time reported in the sleep log were used to set the time in bed for acti-graphic analysis. Furthermore, participants were instructed to push the event-marker button on the actigraph each time they consumed food during the day.

The study was approved by the local ethics committee and carried out in accordance with the Declaration of Helsinki.

Statistical analysis

To compare the BMI groups for all sleep parameters, we ran a set of 2-way mixed ANOVAs with BMI Group (underweight, normal weight, overweight and obese) as a between-subjects factor and Day (schooldays vs. weekend) as a within-subjects factor for each actigraphic sleep parameter.

In addition, we ran a set of one-way ANOVAs with BMI Group as between-subjects factor on interdaily stability, intradaily variability, amplitude, and rMEQ score, separately.

A 3-way mixed ANOVA on mean motor activity was carried out, with BMI Group as a between-subjects factor, and Day and Time-of-Day (24 levels: from 1:00 to 24:00) as within-subjects factors. In addition, a 1-way ANOVA was also performed on each actigraphic estimate of the 24-h activity pattern, with BMI Group as a between-subjects factor.

Finally, a 3-way mixed ANOVA was performed on the mean percentage of event-marker button pressing as a measure of eating behavior, with BMI Group as a between-subjects factor, and Day and Time-of-Day (19 levels: from 6:00 to 24:00) as within-subjects factors. The statistical level was set at $p < 0.05$, and Bonferroni's post hoc test was run when the main effect and interactions were significant.

Results

According to BMI cut-off values for primary schoolchil-dren [25,26], 2.60% of our sample were underweight, 61.70 % were of normal weight, 29.60% were overweight and 6.10% were obese. It is worth noting that there was no difference in BMI values between males (19.85 kg/m2; SD = 3.59 kg/m2) and females (18.92 kg/m2; SD = 3.21 kg/m2), $t(113) = 1.43$, $p = 0.16$.

Table 1 reports the mean values of the actigraphic sleep parameters considered for underweight, normal weight, overweight and obese groups, and for the total sample, during schooldays and at the weekend. No significant main effects or interactions were found for BT, TIB, TST, SOL, WASO, SE, or FI.

The analysis on MS showed a significant Group effect ($F_{(3,111)} = 5.30$, $p = 0.002$, $\eta 2p = 0.13$), suggesting that obese children (03:18; SD = 00:16) had a phase delay compared to normal weight (03:06; SD = 00:16) and overweight (02:59; SD = 00:14) children ($p < 0.050$, for both comparisons).

Finally, schooldays and weekend days showed significant differences for the GUT ($F_{(1,111)} = 8.05$, $p = 0.005$, $\eta 2p = 0.07$), suggesting that during the weekend children woke up later.

The one-way ANOVA showed a BMI Group effect regarding the amplitude of rhythm ($F_{(3,111)} = 4.42$, $p = 0.006$, $\eta 2p = 0.16$), with a higher amplitude for normal weight children (0.96; SD = 0.02) than for overweight children (0.94; SD = 0.03) ($p < 0.005$). No significant Group effect was observed for interdaily stability, intra-daily variability, or rMEQ score (Table 1).

The mixed ANOVA on mean motor activity did not show any BMI Group effect, and, crucially, the BMI Group factor did not interact with other factors (Fig. 1). The analysis revealed a significant Day effect ($F_{(1,111)} = 6.25$, $p = 0.014$, $\eta 2p = 0.05$), suggesting that during schooldays (M = 361.68; SD = 119.97) children had a higher level of motor activity than during the weekend (M = 283.69; SD = 153.72), as shown in Fig. 1. In addition, a significant Time-of-Day effect was found ($F_{(23,2553)} = 82.77$, $p = 0.0001$, $\eta 2p = 0.43$), and this factor interacted with the Day factor ($F_{(23,2553)} = 7.30$, $p = 0.0001$, $\eta 2p = 0.06$). As shown in Fig. 1, the children had higher values of motor activity in the temporal window ranging from 10:00 to 18:00, and these values were higher during the schooldays than in the corresponding hours of the weekend ($p < 0.005$ for all comparisons). During the weekend, the values of motor activity were higher from 19:00 to 23:00 than in the corresponding hours of the schooldays ($p < 0.005$ for all comparisons).

The mixed ANOVA on the percentage of pressing of the event-marker button mirrored the results of the previous ANOVA, with a lack of significant BMI Group effect or interactions with the other two factors (Fig. 1). As before, a significant Time-of-Day effect ($F_{(18,1998)} = 15.73$, $p = 0.0001$, $\eta 2p = 0.12$), and a significant Day 9 Time-of-Day interaction ($F_{(18,1998)} = 3.40$, $p = 0.0001$, $\eta 2p = 0.03$) were found. Again, there were specific times of day (from 07:00 to 10:00, from 12:00 to 13:00, and from 16:00 to 20:00) in which children pressed the event-marker button more frequently than at other times of day. This pattern was different when comparing schooldays and weekend days, especially for the following times of day: during the schooldays the frequency of event-marker button pressing was higher at 07:00, 10:00 and 16:00, while during the weekend the event-marker button was pressed more often at 08:00, 09:00, 15:00 and 18:00 (Fig. 1).

Even if our BMI group distribution was similar to the BMI group distribution of the Italian Primary School population [30,31], the lack of group differences in the ANOVAs could be due to a low statistical test power, given the lower number of children in underweight and obese groups. For this reason, we decided to run a set of multiple stepwise regressions, with BMI values as a dependent variable and, separately, with sleep parameters, circadian (interdaily stability, intradaily variability, amplitude and rMEQ score) parameters, motor activity pattern, and eating behavior pattern, as predictors. For sleep parameters, motor activity and eating behavior patterns, we included the data from both schooldays and weekend days in the regression.

As regards sleep parameters, the BMI was predicted by TST of schooldays (adjusted $R^2 = 0.07$; $F_{(1,113)} = 9.62$, $p = 0.002$). As shown in Table 2, TST predictor was significantly negative, suggesting that a lower sleep time (in minutes) was associated with higher BMI values.

Considering the circadian parameters, the regression confirmed the result of the ANOVA, with a significant model explained by the amplitude factor (adjusted $R^2 = 0.08$; $F_{(1,113)} = 11.22$, $p = 0.001$). The negative standardized b value indicated that a lower amplitude of rhythm was related to higher BMI values (Table 2).

When the pattern of motor activity during schooldays and at the weekend was considered, the BMI was predicted by the model with the motor activity recorded at 02:00, 15:00, and 03:00 of the weekend only (adjusted $R^2 = 0.15$; $F_{(3,111)} = 7.92$, $p = 0.0001$). Specifically, there was a positive association between the motor activity of sleep hours (02:00 and 03:00) and BMI, while there was a negative prediction of motor activity at 15:00 on BMI value (Table 2).

Finally, the BMI was explained by the model composed by the pressing frequency of the event-marker button at 22:00 and 24:00 of schooldays, and at 09:00 and 10:00 of weekends (adjusted $R^2 = 0.13$; $F_{(4,110)} = 5.16$, $p = 0.001$). Interestingly, the two times of day regarding the schooldays were positively associated with BMI, while those regarding the weekend were negatively associated with BMI (Table 2).

Conclusions

In this study, we investigated 24 h of the sleep–wake cycle, motor activity and food intake patterns in different BMI groups using a single tool.

As far as sleep was concerned, differently from our predictions, the actigraphic data did not show any significant differences between BMI groups with the exception of MS. The significant role of MS should indicate a general delayed phase of sleep timing in obese children compared with the other BMI groups, independently from whether the recording was carried out during schooldays or at the weekend. As regards the lack of significant differences, this result could be explained by the higher sleep quality of our sample, as indicated for example by SE. The delayed phase of sleep timing in obese children could be understood by taking into account the fact that the obese children showed a later BT compared to other BMI groups (Table 1); as a result, the MS was delayed. Linked to this result, the regression analysis showed that TST during schooldays negatively predicted the BMI values. As reported in Table 1, this result showed that obese children had a lower TST during schooldays compared to the other BMI groups, in line with previous studies [11,12]. Thus the fact that BMI was associated with MS and TST reflected that sleep quantity, or better sleep duration, contributed to BMI in children.

As regards motor activity, the ANOVA did not show group differences. Differently from studies in which moderate-to-vigorous physical activity played a role in predicting BMI [14], our data did not convey this result. Nevertheless, two results can be taken into account. The first concerns the amplitude of motor activity rhythm, since we found a significant difference not only when using a categorical approach (ANOVA), but also through a continuous procedure of analysis (regression). According to the lines displayed in Fig. 1, the circadian range of motor activity during the day seemed to indicate a different circadian pattern for each BMI group. This result was important because it showed that the variation of circadian pattern during the day was different across all BMI groups, even if the curve patterns were similar; for example, the obese children showed a similar pattern of motor activity during the 24-h period compared to the other groups, but they also showed a lower amplitude (i.e. lower range) during the day. In line with this result, the regression analysis showed that BMI values were predicted in a positive way by motor activity recorded at 02:00 and 03:00 during the weekend, suggesting a greater motor activity in overweight and obese children (Fig. 1b). The amplitude as a significant predictor was not associated with circadian typology, given that no group differences in rMEQ scores were found, even though we recognize that the most marked differences in circadian typology can be seen in adolescence. In addition, it is worth noting that at 15:00 of the weekend days motor activity decreased more markedly in the obese group (Fig. 1b). This result could indicate that the weekend is a particularly interesting period for detecting group differences in circadian variation of motor activity, given that during the weekend children are able to exhibit their own motor activity, being ‘‘free’’ from school activities. Further studies should confirm these data.

Furthermore, the data on the timing of eating behavior, measured through the pressing of the event-marker button of the actigraph, did not show any significant results in relation to the BMI group factor. The prospective memory nature of the task (i.e., to push the event-marker button for each food intake) [32] could partially explain this result. In the literature, in fact, there is no clear convergence regarding the development of prospective memory in schoolchildren. Considering the multi-component nature of this task, and especially the fact that it takes place in a naturalistic setting, the interpretation of these results may be even more problematic. In addition, family habits and school activities may impose a rhythm on the child, also regarding food intake, and may mask a possible presence of feeding behavior pattern. Indeed, as shown in Fig. 1, during schooldays all groups pushed the actigraphic event-marker button at about the same time (morning break, lunch and afternoon break). The constraints imposed by school timetables could also be applied to breakfast, while dinner was probably influenced by family habits. During the weekend, the timing of food intake was probably more related to the family context and habits, which, again, could reduce the time-of-day effect on food intake. However, the regression analysis reported four specific times of day in which the frequency of food intake differentiated the BMI groups. During schooldays, at 24:00 and at 22:00, there were higher frequencies of food intake in the obese group (Fig. 1a); during the weekend at 10:00 and at 09:00 there were lower frequencies of food intake in the obese group (Fig. 1b). These last data seem to be in line with previous studies [5– 7] because they show that a higher frequency of food intake at unusual and late times of day during schooldays, as well as a lower frequency of food intake during weekend mornings, could be contributing to childhood obesity. In particular the regression results related to the frequency and time of day of food intake during the weekend could suggest that the school schedule (there is a morning break between 09:00 and 10:00) is a protective factor for weight gain.

Finally, as expected, we partially confirmed the differences between schooldays and the weekend. During the weekend children woke up later, had a lower motor activity and adopted different times of day for food intake com-pared to schooldays. These significant differences between schooldays and weekend days confirmed that the school schedule requires children to adapt to school activity times, thus influencing the 24-h pattern (e.g. get up time to go to school).

The present data could be limited by the distribution of children between the BMI categories [25,26]. In particular, the small percentage of underweight and obese children may reduce the power of statistical analysis, as indicated by the lack of significant differences, especially regarding sleep parameters. However, our BMI groups were generally distributed in quite a similar way to that described in recent Italian surveys [30,31]. Also, our sample was biased toward females, reducing the presence of a gender effect on BMI, as indicated by the lack of significant differences between genders. Finally, another limit could be that the present study did not consider anxiety and depression levels, and therefore could not take into account the relationship between psychological variables and obesity [33].

The present study, and especially the regression results obtained, provided novel insight into behavior monitored over a 24-h period, confirming that circadian perspective is a promising approach for understanding the causes and triggering factors of obesity [34].

Future studies should also replicate the present research not only in a large sample of schoolchildren, but also in different age groups to overcome the limitations associated with, for example, the time of day of eating behavior (e.g. in university students who are less influenced by family habits or by school schedules). In addition, several other aspects related to the 24-h rhythm, such as social jetlag [35], that is, the difference between external social and biological timing, need to be addressed in a more thorough manner: if someone is forced to eat at times which are unsuitable for the internal clock, that person is prone to weight gain compared to a person who consumes food at ‘‘optimal times’’ [5– 7, 36]. As far as actigraphy is concerned, our study confirms that this is a powerful tool with which to measure several variables associated with weight gain simultaneously and in an ecological way, and this useful technique is recommended for use in children.

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Compliance with ethical standards

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Conflict of interest: On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval: All procedures performed in studies involving participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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Table 1 The mean values (and their SD) for all sleep and circadian parameters are reported for each BMI group and for the total sample of children

	Underweight children	Normal weight children	Overweight children	Obese children	Total sample
BT (h:min)					
Schooldays	22:41 (00:24)	22:20 (00:35)	22:20 (00:37)	22:55 (01:00)	22:22 (00:38)
Weekend	22:23 (01:00)	22:32 (01:29)	22:30 (02:10)	23:34 (01:13)	22:34 (01:41)
GUT (h:min)					
Schooldays	07:39 (00:20)	07:34 (00:29)	07:32 (00:31)	07:14 (00:41)	07:32 (00:30)
Weekend	07:25 (00:18)	08:05 (00:42)	07:55 (00:36)	07:52 (00:56)	08:01 (00:41)
TIB (in min)					
Schooldays	537.8 (43.3)	553.8 (31.4)	552.7 (34.9)	498.8 (35.7)	549.7 (35.1)
Weekend	541.4 (61.1)	573.6 (90.7)	564.3 (131.2)	523.3 (44.5)	566.9 (101.8)
TST (in min)					
Schooldays	492.7 (55.9)	490.2 (27.7)	491.0 (33.1)	447.0 (41.8)	487.8 (32.3)
Weekend	496.3 (71.4)	505.8 (74.1)	495.9 (117.1)	470.6 (51.5)	500.5 (87.5)
SOL (in min)					
Schooldays	07.0 (02.6)	15.3 (11.3)	13.6 (09.1)	14.1 (14.2)	14.5 (10.7)
Weekend	12.7 (10.9)	14.9 (13.2)	15.6 (14.8)	13.3 (13.9)	14.9 (13.5)
WASO (in min)					
Schooldays	34.3 (15.9)	40.9 (16.2)	42.0 (13.8)	32.4 (8.1)	40.6 (15.2)
Weekend	29.7 (10.8)	41.3 (13.2)	44.6 (14.3)	31.9 (8.2)	41.4 (13.5)
SE (in %)					
Schooldays	91.44 (3.14)	88.56 (3.48)	88.86 (2.97)	89.53 (3.75)	88.79 (3.34)
Weekend	91.46 (3.51)	88.35 (3.50)	87.93 (3.47)	89.80 (3.51)	88.39 (3.51)
MS (h:min)					
Schooldays	03:10 (00:22)	02:57 (00:28)	02:56 (00:29)	03:05 (00:48)	02:57 (00:30)
Weekend	02:55 (00:31)	03:14 (00:38)	03:02 (00:36)	03:30 (01:00)	03:10 (00:23)
FI (in min)					
Schooldays	25.5 (10.3)	28.2 (06.6)	29.9 (20.2)	25.3 (07.3)	28.5 (12.3)
Weekend	22.3 (12.2)	29.6 (07.2)	32.8 (13.6)	23.5 (07.2)	29.9 (09.8)
Interdaily stability	0.80 (0.07)	0.75 (0.10)	0.75 (0.10)	0.80 (0.09)	0.76 (0.10)
Intradaily variability	0.57 (0.09)	0.70 (0.17)	0.75 (0.17)	0.70 (0.03)	0.71 (0.16)
Amplitude of rhythm	0.96 (0.02)	0.96 (0.02)	0.94 (0.03)	0.96 (0.02)	0.95 (0.02)
rMEQ	13.00 (1.73)	14.00 (3.06)	14.70 (3.41)	16.28 (4.07)	14.32 (3.23)

BT bedtime, *GUT* get-up time, *TIB* time in bed, *TST* total sleep time, *SOL* sleep onset latency, *WASO* wake after sleep onset, *SE* sleep efficiency, *MS* midpoint of sleep, *FI* fragmentation index

Table 2 The standardized β values of all significant predictors for all models in each step-wise regression are reported

Variables	Models	Standardized *β*	*t* value	*p* value
Sleep parameters	TST of schooldays	−0.28	−3.10	0.002
Circadian parameters	Amplitude of rhythm	−0.30	−3.35	0.001
Motor activity	Motor activity at 02:00 of weekend	+0.26	2.93	0.004
	Motor activity at 15:00 of weekend	−0.21	−2.41	0.018
	Motor activity at 03:00 of weekend	+0.18	2.05	0.043
Eating behavior	Pressing frequency at 24:00 of schooldays	+0.24	2.71	0.008
	Pressing frequency at 22:00 of schooldays	+0.22	2.50	0.014
	Pressing frequency at 10:00 of weekend	−0.19	−2.23	0.028
	Pressing frequency at 09:00 of weekend	−0.18	−1.99	0.049

Note that for all regressions the dependent variable is the BMI value

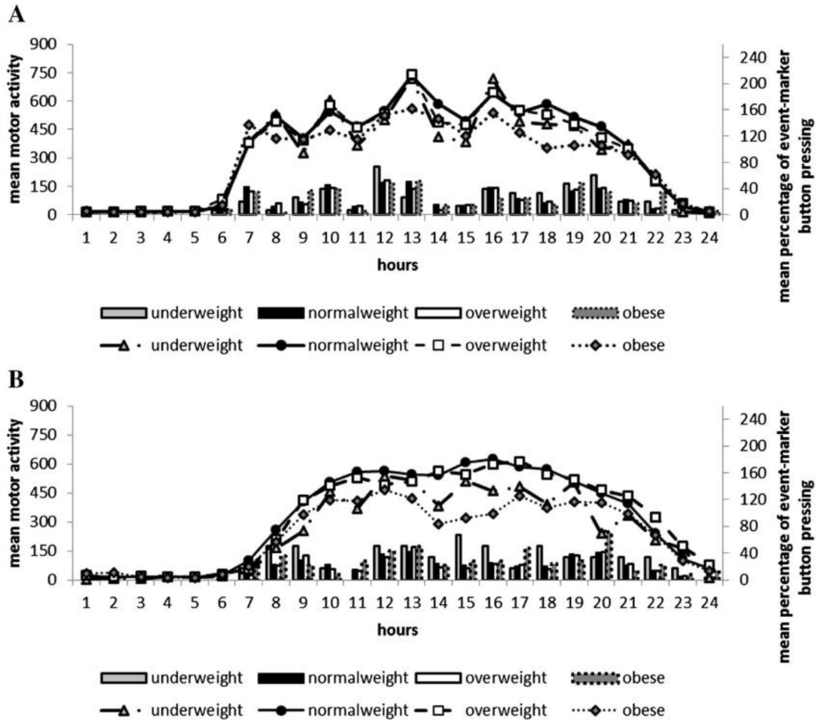

Fig. 1 a The lines represent the circadian motor activity pattern for underweight (black lines and dots with light gray triangles), normal weight (continuous black line with black dots), overweight (broken black line with white squares), and obese (dotted black line with dark gray diamonds) children during the 24-h periods of schooldays, while the histograms represent the mean percentage of event-marker button pressing for underweight (light gray histogram), normal weight (black histogram), overweight (white histogram), and obese (dark gray histogram with dotted line) children from 06:00 to 24:00 on schooldays; **b** the lines represent the circadian motor activity pattern for underweight (black lines and dots with light gray triangles), normal weight (continuous black line with black dots), overweight (broken black line with white squares), and obese (dotted black line with dark gray diamonds) children during the 24-h periods of the weekend, while the histograms represent the mean percentage of event-marker button pressing for underweight (light gray histogram), normal weight (black histogram), overweight (white histogram), and obese (dark gray histogram with dotted line) children from 06:00 to 24:00 at the weekend

Physical self-efficacy is associated to body mass index in schoolchildren

Artigo realizado em colaboração com pesquisadores da Universidade de Bologna, na Itália e da Universidade de Barcelona, na Espanha, e foi aceito para publicação no Jornal de Pediatria (Fator de impacto: 1,24). Neste estudo, objetivou-se investigar a relação entre auto-eficácia física e índice de massa corporal em uma grande amostra de escolares.

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Ms. Ref. No.: JPED-D-15-00487R3
Title: PHYSICAL SELF-EFFICACY IS ASSOCIATED TO BODY MASS INDEX IN SCHOOLCHILDREN
Jornal de Pediatria

Dear Ms. Alicia Carissimi,

I am pleased to inform you that your paper "PHYSICAL SELF-EFFICACY IS ASSOCIATED TO BODY MASS INDEX IN SCHOOLCHILDREN" has been accepted for publication in Jornal de Pediatria.

Thank you for submitting your work to Jornal de Pediatria.

Yours sincerely,

Cristine Henderson Severo
Receiving Ed/Office
Jornal de Pediatria

PHYSICAL SELF-EFFICACY IS ASSOCIATED TO BODY MASS INDEX IN SCHOOLCHILDREN

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The specific contribution of each author to the study: MM, VN, AA and MPLH designed the study. MM and VN performed study coordination. AC and MM wrote the protocol, performed literature searches and analyses. LT and MF helped in the statistical analysis and interpretation of data; AC, VN, MM, MF and LT wrote the draft of the manuscript. All authors contributed and have approved the final version of manuscript.

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ABSTRACT

Objective: The present study aimed to investigate the relationship between physical self-efficacy and body mass index in a large sample of schoolchildren. **Methods:** The Perceived Physical Ability Scale for Children (PPASC) was administered to 1560 children (50.4% boys; 8-12 years) from three different countries. Weight and height were also recorded to obtain the body mass index. **Results:** In agreement with the literature, the boys reported greater perceived physical self-efficacy than girls. Moreover, the number of boys who are obese is double that of girls, while the number of boys who are underweight is half that found in girls. In the linear regression model, the increase in body mass index was negatively related to the physical self-efficacy score, differently for boys and girls. Furthermore, age and nationality also were predictors of low physical self-efficacy only for girls. **Conclusion:** The results of this study reinforce the importance of psychological aspect of obesity, once the perceived physical self-efficacy and body mass index were negatively associated in a sample of schoolchildren for boys and girls.

Keywords: Obesity, overweight, childhood, physical self-efficacy, Perceived Physical Ability Scale for Children

INTRODUCTION

The health benefits of regular physical activity for children are well known.[1] To gain a better understanding of physical activity behavior in children, there has been an increased focus on determining the relationship between physical activity and psychosocial correlates.[2,3] Self-efficacy, defined as people's beliefs about their capacity or ability to perform determined action required to achieve results in a specific situation,[4] is a variable that is considered to be associated with physical activity in adolescents, which can be an important mediator in providing more effective participation in these activities.[5,6,7]

A recent study on 281 children (116 boys and 165 girls) showed that those who have high physical self-efficacy scores participated in significantly more physical activity compared to their low physical self-efficacy score counterparts.[8] Girls are generally less active and report lower perceived physical ability and higher perceived body fat and greater body dissatisfaction than boys in a school setting.[1,2,6,9,10] Thus, the perceived competence for physical activity seems to be sex-related, due to the fact that boys are more physically active, and perceive greater strength and sporting competence than girls.[6,11,12]

In addition to gender, age is a factor that may influence physical self-efficacy, most evidently during adolescence,[6,7] once physical self-efficacy tends to decrease with increase of biological age. Another factor, which correlates with self-efficacy, is the body mass index (BMI), an index of weight-for-height that is used to classify overweight and obesity. Changes in perceived physical abilities[9,10,13,14] are influenced by excess of weight, related to a low perception of competence and motivation to perform physical activity, impacting on physical activity participation and physicalappearance.[15] In fact, higher BMI has been associated to lower levels of self-efficacy for physical activity, being weight status predicted by physical self-efficacy and healthy eating.[16] Indeed, older children and those with a higher BMI perform less physicalactivity.[12] Based on this evidence, we expected to find a significant relationship between physical self-efficacy and BMI.

As demonstrated in the literature, gender is related to BMI, and boys tend to have higher BMI, thus we expected to find this effect. Therefore, we explored the relationship between physical self-efficacy and BMI in a large sample of schoolchildren, controlling for confounding variables that can influence physical self-efficacy, as age, gender, and nationality. We selected three countries where there is a concern with the increased prevalence of overweight and obesity, such as Italy,[17] Spain[18] and Brazil.[19]

METHODS

Sample

This was a cross-sectional study on 1560 children (50.4% male). The sample comprised 1110 Italian (10.01±0.65 years), 280 Brazilian (10.52±1.27 years), and 170 Spanish (10.54±1.02 years) participants. Students were enrolled between January and October 2013 only if parents signed the informed consent form.

Measures and Procedure

This study presents data from a transcultural project that aims to investigate factors linked to energy gain and eating habits, considering the influence of the rhythmicity of behavior from a chronobiological point of view. During the school year, students were invited to answer a set of questionnaires aimed at gathering data on timing of food intake, sleep habits, and physical activity. During school hours, two members of the research group administered questionnaires in the presence of the teacher. The team went to the schools at a prearranged time and students completed the questionnaires in about 30 minutes. The ethics committee of the Universities involved in the project approved this study.

In the present paper, we focus on the data of physical self-efficacy measured through the Perceived Physical Ability Scale for Children (PPASC)[20] in relation to age, gender, nationality and BMI. Participants completed the PPASC, which consists of 6 items: 1) run, ranging from 1 (I run very slowly) to 4 (I run very fast); 2) exercise, ranging from 1 (I am able to do only very easy exercises) to 4 (I am able to do very difficult exercises); 3) muscles, ranging from 1 (My muscles are very weak) to 4 (My muscles are very strong); 4) move, ranging from 1 (I move very slowly) to 4 (I move very rapidly); 5) sure, ranging from 1 (I feel very insecure when I move) to 4 (I feel very sure when I move); 6) tired, ranging from 1 (I feel very tired when I move) to 4 (I don’t feel tired at all when I move). The total test score can range from 6 to 24, and high scores indicate the greatest perceived physical self-efficacy. The PPASC assess individuals' perceptions of physical abilities such as strength, speed, and coordinativeabilities.[20] Studies supported that the PPASC as a reliable and valid measure of physical self-efficacy in children.[9,10,20] The back translation was performed for using the PPASC in Portuguese of Brazil and Spanish languages.

Measurements of weight and height were recorded on the same day that children filled in the questionnaire, using portable scale and a portable stadiometer to obtain the BMI, that is, weight in Kg divided by height in m^2. Children were measured barefoot and without outerwear in a separate room. BMI for age was calculated according to gender, and children were divided into four categories, according to the international classification by Cole et al.: normal weight, underweight,[21] overweight, and obese.[22]

Statistical Analyses

We performed the Kolmogorov-Smirnov test for age, BMI and self-efficacy and the results showed that the variables do not have normal distribution (P value <0.05). To compare each of the considered variables (age, BMI, self-efficacy and nationality) between males and females, we performed the Mann-Whitney U Test for independent samples. To compare weight categories (underweight, normal weight, overweight, and obese), nationality (Brazil, Italy, and Spain), and gender, we used the Chi-square test. To analyze BMI differences in relation to nationality (Brazil, Italy, and Spain), separately by gender, and to compare the weight categories and the total PPASC score, Kruskal-Wallis H test were performed. The effect size was calculated for Mann-
Whitney U Test and Kruskal-Wallis H Test.[23]

Finally, a linear regression was performed to evaluate, separately for gender, how the BMI increase, age and nationality could be related to total perceived physical self-efficacy score, using the enter method. SPSS v.18 was used for all statistical analysis (SPSS Chicago, IL). Statistical significance was set at $p < 0.05$.

RESULTS

Descriptive data on the sample are displayed in Table 1. The median BMI was significantly higher for boys compared with girls (p= 0.043; effect size= 0.059). The frequency of thinness was higher in girls (3.4%) than in boys (1.5%). A higher percentage of boys were overweight (12.3%) or obese (5.1%) than girls (12.2%; 2.8%), ($p < 0.001$). The boys (19; 18-21) reported greater perceived physical self-efficacy than girls (18; 17-19); ($p < 0.001$; effect size= 0.339).

The BMI factor showed no difference between countries (Brazil, Italy, Spain), when analyzed separately by gender in the Kruskal-Wallis H test comparison. The total PPASC score was statistically significant different for weight categories ($p < 0.001$; effect size= 0.003), with a mean rank self-efficacy score of 724.53 for underweight, 826.43 for normal weight, 702.28 for overweight and 639.22 for obese; and for nationality ($p < 0.001$; effect size= 0.003), with a mean rank self-efficacy score of 687.55 for Brazil, 812.89 for Italy, and 722.11 for Spain.

Results from the linear regression model (Table 2), controlling for confounders as age, BMI and nationality separately by gender, demonstrated that lower PPASC score was significantly related to higher BMI in boys (β= −0.15; $p < 0.001$; AdjustedR^2= 0.044; F= 12.98; $p < 0.001$); in girls lower PPASC score was related to higher BMI (β= −0.06; p= 0.012), to older age (β= −0.29; p= 0.001) and nationality, since that Brazilian girls had the lowest score (β= −0.24; p= 0.043; Adjusted R^2= 0.032; F= 9.53; $p < 0.001$).

DISCUSSION

The present study showed a significant relationship between perceived physical ability and BMI in a sample of schoolchildren. Such a relationship emerged statistically significant different for boys and girls, and for nationality in the linear regression analysis.

Perception of physical abilities tends to be higher in boys than in girls.[1,2,10,18]Boys and girls with a higher BMI tend to have a lower self-perception of physicaleffectiveness.[24,25] Fairclough et al. (2012)[11] demonstrated that boys with lower BMI values were the most likely to engage in weekday physical activity. In our study, boys had higher PPASC than girls and the categories of weight showed different total PPASC scores. Low physical self-efficacy can be activated by excessive weight, which contributes to increase of concern with self-perceptions of physical abilities.

Of the children evaluated in this study, the prevalence is of approximately 24% of children with excess weight and 8% with obesity (Table 1); this statistic is similar to the data found in the literature,[18,26] and this percentage differs between genders. The BMI results have no difference among the three countries considered, however it is important to highlight that the prevalence of overweight and obesity is high in these countries. The sample was collected in southern Brazil, descendants of Italian and German, which is culturally similar to the European countries, as Italy and Spain, suggesting that the similarities in BMI are more biological than socio-culturally derived. Besides, physical self-efficacy may be less affected in a society where have increased BMI is normal.

In the linear regression model, for boys and girls, the increase in BMI was related to a decrease in perceived physical self-efficacy score (Table 2). One explanation for the increase in BMI and decrease in physical self-efficacy score is that someone who is classified as overweight or obese may have a self-perception of obesity that makes him or her feel unfit to perform physical activity. Therefore, a child who is classified as obese avoids taking part in physical activity so as not to be judged as being unable to perform, and thus, enters a vicious circle. The physically inactive lifestyle is a trigger to weight gain and vice versa.[27] Furthermore, age and nationality also were predictors of low physical self-efficacy only for girls. The results underlined the differences in physical self-efficacy for girls related to being older and between the countries, since in Italy (Mean rank: 408.17) there is a higher score of self-efficacy comparing to Brazil (Mean rank: 330.78). In Spain, girls (Mean rank: 363.24) presented a similar scores of PPASC to boys (373.24).

Some limitations may have an impact on the generalizability of the present findings. The cross-sectional design of this study excludes statements about causality and direction in relation to the variables of interest. The perceived physical ability is only one of many factors that influence obesity. Other psychosocial aspects correlates of physical activity could be studied in future researches, such as self-confidence and self-esteem, in order to clarify the factors that can be promote healthy behaviors. Clearly, age and gender can be considered, because they influence these variables. The difference in sample size between countries should be taken into account, however, this could be considered as a strong point of the present work:

physical self-efficacy in children was assessed using the same questionnaire in Brazil, Italy, and Spain. Moreover, we considered the same international BMI classification criterion in each sample and we observed a similar BMI distribution in the three countries. Educational programs[28] focused on developing physical skills could consider the association between physical self-efficacy and BMI,[29,30] and could be a means for improving the self-image of obese children, especially during childhood.

To conclude, our results reinforce the importance of psychological aspect of obesity, once the perceived physical self-efficacy and body mass index were negatively associated in a sample of schoolchildren for boys and girls. Furthermore, age and nationality also were predictors of low physical self-efficacy only for girls, given that lower physical self-efficacy was related to being older and Brazilian girls had the lowest score.

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Table 1 Descriptive statistics for age, weight status, perceived physical self-efficacy score, and nationality.

	Boys (n=787)	**Girls (n=773)**	**Total (n=1560)**	**P value**
Age of child£	10 (9.8-10.8)	10 (9.6-11)	10 (9.8-10.9)	0.77
BMI £	18.5 (16.7-21.4)	18.3 (16.4-20.6)	18.4 (16.6-21)	0.043*
PPASC £	19 (18-21)	18 (17-19)	18 (17-20)	< 0.001*
Weight groups, n (%)α				< 0.001*
Underweight	24 (3.0)	53 (6.9)	77 (4.9)	
Normal weight	492 (62.6)	486 (62.9)	978 (62.7)	
Overweight	192 (24.4)	190 (24.6)	382 (24.5)	
Obese	79 (10.0)	44 (5.7)	123 (7.9)	
Nationality, n (%)α				< 0.001*
Brazil	122 (15.5)	158 (20.4)	280 (17.9)	
Italy	587 (74.6)	523 (67.7)	1110 (71.2)	
Spain	78 (9.9)	92 (11.9)	170 (10.9)	

Data shown as median (25-75th percentile) or n (%); Abbreviations: BMI, body mass index; PPASC, Perceived Physical Ability Scale for Children; £Mann-Whitney U Test; αChi-square test; *Statistically significant differences ($p < 0.05$).

Table 2 Linear regression model of total perceived physical self-efficacy score, separately for gender, and age, body mass index, and nationality.

Variables	Multivariate B (Std Error)	Beta	Multivariate t	**P value**
Boys				
Adjusted R^2= 0.044				
Age	-0.19 (0.11)	-0.060	-1.668	0.096
BMI	-0.15 (0.03)	-0.202	-5.768	<0.001**
Nationality	-0.10 (0.14)	-0.024	-0.678	0.498
Girls				
Adjusted R^2= 0.032				
Age	-0.29 (0.09)	-0.119	-3.218	0.001*
BMI	-0.06 (0.03)	-0.090	-2.518	0.012*
Nationality	-0.24 (0.12)	-0.074	-2.031	0.043*

BMI, body mass index. Significant at $p < 0.05$*, $p < 0.001$**.

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Mealtime and the influence on body mass index in children and adolescents

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Mealtime and the influence on body mass index in children and adolescents

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ABSTRACT

The purpose of this study was to evaluate the effect of mealtime on overweight and obesity in children and adolescents. This was a cross-sectional study of 671 students aged 8-18 years living in southern Brazil. Students answered the Morningness-Eveningness Questionnaire (MEQ) and questions about sleep habits and mealtime on weekdays and weekends. Anthropometric measurements of height and weight were taken to assess body mass index (BMI). The prevalence of obesity in children was 15.9% and in adolescents, 4.4%. Normal-weight children who had breakfast before 07:00 AM were those with the highest BMI ($p < 0.001$). Also, adolescents who usually had dinner before 07:00 PM were those with the highest BMI compared to dinner at 8:00-9:00 PM. Children and adolescents showed mealtime variability between weekdays and weekends ($p < 0.001$). Our findings suggest that maintaining the meal schedules acting upon the internal rhythm may contribute to the prevention of obesity.

Keywords: body mass index; mealtime; circadian rhythm; obesity; schoolchildren

INTRODUCTION

Obesity is considered one of the most serious public health problems of the 21st century in children and adolescents (Ogden et al., 2014). According to the World Health Organization (WHO), approximately 40 million children younger than 5 years were considered overweight or obese in 2013 (World Health Organization, 2015). In Brazil, data from the Brazilian Institute of Geography and Statistics show that the highest prevalence of obesity is found in southern Brazil (Instituto Brasileiro de Geografia e Estatística, 2010). Childhood obesity is associated with psychological disorders (Erhart et al., 2012),poor school performance (Tonetti et al., 2015), diabetes (Padwal, 2014), hypertension and cardiovascular disease (Martin et al., 2015).

The increasing prevalence of childhood obesity has been influenced by lifestyle changes and determined by environmental, cultural, and socioeconomic factors (Fung et al., 2013; Van Grouw and Volpe, 2013; Catateanu and Jones, 2014). Irregular daily routines, increased consumption of high-calorie and unhealthy foods, sedentary lifestyle, and more time spent in activities such as watching TV and using electronic devices (Herman et al., 2014)are examples of lifestyle changes that negatively impact on body weight. Moreover, the need to adjust the children's schedules to coincide with the parents' work schedule has been a major factor in the choice of the school shift and, consequently, of meal schedules during working days. However, family routine often changes on weekends, leading to a constant need to adapt the circadian rhythm to the ongoing changes (named *social jet lag*) (Roenneberg et al., 2012).The continuous demand for adaptation to social rhythms and the cyclic discrepancy between social and biological rhythms has been associated with increased depressive symptoms (De Souza and Hidalgo, 2014), cardiovascular risks (Rutters et al., 2014), and body mass index (BMI)(Roenneberg et al., 2012).In addition, metabolic and endocrine alterations have been shown to be influenced by sleep (Beccuti and Pannain, 2011).Ghrelin and leptin release is considered an important mechanism of rhythm and synchronization that plays a role in the control of food intake throughout the day. The secretion of ghrelin, a hormone that stimulates appetite, is usually decreased after meals and during the first hours of night sleep (Dzaja et al., 2004). Elevated leptin levels after meals and during the night are associated with decreased appetite (Diéguez et al., 2011). Aspects of modern lifestyle that influence mealtime routines and the rhythmic control of ghrelin and leptin balance make these hormones to confront each other constantly by signaling to the circadian clock (Bernardi et al., 2009).

The objective of the present study was to investigate the effect of mealtime on overweight and obesity in children and adolescents by evaluating meal and sleep time on weekdays and weekends, circadian typology, and anthropometric measurements.

METHODS

Study population

This was a cross-sectional study of children and adolescents attending school in Lajeado and Progresso. Both cities are located in the *Vale do Taquari*,a region inRio Grande do Sul, the southernmost state of Brazil, where the population is of predominantly Italian and German descentants (Carissimi et al., 2016). All elementary and high school students (N=1014) aged 8 to 18 years were invited to participate in the study. A total of 671 students agreed to participate and were included in the study, with a mean (SD) age of 13.2 (2.6) years (range, 8–18 years; 59% female). The participants were divided into two groups according to age at enrollment: 8 to 12 years (children) and 13 to 18 years (adolescents). Geographic coordinates and a flowchart of the process of sample selection is shown in Fig. 1.

The study was conducted in accordance with international ethical standards (Portaluppi et al., 2010). The Ethics Committee approved the study protocol and participants were included only if both the student and his/her parents signed the informed consent form (Project number 12–0386 GPPG/HCPA).

Anthropometric measurements

Anthropometric measurements were taken by trained researchers following international standards (World Health Organization, 2008). Height (cm) was measured using a wall-mounted stadiometer (Wiso®, Brazil) and body weight (kg) was measured using a digital scale accurate to 0.1 kg and with maximum capacity of 150 kg (Plenna®, Brazil). Waist circumference (cm) was measured using a flexible tape measure accurate to 0.1 cm (Gullik®, Brazil) at the midpoint between the lower rib margin and the iliac crest (Taylor et al., 2000). BMI was calculated as body weight in kilograms divided by the square of height in meters [BMI = weight (kg)/height (m^2)] (Report of a WHO Expert Committee, 1995). Nutritional status was determined using the BMI-for-age according to sex (BMI/A), considering the reference data for 5–19 years of age recommended by the WHO (World Health Organization, 2006), and classified using the WHO AnthroPlus software, version 1.0.4 (World Health Organization, 2007). The values were expressed as z-scores, according to the criteria recommended by the WHO, considering the following cut-off points: ≥ z-score −2 and ≤ z-score +1, eutrophic; < z-score −3, severe thinness; ≥ z-score −3 and < z-score −2, thinness; ≥ z-score +1 and ≤ z-score +2, overweight; ≥ z-score +2 and ≤ z-score +3, obesity; and > z-score +3, severe obesity (World Health Organization, 2007).

Morningness-Eveningness Questionnaire

Chronotype was evaluated using the Morningness-Eveningness Questionnaire (MEQ) developed by Horne and Östberg (Horne and Östberg, 1976). The MEQ is a self-assessment instrument consisting of 19 questions, with scores ranging from 16 to 86 points. Higher scores indicate a morning preference.

Assessment of mealtime and sleep-wake patterns

Data on sleep habits and mealtime were collected using two transcultural instruments proposed by a collegial team (Martoni et al., 2012). At that occasion, all researchers were present and approved the final version of the instruments. In the present study, we used the proposed transcultural instruments translated into Portuguese by a Brazilian team and approved by all authors. Participants and their parents answered questions regarding the students' mealtime habits, and both provided information on the time of eating meals and life rhythm of the children and adolescents. The parents' answers were used to confirm the students' answers. The following questions were asked for both weekdays and weekends: "What time do you usually have breakfast?", "What time do you usually have lunch?", and "What time do you usually have dinner?". We recorded the number of daily meals and time of eating meals to establish the pattern of eating of each participant. The time spent on each meal was recorded based on the parents' report.

Regarding sleep habits, the following questions were asked for both weekdays and weekends: “What time do you usually sleep?” and “What time do you usually wake up?”. The answers were used to calculate sleep duration and the midpoint of sleep on weekdays and weekends. The sleep-wake difference was defined using self-reported time to sleep and wake up as the discrepancy between bedtime and wake-up time on weekends and weekdays (sleep difference = bedtime on weekends – bedtime on weekdays; wake-up difference = wake-up time on weekends – wake-up time on weekdays).

The midpoint of sleep was calculated using self-reported bedtime and defined as an individual’s sleep period on weekends and on weekdays. The midpoint of sleep on weekdays was calculated as sleep onset on weekdays plus sleep duration on weekdays divided by two (SO + SD/2), and the midpoint of sleep on weekends as sleep onset on weekends plus sleep duration on weekends divided by two (SO + SD/2) (Roenneberg et al., 2004).

Social jetlag was defined using self-reported schedules as the discrepancy between social and biological time and calculated as the difference between the midpoint of sleep on weekends and on weekdays (social jetlag = midpoint of sleep on weekends – midpoint of sleep on weekdays) (Roenneberg et al., 2004; Roenneberg et al., 2012).

Statistical analysis

Data are expressed as mean (SD) to describe the general characteristics of children and adolescents. Student’s t test for independent samples was used to compare sex differences and continues variables. The chi-square test was used for comparisons between categorical variables and for comparisons of sleep and meal patterns between normal-weight and overweight/obese groups. One-way analysis of variance (ANOVA) was used to compare BMI/A groups and mealtime between children and adolescents. Student’s t test for paired samples was used to compare mealtime variability on weekdays and weekends. Data were analyzed using SPSS, version 18.0 (SPSS Inc., Chicago, IL, USA), and the level of significance was set at $p < 0.05$.

RESULTS

The demographic characteristics and distribution of the studied variables among children (aged 8–12 years) and adolescents (aged 13–18 years) according to sex are shown in Table 1. There was no significant difference in BMI between children and adolescents. Among children, 67.8% were classified as normal weight, 15.2% as overweight, 15.9% as obese, and 1.1% as underweight. Among adolescents, 76.3% were classified as normal weight, 16.5% as overweight, 4.4% as obese, and 2.8% as underweight. In the two groups, girls had a significantly lower waist circumference than boys.

On weekdays, 19.8% (n= 56) of children and 31.4% (n= 122) of adolescents reported to skip breakfast, while on weekends 17.0% (n= 48) of children and 37.4% (n= 145) of adolescents skipped breakfast. There was no significant difference in BMI between those who did not skip breakfast and those who skipped breakfast in either group (children: $t_{(281)} = 1.539$, $p = 0.13$; adolescents: $t_{(385)} = 0.882$, $p = 0.38$). Likewise, there was no difference in the total number of meals they consumed on weekdays and weekends ($p > 0.05$).

Fig. 2 shows mealtime variability for children and adolescents. Children had breakfast ($t_{(193)} = -15.768$, $p < 0.001$), lunch ($t_{(281)} = -3.540$, $p < 0.001$), and dinner ($t_{(269)} = -4.619$, $p < 0.001$) earlier on weekdays than on weekends. Adolescents had breakfast ($t_{(174)} = -18.684$, $p < 0.001$) and dinner ($t_{(349)} = -2.395$, $p < 0.001$) earlier on weekdays than on weekends.

The results of univariate Pearson correlations between BMI, mealtime differences and sleep parameters are presented in Table 2. BMI was significantly correlated with bedtime on weekdays and on weekends, and with midpoint of sleep on weekends; and significantly negatively correlated with sleep duration on weekdays and on weekends, and with MEQ scores.

On weekdays, breakfast time difference was significantly negatively correlated with wake-up time, sleep duration, and midpoint of sleep. Conversely, on weekends, there was a positive correlation between breakfast time difference and bedtime, wake-up time, sleep duration, and midpoint of sleep; and it was positively correlated with social jetlag. Lunch time was positively correlated with bedtime on weekends, wake-up time on weekdays and on weekends, midpoint of sleep on weekdays and on weekends, and social jetlag.

Considering the classification of BMI, sleep and mealtime patterns were compared between normal-weight and overweight/obese participants and the results are shown in Table 3. Participants in the overweight/obese group tend to woke up later on weekdays than those in the normal-weight group ($p = 0.054$). The length of time spent on breakfast, lunch, and dinner, according to the parents' report, was similar in the two groups.

The influence of mealtime (breakfast, lunch, and dinner) on weight gain during weekdays is presented in Fig. 3. One-way ANOVA showed that, in the normal-weight group, children who had breakfast early in the morning, before 07:00 AM, had the highest BMI ($F_{(2;158)} = 9.370$; $p < 0.001$). Among adolescents, BMI was higher for those who had an early dinner, before 07:00 PM, in the normal-weight group ($F_{(3;268)} = 4.178$; $p = 0.007$) and in the overweight/obese group ($F_{(3;68)} = 3.445$; $p = 0.021$) compared to dinner time at 8:00 PM and 9:00 PM.

DISCUSSION

The present study evaluated different markers of circadian rhythms that change from childhood to adolescence and may influence the development of overweight and obesity. The school time causes an advance in mealtime, mainly in breakfast. In turn, in children, early breakfast time was associated with an increase in BMI and early dinner time was associated with an increase in BMI in adolescents. Being eveningness and having higher social jetlag were associated with a greater difference in mealtime on weekdays and weekends. In addition, in this study, being eveningness and presenting short sleep duration were associated with an increased BMI.

We observed that school time was not only responsible for an advance in sleep pattern (Carissimi et al., 2016), but also interfered with eating habits that were related to an increased BMI. In children, early morning breakfast influenced weight gain, whereas, among adolescents, an early dinner (before 07:00 PM) was associated with overweight and obesity—although there was no difference in the number of meals eaten per day.

Regarding sleep, a large difference between mid-sleep time on weekdays and weekends was denominated social jetlag. Social-Jetlag has been deeply studied in relation to disrupted physiology (Roenneberg et al., 2012). Nevertheless, this definition is not exclusive to sleep pattern—regular school and work schedules also provoke a meal jetlag, and this global misalignment will probably contribute to metabolic disturbances in the long term. In children and adolescents, this difference in mealtime between weekends and weekdays has not yet been correlated with BMI, and when BMI was categorized according to age and sex there was no difference in sleep pattern. Therefore, there is a great probability that the eveningness adolescents, until now, have not had their circadian system disrupted by working against their meal and sleep schedule (social *zeitgebers*). In a sample of young adults, evening preference was associated with increased weight gain over time compared to morning and intermediate preference (Culnan et al., 2013). It seems plausible that the chronic disruption found in adults may lead to metabolic disorder.

Some cultural issues are related to eating habits. In Brazil, lunch time is the main meal (Hidalgo et al., 2002). Adolescents do not demonstrate variability in lunch time; therefore, this stability of mealtime may reflect the social and cultural environment in which participants live. In spite of this cultural aspect, common sense defines breakfast as the most important meal to maintain the regularity of metabolism (Antonogeorgos et al., 2012) found that fewer levels of overweight or obese were associated with the consumption of breakfast and more than three meals per day. Our results contradict this knowledge: there was no significant difference in BMI between those who did not skip breakfast and those who skipped breakfast in either group.

This study has some limitations. Information on mealtime was based on self-reported data obtained from students; however, to minimize bias, their parents also answered the same questionnaire to confirm the answers. Furthermore, as the study focused on evaluating feeding schedules, food intake and energy expenditure were not evaluated. Finally, our study with a homogenous countryside sample was conducted in schools where the majority of students are of Caucasian origin, so the genetic and metropolitan confounding variables are likely controlled.

Although the factors that might explain the association of mealtime with weight control are not fully understood, it is clear that school time causes an advance in mealtime frequently against the circadian typology and sleep needs, influencing feeding schedules. Moreover, early breakfast and dinner were associated with increased BMI, reinforcing the idea that mealtime, taking into account the internal time, may contribute to the management of obesity, reducing future health risks in adulthood.

Conflict of Interest

Authors have reported no financial conflicts of interest regarding the subject of the present study.

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Table 1

Demographic characteristics and sleep patterns by age groups and sex

Characteristics	Children aged 8–12 years			Adolescents aged 13–18 years		
	Male (n=122)	Female (n=161)	*p- value*	Male (n=155)	Female (n=233)	*p- value*
Age[T]	10.50±1.21	10.53±1.31	0.855	15.10±1.51	15.10±1.33	0.976
BMI/A[#]			0.31			0.16
Underweight, n (%)	2 (1.6%)	2 (1.2%)		6 (3.9%)	5 (2.2%)	
Normal weight, n (%)	77 (63.1%)	115 (71.4%)		109 (70.3%)	186 (80.2%)	
Overweight, n (%)	18 (14.8%)	24 (14.9%)		32 (20.6%)	32 (13.8%)	
Obese, n (%)	25 (20.5%)	20 (12.4%)		8 (5.2%)	9 (3.9%)	
Waist circumference (cm)[T]	0.68±0.10	0.65±0.08	0.002*	0.74±0.12	0.70±0.09	0.001*
Midpoint of sleep on weekdays (h)[T]	2.34±1.01	2.35±1.01	0.818	2.49±1.08	2.43±1.10	0.326
Midpoint of sleep on weekends (h)[T]	4.23±1.50	4.02±1.33	0.079	4.22±1.52	4.26±1.58	0.727
Sleep duration[T]						
Weekdays (h)	8.47±1.17	8.49±1.08	0.803	7.59±1.15	7.59±1.09	0.972
Weekends (h)	9.27±1.52	10.07±1.29	0.001*	9.28±1.34	9.43±1.31	0.103
MEQ[T]	50.63±9.39	49.92±8.75	0.512	49.35±8.70	48.05±9.07	0.162
Class schedules[#]			0.566			0.104
Morning, n (%)	88 (72%)	121 (75%)		127 (82%)	202 (87%)	
Afternoon, n (%)	34 (28%)	40 (25%)		16 (10%)	11 (5%)	
Evening, n (%)	-----	-----		12 (8%)	20 (9%)	

Abbreviations: BMI/A, body mass index-for-age according to sex; MEQ, Morningness-Eveningness Questionnaire. Values are expressed as mean ± SD or n (%).

Level of significance: $p < 0.05$*; Student's t test[T];Chi-square test[#]

Table 2
Results of univariate Pearson correlations between body mass index, mealtime differences and sleep parameters

	BMI	Breakfast difference (h)	Lunch difference (h)	Dinner difference (h)
BMI	--	0.084	0.000	0.018
Bedtime (h)				
Weekdays	0.132**	0.037	0.054	-0.087*
Weekends	0.145**	0.334**	0.317**	-0.003
Wake-up time (h)				
Weekdays	-0.041	-0.383**	0.088*	-0.099*
Weekends	0.044	0.508**	0.296**	0.035
Sleep duration (h)				
Weekdays	-0.170**	-0.358**	0.027	-0.015
Weekends	-0.123**	0.166**	-0.062	0.045
MEQ	-0.124**	-0.364**	-0.162**	0.016
Midpoint of sleep on weekends (h)	0.094*	0.226**	0.356**	-0.009
Midpoint of sleep on weekdays (h)	0.056	-0.201**	0.079*	-0.112**
Social Jetlag	0.065	0.348**	0.330**	0.058

Abbreviations: BMI, body mass index; MEQ, Morningness-Eveningness Questionnaire. Weekends/weekdays difference in time of breakfast, lunch, and dinner.
Level of significance: P <0.001**; P<0.05*.

Table 3
Comparison of sleep and mealtime between normal-weight and overweight/obese groups

	Normal weight	Overweight and obese	*p- value*
Waist circumference (cm)	0.67±0.07	0.78±0.13	<0.001*
Bedtime (h)			
Weekdays	22.32±1.17	22.29±1.16	0.564
Weekends	24.30±1.58	24.01±2.01	0.615
Wake-up time (h)			
Weekdays	6.47±1.13	7.01±1.20	0.054
Weekends	9.55±1.53	9.43±1.47	0.256
MEQ	49.23±8.81	48.97±9.62	0.762
Midpoint of sleep on weekdays (h)	2.40±1.01	2.44±1.08	0.493
Midpoint of sleep on weekends (h)	4.19±1.50	4.22±1.50	0.823
Social jetlag (h)	1.40±1.41	1.37±1.44	0.769
Time spent on breakfast (min)			
Weekdays	11.45±5.16	12.34±5.59	0.243
Weekends	14.50±7.01	15.32±7.51	0.430
Time spent on lunch (min)			
Weekdays	19.12±8.11	19.19±7.35	0.881
Weekends	21.43±8.41	21.27±9.21	0.771
Time spent on dinner (min)			
Weekdays	18.29±8.40	16.58±8.09	0.073
Weekends	19.58±9.01	18.55±8.01	0.208

Abbreviations: MEQ, Morningness-Eveningness Questionnaire. Time spent on breakfast, lunch, and dinner were assessed based on the parents' report. Values are expressed as mean ± SD; Student's t test; Level of significance $p < 0.05$*.

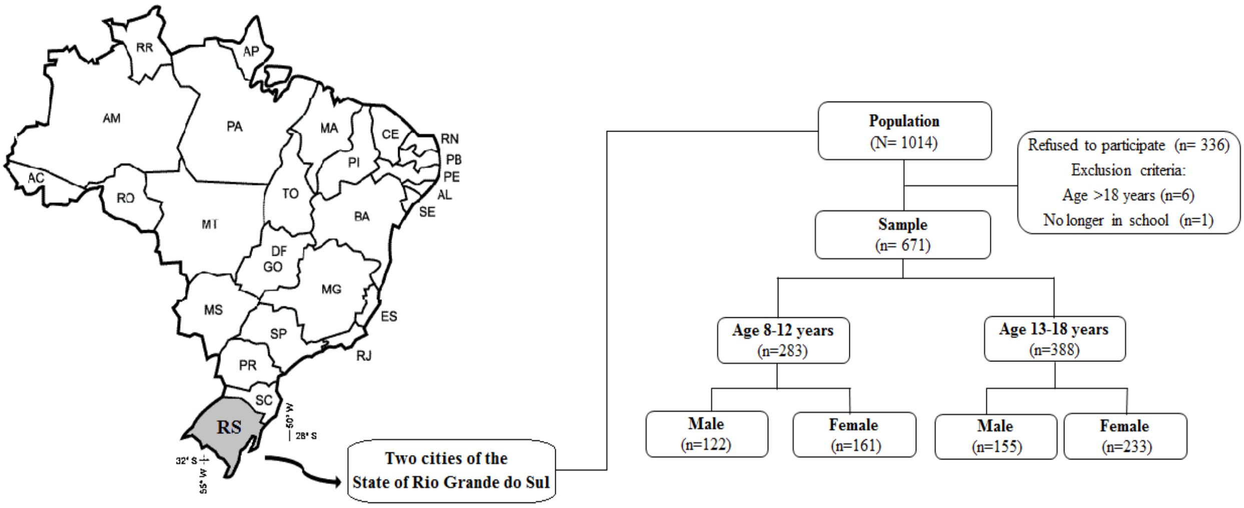

Fig. 1. Geographic coordinates and flowchart of sample selection.

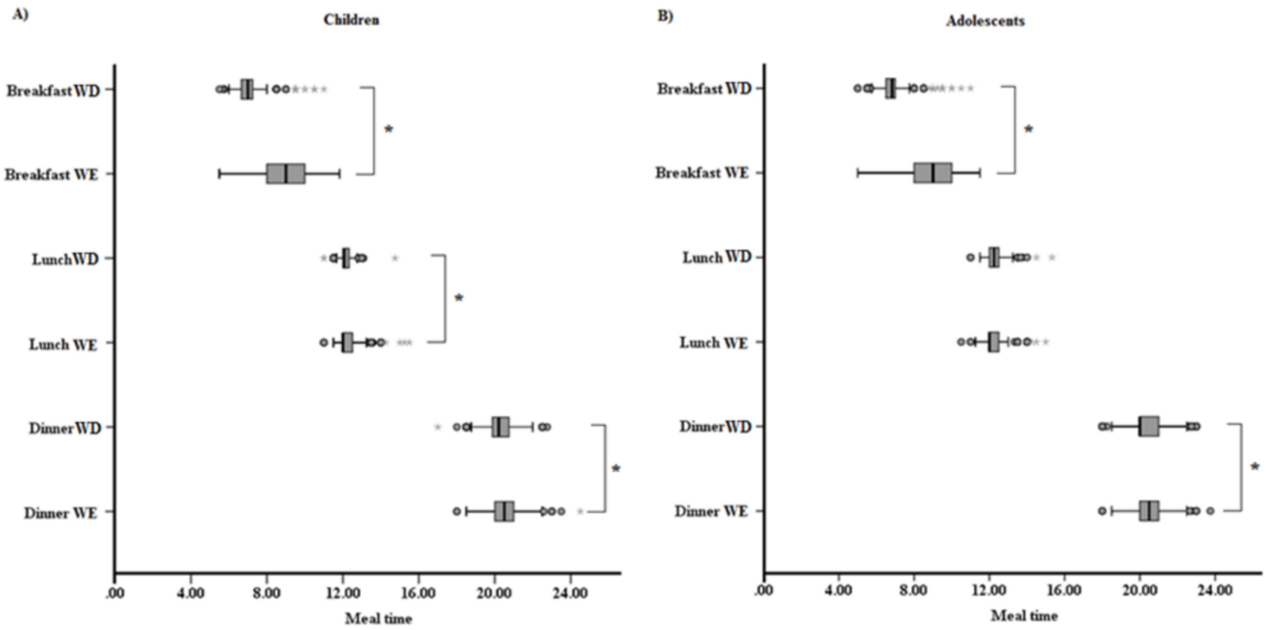

Fig. 2. Mealtime variability intervals for children and adolescents on weekdays (WD) and weekends (WE). Student's t test for paired samples showed a statistically significant difference between mealtime on WD and WE, as indicated by $p < 0.001$*.

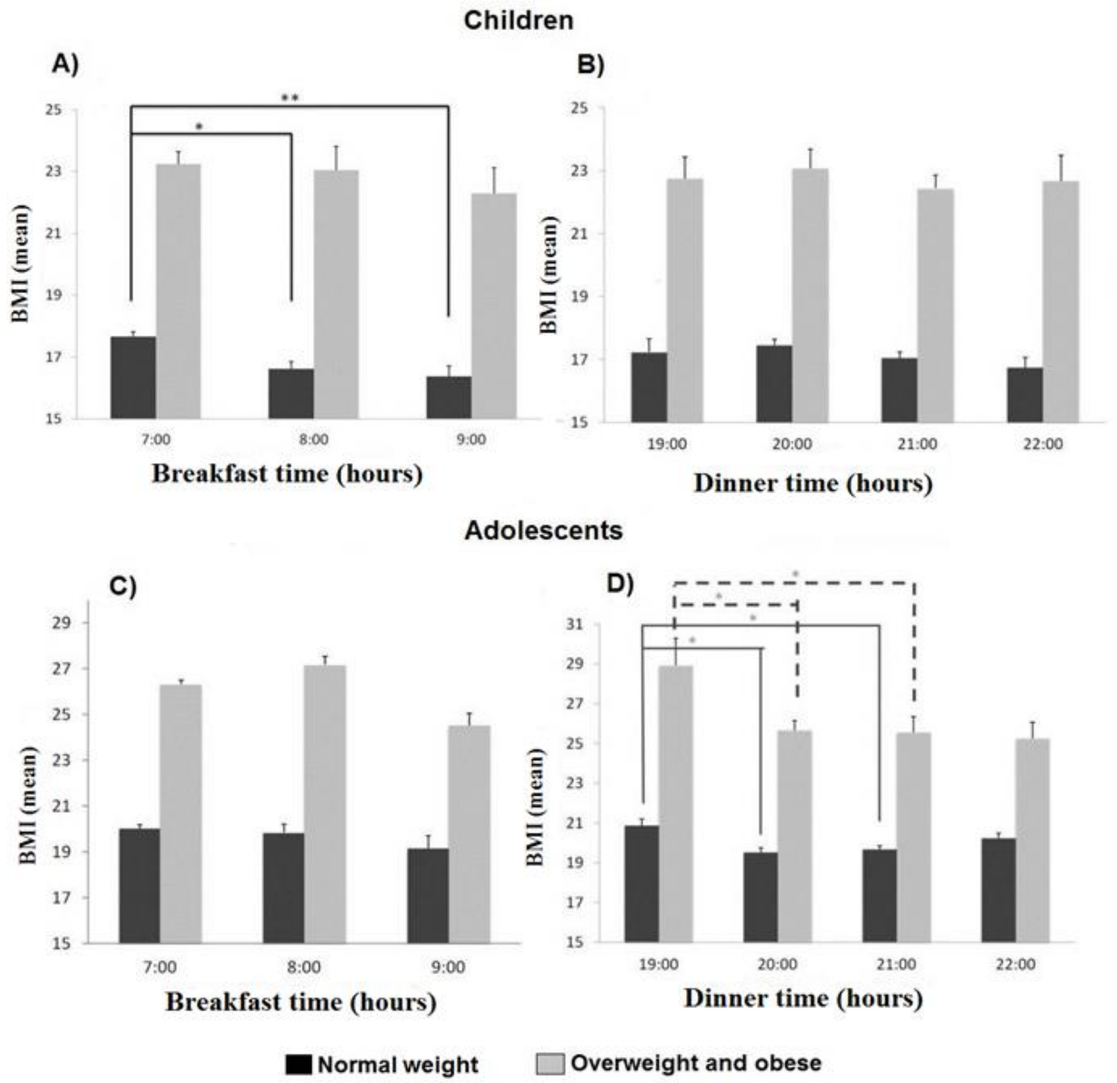

Fig. 3. Comparison of BMI and mealtime on weekdays according to BMI groups (normal weight and overweight/obese) classified according to the criteria recommended by the World Health Organization (2008); (A) breakfast time for children, (B) dinner time for children, (C) breakfast time for adolescents, and (D) dinner time for adolescents. ANOVA showed a statistically significant difference between groups, as indicated by $p < 0.001$** and $p < 0.05$*. BMI, body mass index.

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Abstracts em anais de eventos e apresentações (ANEXO 2)

Pôster: Martins AC, Dresch F, Carissimi A, Levandovski R, Adan A, Martoni M, Natale V, Hidalgo MP. Feeding Schedule and the influence on body mass index in children and adolescents. 35ª Semana Científica do HCPA, Hospital de Clínicas de Porto Alegre, 2015.

Pôster: Freitas JJ, Carissimi A, Dresch F, Martins AC, Levandovski R, Adan A, Martoni M, Natale V, Hidalgo MP. Factors associated with sleep deficit in children and adolescents. 35ª Semana Científica do HCPA, Hospital de Clínicas de Porto Alegre, 2015.

Pôster: Carissimi A, Dresch F, Martins AC, Adan A, Levandovski R, Martoni M, Natale V, Hidalgo MP. Fatores associados ao déficit de sono em crianças e adolescentes. XIII Simpósio Brasileiro de Cronobiologia, Barbacena, Minas Gerais, 2014.

Pôster: Dresch F, Carissimi A, Martins AC, Levandovski R, Hidalgo MP. Dessincronização da ritmicidade circadiana e sua influência sobre o índice de massa corporal em crianças e adolescentes. Jornadas de la Sociedad Uruguaya de Biociencias, Argentino Hotel de Piriápolis, Maldonado, 2014.

Pôster: Martins AC, Carissimi A, Dresch F, Adan A, Martoni M, Levandovski R, Natale V, Hidalgo MP. Dessincronização da ritmicidade circadiana e sua influência sobre o índice de massa corporal em crianças e adolescentes. 34ª Semana Científica do Hospital de Clínicas de Porto Alegre, Hospital de Clínicas de Porto Alegre, 2014.

Pôster: Martins AC, Carissimi A,Dresch F, Adan A, Martoni M,Levandovski R, Natale V, Hidalgo MP. Circadian preference and school food schedules: a chronobiological approach to weight gain in childhood development. 33ª Semana Científica do Hospital de Clínicas de Porto Alegre, Hospital de Clínicas de Porto Alegre, 2013.

Apresentação oral: Martins AC, Carissimi A, Dresch F, Adan A, Martoni M, Levandovski R, Natale V, Hidalgo MP. Circadian preference and school food schedules: a chronobiological approach to weight gain in childhood development, reapresentado na sessão “CS – Sessão Especial 25/10/2013. Salão da UFRGS 2013: SIC - XXV Salão de Iniciação Científica da UFRGS, 2013.

Projeto de divulgação científica (ANEXO 3)

Apresentações pela bolsista de iniciação científica

Pôster: Martins AC, Dresch F, Carissimi A, Levandovski R, Adan A, Martoni M, Natale V, Hidalgo MP. Difusão da ciência: respeitando a diversidade de ritmos e as fronteiras fisiológicas. Salão UFRGS 2015: V Feira de Popularização e Ensino da Ciência, 2015.

Pôster: Martins AC, Carissimi A, Dresch F, Martoni M, Levandovski R, Adan A, Natale V, Hidalgo MP. Difusão da ciência: respeitando a diversidade de ritmos e as fronteiras fisiológicas. Salão UFRGS 2014: IV Feira de Popularização e Ensino da Ciência, 2014.

Notícias em jornais

- Jornal o Informativo, 2013.

Especialistas avaliam hábitos e obesidade

Pesquisadoras do Laboratório de Cronobiologia do Hospital de Clínicas de Porto Alegre e Universidade Federal do Rio Grande do Sul (Ufrgs) - doutoranda Alicia Carissimi, mestranda Fabiane Dresch e a estudante de graduação em medicina Alessandra Martins -, sob a orientação da professora-doutora Maria Paz L. Hidalgo, deram continuidade ao projeto de pesquisa intitulado Avaliação do Cronotipo e Comportamento de Alunos em Escolas" no educandário estadual São Francisco e no municipal de São Valentim.

A pesquisa investigou os "determinantes temporais" de sobrepeso e obesidade na idade evolutiva. Essa etapa ocorreu recentemente, com a entrega do relatório de resultados aos 671 participantes, conforme os questionários respondidos anteriormente pelos alunos com idade entre 8 e 18 anos e pelos seus responsáveis. Além disso, teve início a segunda etapa, a qual contou com estudantes previamente sorteados para realização da coleta de saliva, a fim de avaliar substâncias como a melatonina e o cortisol, os quais interferem no sono e no estresse.

O projeto tem a colaboração de pesquisadores da Universidade de Bologna, na Itália, onde Alicia Carissimi fez seu doutorado durante um ano, o que possibilitou o aprendizado para avaliação dos instrumentos utilizados na pesquisa. Além disso, tem apoio do Programa Ciência na Sociedade, Ciência na Escola-Ufrgs. De acordo com elas, entre alguns cuidados a serem tomados para não aumentar de peso, de acordo com os resultados, estão o de não pular as refeições, realizando almoço e janta em horários regulares; e durante a semana é importante não dormir mais do que oito horas e 30 minutos, a fim de se ter tempo de gastar energia.

- Jornal O Boqueirão, 2013.

O Progresso
Sexta-feira, 17 de maio de 2013.

AVALIAÇÃO> **Foi também realizada a coleta de saliva para medida de substâncias que podem interferir no sono**

Alunas de uma universidade realizam pesquisa em escolas

As pesquisadoras do Laboratório de Cronobiologia do Hospital de Clínicas de Porto Alegre - Universidade Federal do Rio Grande do Sul (UFRGS), através da aluna de doutorado Alicia Carissimi e da aluna de mestrado Fabiane Dresch, orientadas pela professora Dr. Maria Paz L. Hidalgo, estão realizando nas Escolas do município de Progresso o projeto de pesquisa intitulado Avaliação do cronotipo e comportamento de alunos em escolas.


Alicia com os alunos realizando trabalhos na biblioteca da escola

Neste projeto, objetivam avaliar a influência do ritmo corporal, que ocorre ao longo de um dia, denominado de ritmo circadiano sobre comportamentos das crianças e/ou adolescentes, sono, digestão e casos de obesidade observados cada vez com mais frequência pelos mais novos.

Todos os pais e os alunos com idades entre 09 a 18 anos, estudantes da Escola São Fransisco e da Escola São Valentim estão sendo convidados à participar desta pesquisa, realizando questionários com perguntas direcionadas aos assuntos.

SOBRE

Os alunos também realizam avaliação antropométrica e coleta de saliva para medida de substâncias que podem interferir no sono, tais como melatonina e cortisol. Este estudo tem como parceria a Universidade de Bolonha, na Itália e, possibilitará a comparação entre os hábitos dos estudantes do município de Progresso com os estudantes italianos.

- Jornal O Boqueirão, 2013.

O Progresso

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PROPÓSITO> **O concurso foi feito para poder escolher slogan e logomarca que caracterizará a Administração 2013/2016**

Ganhadores da logomarga e slogan recebem prêmiação

Durante a Feira do Livro também foi realizada entrega da premiação aos vencedores do Concurso que escolheu o desenho o qual será a logomarca e a frase slogan da Administração Municipal para a gestão 2013 a 2016.

Secrtários da Educação e da Administração Raênio e Rose com os ganhadores

O concurso foi realizado entre os alunos das escolas municipais e estaduais e os vencedores foram João Pedro S. Mattos, autor do desenho campeão, estudante da 7ª série da Escola Municipal São Valentim e Sandra Freisleben, do ensino média da Escola Estadual São Francisco que criou a frase vencedora "Juntos Fazemos Melhor".

Os desenhos e frases foram selecionados por uma Comissão, composta pelo Prefeito Edegar Cerbaro e seus Secretários de Governo. O vencedor do desenho recebeu como prêmio uma câmera fotográfica digital e a vencedora da frase uma bicicleta.

A Secretária de Administração e Planejamento Rosani Gilardi realizou a entrega dos prêmios, representando o Prefeito Municipal e, em seu pronunciamento, em nome do Chefe do Executivo, agradeceu aos vencedores pela participação, colaboração e criatividade.

O Secretário de Educação e Cultura Raênio Roque Battisti destaca que a ação também tem como intuito incentivar as habilidades dos estudantes do Município, sendo a forma de competição motivadora para que os estudantes desenvolvam seu lado criativo.

ATIVIDADES> **Já no dia 12 de agosto, as crianças receberam os Pais para participarem da rotina da escola**

Gente Miúda participa de feira

Os alunos da Emei Gente Miúda realizaram apresentação no último dia da Feira do Livro, 09/08, com o tema Emílias. Participaram da atividade as turmas do nível I e II e o pré-escolar I e II, do turno da manhã.

Segundo a Diretora Márcia Brancher, é nesta idade que as crianças começam a desinibir-se e, com naturalidade, tentam expressar o tema trabalhado.

Já no dia 12, as crianças receberam os Pais para participarem da rotina da escola. Após as atividades os pequenos entregaram uma recordação feita por eles mesmos, lembrando o Dia dos Pais.

A Diretora comenta que é gratificante receber familiares na escola e ver estampada no rosto de cada criança a alegria em ver o pai chegar na sala de aula e brincar com seu(a) filho(a). Continua dizendo que a expectativa das crianças é muito grande em participar desse momento.

Disse também que espera poder contar cada vez mais com a presença das famílias nas programações da escola.

Agradece as educadoras que de uma ou outra forma organizaram-se para que esse momento com os pais fosse prazeroso e agradável.

Apresentação prendeu a atenção dos presentes

Finaliza transmitindo um abraço carinhoso a todos os Pais pelo seu dia.

Palestra na escola

No dia 30 de julho de 2013, a aluna de doutorado Alicia Carissimi e a aluna de mestrado Fabiane Dresch, **(foto)** pesquisadoras do Laboratório de Cronobiologia do Hospital de Clínicas de Porto Alegre - Universidade Federal do Rio Grande do Sul (UFRGS), orientadas pela professora Dr. Maria Paz L. Hidalgo realizaram a palestra intitulada "Influência dos hábitos alimentares no sono de crianças e adolescentes" para os professores da Escola Estadual São Francisco e da Escola Municipal São Valentim. No encontro foram abordados os resultados encontrados na pesquisa quanto ao perfil do sono e ao perfil nutricional dos alunos. Além disso, foram entregues relatórios com os resultados individuais aos alunos de cada escola, participantes do projeto de pesquisa intitulado "Avaliação do cronotipo e comportamento de alunos em escolas" realizado nos meses de abril, maio e junho no município de Progresso.

O projeto desenvolvido conta com apoio do Programa Ciência na Sociedade e Ciência na Escola da UFRGS. A pesquisa terá continuidade no município de Lajeado e, conta com a colaboração de pesquisadores da Universidade de Bologna na Itália, onde a aluna Alicia Carissimi fará seu doutorado sanduíche durante um ano. As alunas têm financiamento CAPES/UFRGS. A equipe de pesquisa agradece as escolas e aos pais e alunos pela colaboração com a pesquisa.

- Jornal O Informativo, 2013.

16 MEIO AMBIENTE NA ESCOLA SETEMBRO DE 2013

MURAL

Meio Ambiente na Escola

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fotos divulgação

A aluna de doutorado Alicia Carissimi, natural de Progresso, e a estudante de mestrado Fabiane Dresch, pesquisadoras do Laboratório de Cronobiologia do Hospital de Clínicas, de Porto Alegre, visitaram, em julho, a Escola Estadual São Francisco e a Escola Municipal São Valentim, em Progresso, onde realizaram palestra com o tema "Influência dos hábitos alimentares no sono de crianças e adolescentes". Na ocasião, elas entregaram os resultados de cada aluno pesquisado entre os meses de abril e junho. O projeto conta com apoio do Programa Ciência na Sociedade e Ciência na Escola, da Ufrgs. A pesquisa terá continuidade em Lajeado, com a colaboração de pesquisadores da Universidade de Bologna, na Itália, onde a aluna Alicia Carissimi fará seu doutorado durante um ano.

fotos Cíntia Marchi

Alunos da Escola Estadual Nova Bréscia montaram um jardim ecológico ao lado da porta de entrada da instituição. Bonito e educativo!

O aviso para não colocar lixo no local não foi levado em consideração no Bairro Santo Antônio, em Lajeado

Alunos do Ensino Médio Politécnico da Escola Estadual São Francisco, de Progresso, realizaram, em agosto, uma viagem de estudos a Montenegro, acompanhados de professores e direção da escola. Lá, visitaram a agroindústria Ecocitrus, Usina de Compostagem Ecocitrus e a "Casa da Atafona". Houve caminhada pela propriedade, visitação ao museu da família e o proprietário falou sobre turismo rural. Os alunos escolheram o local para a viagem por estar relacionado ao tema do projeto desenvolvido dentro do Politécnico, "Turismo Sustentável".

EXPEDIENTE
Coordenação: Miriam Volkmer Destefani
Reportagem: Bruna Lovato, Cíntia Marchi, Rodrigo Nascimento, Susana Leite
Edição: Emilio Rotta
Fotografia: Frederico Sehn, Susana Leite, Cíntia Marchi, Edson Junkes, arquivo, divulgação
Projeto gráfico: Infoarte
Editoração: Jennifer de Freitas, Josiane Fischer e Renan Silva
Revisão: Adriana Mellos e Letícia Werle
Colaboração: Univates
Apoio: 3ª Coordenadoria Regional de Educação (CRE) e Fundação Oswaldo Carlos van Leeuwen

Parte integrante do jornal **OInformativo**. Não pode ser vendido separadamente.

- Jornal O Boqueirão, 2014.

O Progresso

Progresso, sexta-feira, 12 de dezembro de 2014

PROJETO DE PESQUISA> O projeto de pesquisa conta com a colaboração de pesquisadores da Universidade de Bologna, na Itália

Alunos participam da 2ª fase de projeto de pesquisa da UFRGS

Catieli Heineck
catiheineck@gmail.com

As pesquisadoras do Laboratório de Cronobiologia do Hospital de Clínicas de Porto Alegre/ Universidade Federal do Rio Grande do Sul (UFRGS), Doutoranda Alicia Carissimi, Mestranda Fabiane Dresch, e a estudante de graduação em Medicina Alessandra Martins, sob orientação da Professora Drª. Maria Paz L. Hidalgo, deram continuidade no projeto de pesquisa intitulado "Avaliação do cronotipo e comportamento de alunos em escolas" na Escola Estadual São Francisco e na Escola Municipal de São Valentim do município de Progresso.

A pesquisa investigou os "determinantes temporais" de sobrepeso e obesidade na idade evolutiva, partindo do pressuposto que existe um tempo "ideal" para dormir, para estudar e para se alimentar.

Esta etapa ocorreu nos dias 24 a 26 de novembro/2014, com a entrega do relatório de resultados de todos os 671 participantes, conforme os questionários respondidos anteriormente pelos alunos com idades entre 08 a 18 anos e pelos seus responsáveis. Além disso, as alunas iniciaram a segunda etapa do projeto, a qual contou com a participação de alguns alunos previamente sorteados para realização da coleta de saliva, a fim de avaliar substâncias como a melatonina e o cortisol, os quais interferem no sono e no estresse, respectivamente.

O projeto de pesquisa conta com a colaboração de pesquisadores da Universidade de Bologna, na Itália, onde a aluna Alicia Carissimi fez seu Doutorado Sanduiche durante o período de um ano, o que possibilitou o aprendizado para avaliação dos instrumentos utilizados na pesquisa. Além disso, o projeto conta com o apoio do Programa Ciência na Sociedade, Ciência na Escola-UFRGS. O financiamento do projeto é realizado pelo FIPE-HCPA e CAPES-UFRGS.

Alguns cuidados a serem tomadospara não aumentar de peso, de acordo com os resultados:

" É importante não pular as refeições e realizar o almoço e janta em horários regulares.

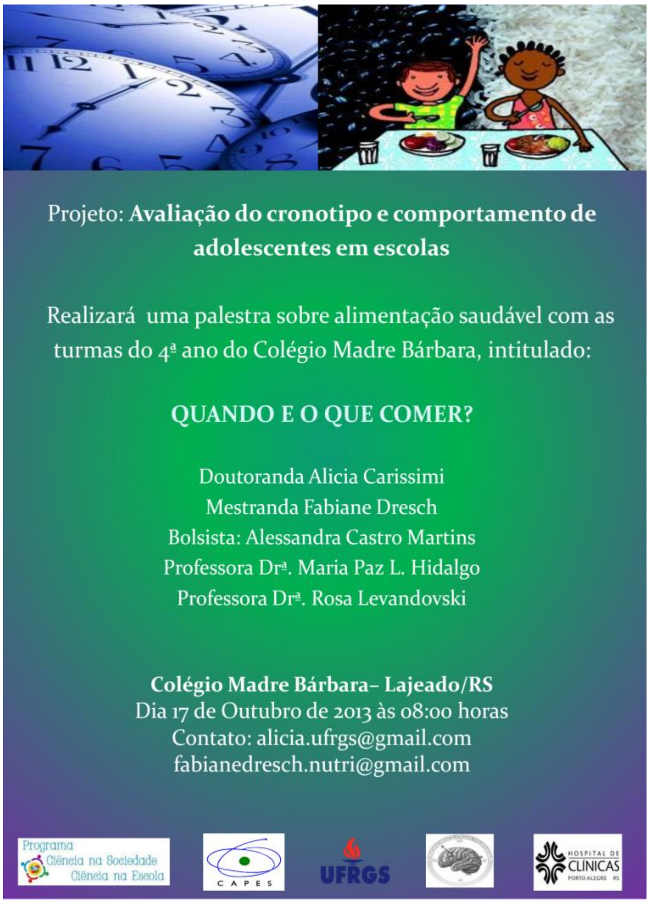
" Durante a semana, é importante não dormir mais que 8 horas e 30 minutos para ter tempo de gastar energia. Se isto acontece, seria importante que o aluno fizesse atividade física no horário em que não está na escola para diminuição de peso (caminhada, corrida, jogos).

" Cuidar do peso é fundamental, pois influencia no bem-estar e na auto-estima.

Catieli Heineck- O Progresso

Professoras e alunos empolgados com a participação no projeto

Palestras nas escolas



Concurso de fotografias

Detalhes metodológicos adicionais (ANEXO 4)

Os artigos incluídos nessa tese foram desenvolvidos a partir do projeto número 12-0386 GPPG/HCPA intitulado "Avaliação do cronotipo e comportamento de adolescentes em escolas".

Delineamento

Estudo epidemiológico

Amostragem

O projeto foi executado nas escolas da rede pública estadual e municipal de ensino das cidades de Progresso e Lajeado. Nas escolas, realizou-se reunião geral para a apresentação do projeto com pais e professores. Após, todos os alunos foram convidados a participar, levando o termo de consentimento aos pais e/ou responsáveis para devida autorização da sua participação na pesquisa. Os alunos somente eram incluídos após a assinatura do Termo de Consentimento.

Na primeira fase, os alunos responderam questionários sobre hábitos de sono, hábitos alimentares e auto-eficácia física durante o período da aula. Além de responder os questionários, eles foram pesados e medidos para avaliação do índice de massa corporal. Os pais e/ou responsáveis também responderam questionários sobre os hábitos de sono e alimentação para confirmar as informações respondidas pelas crianças e pelos adolescentes. Além disso, eles responderam questionários que avaliam sintomas psiquiátricos e distúrbios do sono (dados ainda não avaliados).

Na segunda fase, 80 alunos foram sorteados, realizando coleta de saliva para avaliação das medidas de cortisol e melatonina. O sorteio foi de acordo com a classificação de sintomas psiquiátricos, investigando as crianças e adolescentes com alteração no comportamento e sem alteração no comportamento. Amostras de saliva foram coletadas durante um dia, três vezes ao dia. A primeira coleta foi realizada no período da manhã, entre às 8h00min e 9h00min, não ultrapassando uma hora após o levantar, a segunda entre às 16h00mine 17h00min, e a terceira entre 22h00min e 23h00min. Os alunos foram orientados a se abster de comer, beber, escovar os dentes e a não fazer uso de qualquer medicação dentro de 30 minutos antes da coleta. Além disso, eles foram orientados a realizar uma limpeza da boca antes da coleta. As amostras foram coletadas em ependorfes e cada participante armazenou-as na geladeira de sua residência, levando até aos pesquisadores no dia seguinte. Após, as amostras foram devidamente armazenadas no Hospital de Clínicas de Porto Alegre e analisaram-se os hormônios de melatonina e cortisol.

No Laboratório de Cronobiologia e Sono do HCPA, realizou-se a digitação dos resultados, análise e interpretação dos questionários e dos índices de melatonina e cortisol.

Os questionários sobre hábitos de sono e alimentação foram originalmente desenvolvidos na Itália pelos pesquisadores Vincenzo Natale e Monica Martoni, e foram traduzidos e adaptados para o português do Brasil. Essa tradução foi discutida em reunião com a coordenadora do projeto e os pesquisadores Italianos.

Instrumentos utilizados (ANEXO 5)

1. Questionário de Matutinidade-Vespertinidade (em inglês, *Morningness-Eveningness Questionnaire*, MEQ)
2. Questionário sobre Hábitos de sono e alimentação – Crianças e adolescentes
3. Questionário sobre Hábitos de sono e alimentação – Pais
4. Lista de verificação comportamental para crianças e adolescentes (em inglês, *Child Behavior Checklist*, CBCL)

Questionário de Matutinidade-Vespertinidade

MEQ: QUESTIONÁRIO PARA IDENTIFICAÇÃO DE INDIVÍDUOS MATUTINOS E VESPERTINOS

GRUPO DE PESQUISA EM CRONOBIOLOGIA

Nome:_________________________________ **Data:** ___/___/___
Entrevistador: ____

Testagem: _________
Nº no Banco: ______

1.Considerando apenas seu bem-estar pessoal e com liberdade total de planejar seu dia, a que horas você se levantaria?

05 06 07 08 09 10 11 12

2.Considerando apenas seu bem-estar pessoal e com liberdade total de planejar sua noite, a que horas você se deitaria?

20 21 22 23 24 01 02 03

3. Até que ponto você depende do despertador para acordar de manhã?

Nada dependente ( ) Não muito dependente ( ) Razoavelmente dependente ( ) Muito dependente ( )

4. Você acha fácil acordar de manhã?

Nada fácil ( ) Não muito fácil ( ) Razoavelmente fácil ( ) Muito fácil ( )

5. Você se sente alerta durante a primeira meia hora depois de acordar?

Nada alerta ( ) Não muito alerta ( ) Razoavelmente alerta ( ) Muito alerta ( )

6. Como é o seu apetite durante a primeira meia hora depois de acordar?

Muito ruim ( ) Não muito ruim ( ) Razoavelmente bom ( ) Muito bom ( )

7. Durante a primeira meia hora depois de acordar você se sente cansado?

Muito cansado ( ) Não muito cansado ( ) Razoavelmente em forma ( ) Em plena forma ( )

8. Se você não tem compromisso no dia seguinte e comparando com sua hora habitual, a que horas você gostaria de ir deitar?

Nunca mais tarde ( ) Menos que uma hora mais tarde ( ) Entre uma e duas horas mais tarde ( ) Mais do que duas horas mais tarde ( )

9. Você decidiu fazer exercícios físicos. Um amigo sugeriu o horário das 07:00 às 08:00 horas da manhã, duas vezes por semana. Considerando apenas seu bem-estar pessoal, o que você acha de fazer exercícios nesse horário?

Estaria em boa forma ( ) Estaria razoavelmente em forma ( ) Acharia isso difícil ( ) Acharia isso muito difícil ( )

10. A que horas da noite você se sente cansado e com vontade de dormir?

20 21 22 23 24 01 02 03

(Traduzido e adaptado pelo Grupo Multidiciplinar de Desenvolvimento e Ritmos Biológicos Depto. Fisiologia e Biofísica- Inst. Ciências Biomédicas/ USP. Instrumento original de Horne, J.A. e Ostberg, O., *A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. International Journal of Chronobiology, vol. 4:97-110,1976*)

11. Você quer estar no máximo de sua forma para fazer um teste que dura duas horas e que você sabe que é mentalmente cansativo. Considerando apenas o seu bem-estar pessoal, qual desses horários você escolheria para fazer esse teste?

Das 08:00 às 10:00 horas ( )	Das 11:00 às 13:00 horas ( )	Das 15:00 às 17:00 horas ( )	Das 19:00 às 21:00 horas ( )

12. Se você fosse deitar às 23:00 horas em que nível de cansaço você se sentiria?

Nada cansado ( )	Um pouco cansado ( )	Razoavelmente cansado ( )	Muito cansado ( )

13. Por alguma razão você foi dormir várias horas mais tarde do que é seu costume. Se no dia seguinte você não tiver hora certa para acordar, o que aconteceria com você?

Acordaria na hora normal, sem sono ( )	Acordaria na hora normal, com sono ( )	Acordaria na hora normal e dormiria novamente ( )	Acordaria mais tarde do que seu costume ( )

14. Se você tiver que ficar acordado das 04:00 às 06:00 horas para realizar uma tarefa e não tiver compromissos no dia seguinte, o que você faria?

Só dormiria depois de fazer a tarefa ( )	Tiraria uma soneca antes da tarefa e dormiria depois ( )	Dormiria bastante antes e tiraria uma soneca depois ( )	Só dormiria antes de fazer a tarefa ( )

15. Se você tiver que fazer duas horas de exercício físico pesado e considerando apenas o seu bem-estar pessoal, qual destes horários você escolheria?

Das 08:00 às 10:00 horas ( )	Das 11:00 às 13:00 horas ( )	Das 15:00 às 17:00 horas ( )	Das 19:00 às 21:00 horas ( )

16. Você decidiu fazer exercícios físicos. Um amigo sugeriu o horário das 22:00 às 23:00 horas, duas vezes por semana. Considerando apenas o seu bem-estar pessoal o que você acha de fazer exercícios nesse horário?

Estaria em boa forma ( )	Estaria razoavelmente em forma ( )	Acharia isso difícil ( )	Acharia isso muito difícil ( )

17. Suponha que você possa escolher o seu próprio horário de trabalho e que você deva trabalhar cinco horas seguidas por dia. Imagine que seja um serviço interessante e que você ganhe por produção. Qual o horário que você escolheria? **(Marque a hora do início e a hora do fim)**

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

18. A que hora do dia você atinge seu melhor momento de bem-estar?

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

19. Fala-se em pessoas matutinas e vespertinas (as primeiras gostam de acordar cedo e dormir cedo; as segundas, de acordar tarde e dormir tarde). Com qual desses tipos você se identifica?

Tipo matutino ( )	Mais matutino que vespertino ( )	Mais vespertino que matutino ( )	Tipo vespertino ( )

(Traduzido e adaptado pelo Grupo Multidiciplinar de Desenvolvimento e Ritmos Biológicos Depto. Fisiologia e Biofísica- Inst. Ciências Biomédicas/ USP. Instrumento original de Horne, J.A. e Ostberg, O., *A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. International Journal of Chronobiology, vol. 4:97-110,1976*)

Questionário sobre Hábitos de sono e alimentação – Crianças e adolescentes

“Meu dia”

Instrução

- Leia atentamente cada questão e responda pensando em seu cronograma e seus hábitos durante o ano letivo.
- Responda a todas as perguntas em ordem.
- Não há respostas certas ou erradas.
- O questionário é anônimo.

Horário Escolar

Segunda-feira	
Terça-feira	
Quarta-feira	
Quinta-feira	
Sexta-feira	
Sábado	

Educação Física na Escola?

☐ Sim ☐ Não

Se sim,

Quantas vezes na semana? ________________

Por quanto tempo?

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MINHA APRESENTAÇÃO

IDADE .... anos

☐ MASCULINO ☐ FEMININO

Meu ANIVERSÁRIO é no **MÊS** de ……………………………...

A **CIDADE** onde eu nasci é...

MEUS HÁBITOS ALIMENTARES DURANTE A ESCOLA

SEGUE UMA ALIMENTAÇÃOESPECIAL?

(não come carne, não pode comer pães e massas, não pode comer doces, não come carne de porco, etc.)

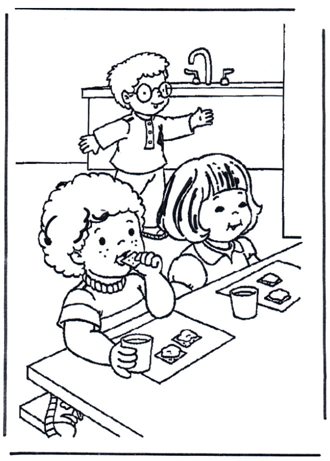
☐ SIM ☐ NÃO

NA MANHÃ, APÓS VOCÊ ACORDAR, TOMA CAFÉ DA MANHÃ?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... **minutos**



GERALMENTE, COME DURANTE O RECREIO DA MANHÃ?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... **minutos**

GERALMENTE ALMOÇA?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... **minutos**

ONDE VOCÊ COSTUMA ALMOÇAR?

☐ **EM CASA** ☐ **ÀS VEZES, EM CASA/ ÀS VEZES, NA ESCOLA** ☐ **NA ESCOLA**

COSTUMA COMER O LANCHE DA TARDE?

☐ SIM ☐ NÃO

ONDE? ☐ EM CASA ☐ NA ESCOLA ☐ OUTRO LUGAR:___________

<u>SE VOCÊ RESPONDEU SIM</u>, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... minutos

COME A MERENDA QUE A ESCOLA OFERECE, NO HORÁRIO QUE ESTUDA?

☐ SIM ☐ NÃO ☐ ÀS VEZES

NA SAÍDA DA ESCOLA, FAZ ALGUM TIPO DE ALIMENTAÇÃO ATÉ CHEGAR EM CASA?

☐ SIM ☐ NÃO ☐ ÀS VEZES

GERALMENTE JANTA?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... minutos

DEPOIS DO JANTAR, ACONTECE DE VOCÊ COMER OUTRA COISA ANTES DE IR PARA A CAMA?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, O QUE COME?..

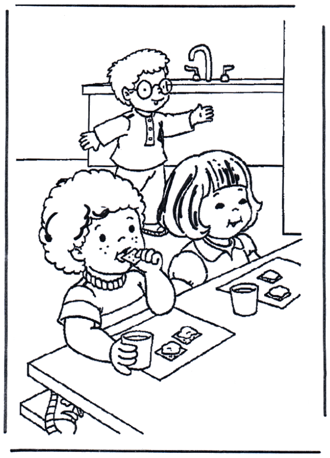
MEUS HÁBITOS ALIMENTARES NOS DIAS EM QUE NÃO VOU À ESCOLA

NA MANHÃ, APÓS VOCÊ ACORDAR, TOMA CAFÉ DA MANHÃ?

☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... **minutos**



GERALMENTE, COME LANCHE DURANTE A MANHÃ?

☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM, A QUE HORAS? ....

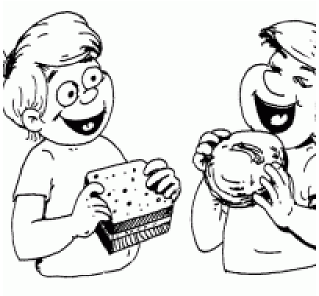
QUANTOS MINUTOS DEMORA? .... **minutos**

GERALMENTE ALMOÇA?

☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... **minutos**



COSTUMA COMER O LANCHE DA TARDE?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... **minutos**

GERALMENTE JANTA?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, A QUE HORAS? ....

QUANTOS MINUTOS DEMORA? .... **minutos**

DEPOIS DO JANTAR, ACONTECE DE VOCÊ COMER OUTRA COISA ANTES DE IR PARA A CAMA?

☐ SIM ☐ NÃO

<u>SE VOCÊ RESPONDEU SIM</u>, O QUE COME? ....

MEUS HÁBITOS DE SONO

DURANTE <u>OS DIAS DE ESCOLA</u>

A QUE HORAS VOCÊ DORME? ....

A QUE HORAS VOCÊ NORMALMENTE ACORDA? ....

VOCÊ TIRA UMA SONECA À TARDE? ☐ SIM ☐ NÃO

SE SIM, A QUE HORAS VOCÊ FAZ A SONECA?...........................

SE SIM, A QUE HORAS VOCÊ ACORDA DA SONECA?.................

VOCÊ SE SENTE CANSADO NA ESCOLA?

☐ NUNCA ☐ ÀS VEZES ☐ SEMPRE

DURANTE <u>O DIA QUE VOCÊ NÃO VAI À ESCOLA</u>

A QUE HORAS VOCÊ DORME? ....

A QUE HORAS VOCÊ ACORDA? ....

VOCÊ TIRA UMA SONECA A TARDE? ☐ SIM ☐ NÃO

SE SIM, A QUE HORAS VOCÊ FAZ A SONECA?...........................

SE SIM, A QUE HORAS VOCÊ ACORDA DA SONECA?.................

1) SE PUDESSE ESCOLHER O HORÁRIO DE ACORDAR, A QUE VOCÊ HORAS VOCÊ SE LEVANTARIA?

HORAS .... MINUTOS...........

2) SE PUDESSE ESCOLHER A HORA DE IR DORMIR, A QUE HORAS VOCÊ SE DEITARIA?

HORAS .... MINUTOS ....

3) DURANTE A PRIMEIRA MEIA HORA DEPOIS DE ACORDAR VOCÊ SE SENTE CANSADO?

☐ **MUITO CANSADO** ☐ **NÃO MUITO CANSADO**

☐ **RAZOAVELMENTE EM FORMA** ☐ **EM PLENA FORMA**

4) A QUE HORA DO DIA VOCÊ SE SENTE MAIS DISPOSTO?

HORAS .... MINUTOS………..

5) VOCÊ SE SENTE MAIS ATIVO NA MANHÃ OU À TARDINHA?

☐ **MUITO MAIS DISPOSTO PELA MANHÃ**

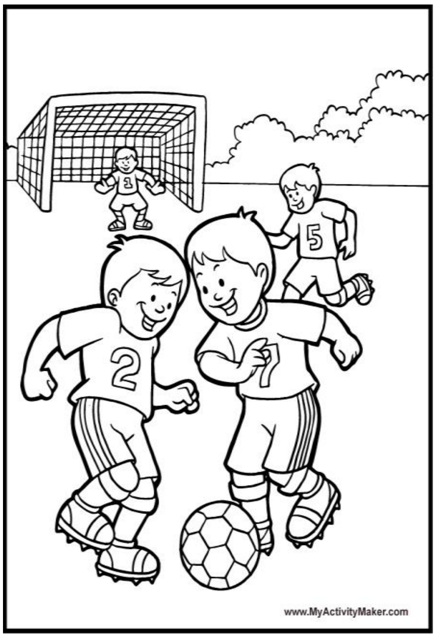
☐ **UM POUCO MAIS DISPOSTO PELA MANHÃ DO QUE NA TARDINHA**

☐ **UM POUCO MAIS DISPOSTO PELA TARDINHA DO QUE NA MANHÃ**

☐ **MUITO MAIS DISPOSTO PELA TARDINHA**

AS FRASES DESCRITAS ABAIXO SE REFEREM A SITUAÇÕES DE JOGO, PRÁTICA DE EXERCÍCIOS E ESPORTE.

LEIA TODAS AS FRASES E MARQUE A RESPOSTA QUE MELHOR DESCREVE O QUE VOCÊ PENSA SOBRE SI MESMO. ESCOLHA APENAS UM QUADRADINHO EM CADA CONJUNTO DE OPÇÕES.



☐ CORRO MUITO DEVAGAR
☐ CORRO DEVAGAR
☐ CORRO RÁPIDO
☐ CORRO MUITO RÁPIDO

☐ SOU CAPAZ DE FAZER EXERCÍCIOS FÍSICOS MUITO DIFÍCEIS
☐ SOU CAPAZ DE FAZER EXERCÍCIOS DIFÍCEIS
☐ SOU CAPAZ DE FAZER EXERCÍCIOSFÁCEIS
☐ SOU CAPAZ DE FAZER EXERCÍCIOS MUITO FÁCEIS

☐ NÃO TENHO FORÇA NOS MEUS MÚSCULOS
☐ TENHO POUCA FORÇA NOS MEUS MÚSCULOS
☐ TENHO FORÇA NOS MEUS MÚSCULOS
☐ TENHO MUITA FORÇA NOS MEUS MÚSCULOS

☐ SOU MUITO RÁPIDO QUANDO ME MEXO
☐ SOU RÁPIDO QUANDO ME MEXO
☐ SOU LENTO QUANDO ME MEXO
☐ SOU MUITO LENTO QUANDO ME MEXO

☐ SOU MUITO INSEGURO E FICO MUITO NA DÚVIDA QUANDO ME MEXO
☐ SOU INSEGURO E FICO NA DÚVIDA QUANDO ME MEXO
☐ SOU SEGURO E NÃO FICO NA DÚVIDA QUANDO ME MEXO
☐ SOU MUITO SEGURO E NÃO FICO NEM UM POUCO NA DÚVIDA QUANDO ME MEXO

☐ NÃO FAÇO NENHUM ESFORÇO QUANDO ME MEXO
☐ NÃO FAÇO ESFORÇO QUANDO ME MEXO
☐ FAÇO ESFORÇO QUANDO ME MEXO
☐ FAÇO MUITO ESFORÇO QUANDO ME MEXO

VOCÊ CHEGOU AO FINAL, OBRIGADO!!!

Questionário sobre Hábitos de sono e alimentação – Pais

“Questionário sobre hábitos alimentares e ritmos de vida”

Instruções

O questionário contém perguntas relacionadas aos hábitos de seu filho(a), e perguntas sobre a família.
Solicitamos que leia atentamente cada pergunta e responda com a maior sinceridade e que mais se aproxime de sua realidade.
Por favor, responda as questões na ordem em que elas são apresentadas.
A informação é completamente confidencial e somente será utilizada para fins de pesquisa.
O questionário é não identificado.

Nós solicitamos que devolva o questionário devidamente preenchido até a data de …………….

Obrigada pela colaboração!

CÓDIGO

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ALGUMAS PERGUNTAS SOBRE A PESSOA QUE ESTÁ PREENCHENDO O QUESTIONÁRIO

ANO de NASCIMENTO……………………….

NACIONALIDADE ………………………………………

NATURAL DE (onde nasceu, cidade e país)……………………………………

QUAL É SEU PARENTESCO COM A CRIANÇA/ADOLESCENTE?

☐ SOU A MÃE
☐ SOU O PAI
☐ OUTRO PARENTESCO ………………………………….
☐ NENHUM PARENTESCO

NO MOMENTO TRABALHA FORA DE CASA?

☐ SIM, O TEMPO INTEIRO

☐ SIM, PARTE DO TEMPO

☐ NÃO

QUAL É SEU GRAU DE ESTUDO?

☐ NÃO ESTUDEI E NÃO SEI LER

☐ NÃO ESTUDEI, MAS SEI LER

☐ ENSINO FUNDAMENTAL – SÉRIES INICIAIS (1ª a 4ª – 1º grau)
☐ Completa ☐ Incompleta

☐ ENSINO FUNDAMENTAL – SÉRIES FINAIS (5ª a 8ª – 1º grau)
☐ Completo ☐ Incompleto

☐ ENSINO MÉDIO (2º GRAU)
☐ Completo ☐ Incompleto

☐ GRADUAÇÃO
☐ Completa ☐ Incompleta

☐ PÓS-GRADUAÇÃO
☐ Completa ☐ Incompleta

CADA UMA DAS 5 PERGUNTAS SEGUINTES INDICAM A RESPOSTA QUE MELHOR DESCREVE SEU COMPORTAMENTO.

1. Considerando apenas seu bem-estar pessoal e com a liberdade total de planejar seu dia, a que horas você se levantaria?

Horas ______________ minutos ______________

2. Considerando apenas seu bem-estar pessoal e com a liberdade total de planejar sua noite, a que horas você se deitaria?

Horas _______________minutos ______________

3. Durante a primeira meia hora depois de acordar você se sente cansado?

( ) Muito cansado
( ) Não muito cansado
( ) Razoavelmente em forma
( ) Em plena forma

4. A que hora do dia você se sente mais disposto?

Horas _______________ minutos ________________

5. Fala-se em pessoas matutinas e vespertinas (as primeiras gostam de acordar cedo e dormir cedo; as segundas, de acordar tarde e dormir tarde). Com qual desses tipos você se identifica?

( ) Tipo matutino
( ) Mais matutino que vespertino
( ) Mais vespertino que matutino
( ) Tipo vespertino

As PERGUNTAS a seguir referem-se aos HÁBITOS DA CRIANÇA/ADOLESCENTE

A CRIANÇA/ADOLESCENTE SEGUE UMA ALIMENTAÇÃO ESPECIAL (não come carne, não pode comer pães e massas, não pode comer doces, não come carne de porco, etc.)?

☐ SIM ☐ NÃO

Abaixo, você responderá uma série de perguntas sobre hábitos alimentares da criança/adolescente, em referência as cinco refeições principais. Para cada refeição, serão hábitos distintos relacionados com os dias de escola/trabalho e com os finais de semana.

CAFÉ DA MANHÃ

NOS DIAS ESCOLARES

A CRIANÇA/ADOLESCENTE TOMA CAFÉ DA MANHÃ? ☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM,

ONDE? ☐ CASA ☐ ÀS VEZES, EM CASA/ ÀS VEZES, NA ESCOLA ☐ ESCOLA

A QUE HORAS? ………………..

O CAFÉ DA MANHÃ É REALIZADO COM TODA FAMÍLIA REUNIDA? ☐ SIM ☐ NÃO

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA TOMAR O CAFÉ DAMANHÃ? .... minutos

NORMALMENTE, QUEM PREPARA O CAFÉ DA MANHÃ?..

QUANTO TEMPO DEMORA PARA PREPARAR O CAFÉ DA MANHÃ? .... minutos

DURANTE O FIM DE SEMANA

GERALMENTE, A CRIANÇA/ADOLESCENTE TOMA O CAFÉ DA MANHÃ? ☐ SIM ☐NÃO

SE VOCÊ RESPONDEU SIM,

A QUE HORAS? ………………..

O CAFÉ DA MANHÃ É REALIZADO COM TODA FAMÍLIA REUNIDA? ☐SIM ☐NÃO

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA TOMAR O CAFÉ DA MANHÃ? .... minutos

NORMALMENTE, QUEM PREPARA O CAFÉ DA MANHÃ?..

QUANTO TEMPO DEMORA PARA PREPARAR O CAFÉ DA MANHÃ? .... minutos

LANCHE DA MANHÃ

NOS DIAS DE ESCOLA

GERALMENTE, A CRIANÇA/ADOLESCENTE FAZ UM LANCHE? ☐ SIM ☐NÃO

SE VOCÊ RESPONDEU SIM, A QUE HORAS? ………………..

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA COMER O LANCHE?…………………....... minutos

GERALMENTE, QUEM PREPARA O LANCHE? ....

QUANTO TEMPO DEMORA PARA PREPARAR O LANCHE? .... minutos

DURANTE O FIM DE SEMANA

GERALMENTE, A CRIANÇA/ADOLESCENTE COME UM LANCHE? ☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM,

A QUE HORAS? ………………..

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA COMER O LANCHE?…………………………………...... minutos

GERALMENTE, QUEM PREPARA O LANCHE? ....

QUANTO TEMPO DEMORA PARA PREPARAR O LANCHE? .... minutos

ALMOÇO

NOS DIAS DE ESCOLA

GERALMENTE, A CRIANÇA/ADOLESCENTE ALMOÇA? SIM ☐ NÃO ☐

SE VOCÊ RESPONDEU SIM,

ONDE? ☐ CASA ☐ ÀS VEZES, EM CASA/ ÀS VEZES, NA ESCOLA ☐ ESCOLA QUE HORAS? ………………..

O ALMOÇO É REALIZADO COM TODA FAMÍLIA REUNIDA? ☐ SIM ☐ NÃO

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA ALMOÇAR? ……………………………................. minutos

NORMALMENTE, QUEM PREPARA O ALMOÇO? ....

QUANTO TEMPO DEMORA PARA PREPARAR O ALMOÇO? .... minutos

DURANTE O FIM DE SEMANA

GERALMENTE, A CRIANÇA/ADOLESCENTE ALMOÇA? ☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM,

A QUE HORAS? ………………..

O ALMOÇO É REALIZADO COM TODA FAMÍLIA REUNIDA? ☐SIM ☐ NÃO

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA ALMOÇAR? .... minutos

NORMALMENTE, QUEM PREPARA O ALMOÇO? ....

QUANTO TEMPO DEMORA PARA PREPARAR O ALMOÇO? .... minutos

LANCHE DA TARDE

NOS DIAS DE ESCOLA

GERALMENTE, A CRIANÇA/ADOLESCENTE FAZ UM LANCHE? ☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM,

ONDE? ☐ CASA ☐ ÀS VEZES,EM CASA/ ÀS VEZES,NA ESCOLA ☐ ESCOLA

A QUE HORAS? ………………..

O LANCHE É REALIZADO COM TODA FAMÍLIA REUNIDA? ☐ SIM ☐ NÃO

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA COMER O LANCHE?
……………………....................... minutos

NORMALMENTE, QUEM PREPARA O LANCHE? ....

QUANTO TEMPO DEMORA PARA PREPARAR O LANCHE? .... minutos

DURANTE O FIM DE SEMANA

GERALMENTE, A CRIANÇA/ADOLESCENTE FAZ UM LANCHE? ☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM,

A QUE HORAS? ………………..

QUANTO TEMPO A CRIANÇA DEMORA PARA COMER O LANCHE?
.... minutos

GERALMENTE, QUEM PREPARA O LANCHE? ....

QUANTO TEMPO DEMORA PARA PREPARAR O LANCHE? .... minutos

JANTAR

NOS DIAS DE ESCOLA

GERALMENTE, A CRIANÇA/ADOLESCENTE JANTA? ☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM,

A QUE HORAS? ………………..

A JANTA É REALIZADA COM TODA FAMÍLIA REUNIDA? ☐ SIM ☐ NÃO

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA JANTAR?
.... minutos

NORMALMENTE, QUEM PREPARA A JANTA? ....

QUANTO TEMPO DEMORA PARA PREPARAR A JANTA? .... minutos

DURANTE O FIM DE SEMANA

GERALMENTE, A CRIANÇA/ADOLESCENTE JANTA? ☐ SIM ☐ NÃO

SE VOCÊ RESPONDEU SIM,

A QUE HORAS? ………………..

A JANTA É REALIZADA COM TODA FAMÍLIA REUNIDA? ☐ SIM ☐ NÃO

QUANTO TEMPO A CRIANÇA/ADOLESCENTE DEMORA PARA JANTAR?
.... minutos

NORMALMENTE, QUEM PREPARA A JANTA? ....

QUANTO TEMPO DEMORA PARA PREPARAR A JANTA? .... minutos

A FAMÍLIA REALIZA REFEIÇÕES EM HORÁRIOS REGULARES?

☐ SEMPRE ☐ FREQUENTEMENTE ☐ ÀS VEZES ☐NUNCA

A CRIANÇA/ADOLESCENTE PARTICIPA DO PREPARO DA COMIDA?

☐ SEMPRE ☐ FREQUENTEMENTE ☐ ÀS VEZES ☐ NUNCA

NA SUA OPINIÃO A CRIANÇA/ADOLESCENTE É:

☐ ABAIXO DO PESO ☐ UM POUCO ACIMA DO PESO

☐ PESO NORMAL ☐ MUITO ACIMA DO PESO

HÁBITOS DE SONO DA CRIANÇA/ADOLESCENTE

GERALMENTE, NOS DIAS DE ESCOLA, A CRIANÇA/ADOLESCENTE:

DORME QUE HORAS? ……………………

ACORDA QUE HORAS? ……………………

DORME DURANTE A TARDE (SONECA)? ☐ SIM ☐ NÃO

SE SIM, GERALMENTE, DE QUE HORAS ATÉ QUE HORAS? DE……….A……….

GERALMENTE, NOS FINAIS DE SEMANA, A CRIANÇA:

DORME QUE HORAS? ……………………

ACORDA QUE HORAS? ……………………

DORME DURANTE A TARDE (SONECA)? ☐ SIM ☐ NÃO

SE SIM, GERALMENTE, DE QUE HORAS ATÉ QUE HORAS? DE……….A………

ESPORTE E HORÁRIO DE LAZER DACRIANÇA/ADOLESCENTE

NO HORÁRIO DE LAZER A CRIANÇA/ADOLESCENTE PRATICA ATIVIDADE ESPORTIVA?
SIM ☐ **NÃO** ☐

NO HORÁRIO DE LAZER A CRIANÇA/ADOLESCENTE ESTÁ ENVOLVIDA EM ATIVIDADES NÃO ESPORTIVAS (por exemplo, escoteiros, catequese, instrumento musical, aulas particulares, etc.)**?**
SIM ☐ **NÃO** ☐

POR FAVOR, NESTA TABELA ESCREVA O TIPO DE ATIVIDADE E O HORÁRIO REFERENTE A OUTRA ATIVIDADE ESPORTIVA OU OUTRO TIPO DE ATIVIDADE QUE A CRIANÇA/ADOLESCENTE PRATICA REGULARMENTE <u>QUANDO NÃO ESTÁ NA ESCOLA</u>.

DIA	ATIVIDADE ESPORTIVA	OUTRA ATIVIDADE
SEGUNDA-FEIRA	………..……. De …… até…… ………..……. De …… até……	………..……. De …… até…… ………..……. De …… até……
TERÇA-FEIRA	………..……. De …… até…… ………..……. De …… até……	………..……. De …… até…… ………..……. De …… até……
QUARTA-FEIRA	………..……. De …… até…… ………..……. De …… até……	………..……. De …… até…… ………..……. De …… até……
QUINTA-FEIRA	………..……. De …… até…… ………..……. De …… até……	………..……. De …… até…… ………..……. De …… até……
SEXTA-FEIRA	………..……. De …… até…… ………..……. De …… até……	………..……. De …… até…… ………..……. De …… até……
SÁBADO	………..……. De …… até…… ………..……. De …… até……	………..……. De …… até…… ………..……. De …… até……
DOMINGO	………..……. De …… até…… ………..……. De …… até……	………..……. De …… até…… ………..……. De …… até……

Por favor, indique hábitos da criança/adolescente a respeito do **uso de jogos de computador ou videogame**, e o uso da **televisão** nos dias de escola e nos finais de semana.
Se a criança geralmente utiliza computadores e/ou videogames ou a televisão várias vezes por dia, para cada vez é necessário indicar o horário de início e o horário de fim.

Marque o inicio e o fim de acordo com a atividade, conforme solicitado. Siga o exemplo:SEGUE UM EXEMPLO DE COMO RESPONDER AS PERGUNTAS CORRETAMENTE (exemplo DE 08:00 ATÉ 10:30 e DE 15:15 ATÉ 19:00).

24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

DURANTE OS DIAS DE ESCOLA, A QUE HORAS A CRIANÇA/ADOLESCENTE USA O COMPUTADOR E/OU OS JOGOS ELETRÔNICOS?

24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

DURANTE OS DIAS DE ESCOLA, A QUE HORAS A CRIANÇA/ADOLESCENTE ASSISTE TELEVISÃO?

24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

DURANTE O FIM DE SEMANA,A QUE HORAS A CRIANÇA/ADOLESCENTE USA O COMPUTADOR E/OU OS JOGOS ELETRÔNICOS?

24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

DURANTE O FIM DE SEMANA,A QUE HORAS A CRIANÇA/ADOLESCENTE ASSISTE TELEVISÃO?

24 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

GERALMENTE, A CRIANÇA/ADOLESCENTE:

COMO VAI À ESCOLA?

☐ A PÉ ☐ DE BICICLETA ☐ DE CARRO ☐ DE ÔNIBUS

EM QUANTO TEMPO VAI PARA A ESCOLA?

.... minutos

Você pode usar este espaço para escrever quaisquer comentários com relação às perguntas que acabam de ser respondidas, e/ou relatar qualquer dificuldade no preenchimento do questionário.

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Lista de verificação comportamental para crianças e adolescentes

LISTA DE VERIFICAÇÃO COMPORTAMENTAL PARA CRIANÇAS/ADOLESCENTES DE 4-18 ANOS (C.B.C.L)

ID:

NOME DA CRIANÇA:

Idade _______anos	Sexo ☐masculino ☐feminino	Raça	TIPO DE TRABALHO DOS PAIS, mesmo que não esteja trabalhando no momento. *(Especifique, por favor – por exemplo: mecânico de automóveis, professora de ensino secundário, doméstica, operário, vendedor, vigilante)*
Escolaridade ________ série Não freqüenta a escola ☐	Data de hoje: Dia___Mês_______Ano_____ Data de Nascimento: Dia___Mês_______Ano_____ ______________________________ Por favor responda a este formulário de acordo com o modo como você vê o comportamento da criança mesmo que outras pessoas possam não concordar. Esteja a vontade para escrever quaisquer comentários adicionais abaixo de cada questão e no espaço livre da página 2.		Tipo de trabalho do pai: ______________________________________ Tipo de trabalho da mãe: ______________________________________ Formulário preenchido por: ☐ Mãe (nome)____ ☐ Pai (nome)____ ☐ Outro – nome e relação com a criança___________________________

I. Por favor enumere os esportes que seu filho mais gosta de praticar. Por exemplo: natação, futebol, patinação, skate, andar de bicicleta, etc.

☐ Nenhum

Em comparação com outras crianças da mesma idade, quanto tempo aproximadamente pratica cada um? / Em comparação com outras crianças da mesma idade, em que grau consegue se sair bem em cada um?

	Não sei	Menos que a média	Dentro da média	Mais que a média	Não sei	Abaixo da média	Dentro da média	Acima da média
a) ____________	☐	☐	☐	☐	☐	☐	☐	☐
b) ____________	☐	☐	☐	☐	☐	☐	☐	☐
c) ____________	☐	☐	☐	☐	☐	☐	☐	☐

II. Por favor enumere os passatempos, atividades e jogos favoritos do seu filho que não sejam esportes. Por exemplo: selos, bonecas, livros, trabalhos manuais, cantar, etc. (não inclua ouvir rádio ou ver televisão)

☐ Nenhum

Em comparação com outras crianças da mesma idade, quanto tempo aproximadamente pratica cada um? / Em comparação com outras crianças da mesma idade, em que grau consegue se sair bem em cada um?

	Não sei	Menos que a média	Dentro da média	Mais que a média	Não sei	Abaixo da média	Dentro da média	Acima da média
a) ____________	☐	☐	☐	☐	☐	☐	☐	☐
b) ____________	☐	☐	☐	☐	☐	☐	☐	☐
c) ____________	☐	☐	☐	☐	☐	☐	☐	☐

III. Por favor enumere quaisquer organizações, clubes, equipes ou grupos a que seu filho(a) pertença

☐ Nenhum

Em comparação com outras crianças da mesma idade, em que grau é ativo(a) em cada um?

	Não sei	Menos ativo	Médio	Mais ativo
a) ____________	☐	☐	☐	☐
b) ____________	☐	☐	☐	☐
c) ____________	☐	☐	☐	☐

IV. Por favor enumere quaisquer empregos ou tarefas de seu filho(a). Por exemplo: lavar a louça, tomar conta das crianças, fazer a cama, etc. (inclui tanto trabalhos pagos como não pagos)

☐ Nenhum

Em comparação com outras crianças da mesma idade, em que grau consegue desempenhá-las bem?

	Não sei	Abaixo da média	Dentro da média	Acima da média
a) ____________	☐	☐	☐	☐
b) ____________	☐	☐	☐	☐
c) ____________	☐	☐	☐	☐

V 1. O seu filho(a) tem aproximadamente quantos(as) amigos(as) íntimos(as)? □ nenhum □ 1 □ 2 ou 3 □ 4 ou mais
(não inclua irmãos e irmãs)

2. O seu filho(a) tem atividade com os amigos(as) fora das horas de aula aproximadamente quantas vezes por semana?
(não inclua irmãos e irmãs) □ Menos que 1 □ 1 ou 2 □ 3 ou mais

VI Em comparação com outras crianças da mesma idade, até que ponto:

	Pior	Próximo(a) da média	Melhor	
a) Consegue relacionar-se adequadamente com os seus/suas irmãos ou irmãs?	□	□	□	□ não tem irmãos ou irmãs
b) Consegue relacionar-se adequadamente com as outras crianças?	□	□	□	
c) Consegue comportar-se adequadamente em relação aos pais?	□	□	□	
d) Consegue divertir-se e trabalhar sozinho(a)	□	□	□	

VII 1. Para crianças com 6 ou mais anos de idade – desempenho em disciplinas escolares: (se a criança não vai a escola, indique as razões, por favor)

		Maus resultados	Abaixo da média	Dentro da média	Acima da média
	a) Português	□	□	□	□
	b) Matemática	□	□	□	□
	c) História ou Estudos Sociais	□	□	□	□
	d) Ciências	□	□	□	□
Outras matérias – por exemplo: computação, língua estrangeira. Não inclua educação física, educação no trânsito, etc.	e)___________________________	□	□	□	□
	f) ___________________________	□	□	□	□
	g) ___________________________	□	□	□	□

2. O seu filho(a) freqüenta algum estabelecimento ou classe de ensino especial? □ Não □ Sim – que tipo de escola ou classe?

3. O seu filho(a) repetiu algum ano? □ Não □ Sim – qual e porque?

4. O seu filho(a) teve algum problema na escola, de aprendizagem ou outro? □ Não □ Sim – Descreva-o por favor, em que série?

Quando começaram estes problemas?_____________________
Os problemas mencionados já acabaram? □ Não □ Sim – quando?

O seu filho(a) tem alguma doença, deficiência física ou deficiência mental? □ Não □ Sim – Descreva-o por favor

Qual é a sua maior preocupação em relação ao seu filho ou filha?

Por favor descreva os aspectos mais positivos do seu filho ou filha

Logo abaixo você encontrará uma lista de afirmações que descrevem as crianças. Para cada afirmação que descreva seu/sua filho(a) NESTE MOMENTO ou NOS ÚLTIMOS SEIS MESES, trace um círculo à volta do 2 se a afirmação é MUITO VERDADEIRA OU FREQUENTEMENTE VERDADEIRA em relação ao seu filho(a). Trace um circulo à volta do 1 se a afirmação é ALGUMAS VEZES VERDADEIRA em relação ao seu filho. Se a afirmação NÃO É VERDADEIRA em relação ao seu filho(a), trace um círculo à volta do 0. Por favor responda a todas as afirmações melhor que possa, mesmo que algumas não pareçam aplicar-se ao seu filho.

0 = NÃO É VERDADEIRA(tanto quanto sabe) **1 = ALGUMAS VEZES VERDADEIRA** **2 = FREQUENTEMENTE VERDADEIRA**

0 1 2	1. Age de maneira muito infantil para a sua idade.
0 1 2	2. Tem alergia(s) (descreva-as) ________________________
0 1 2	3. Discute muito.
0 1 2	4. Tem asma
0 1 2	5. Comporta-se como se fosse do sexo oposto.
0 1 2	6. Faz suas necessidades fora do banheiro.
0 1 2	7. É vaidoso(a).
0 1 2	8. Não consegue concentrar-se , não consegue ficar atento(a) muito tempo.
0 1 2	9. Não consegue tirar certos pensamentos da cabeça; obsessões (descreva-as) __________________________
0 1 2	10. Não consegue ficar sentado (a), é irriquieto (a) ou hiperativo (o).
0 1 2	11. Agarra-se aos adultos ou é muito dependente.
0 1 2	12. Reclama de estar muito sozinho (a).
0 1 2	13. Fica confuso (a) ou parece ficar sem saber onde está.
0 1 2	14. Chora muito.
0 1 2	15. É cruel com os animais.
0 1 2	16. Manifesta crueldade, intimidação ou maldade para com os outros.
0 1 2	17. Sonha acordado (a) ou perde-se em seus pensamentos.
0 1 2	18. Já tentou se suicidar.
0 1 2	19. Requer muita atenção.
0 1 2	20. Destrói as suas próprias coisas.
0 1 2	21. Destrói objetos da sua família ou de outras crianças.
0 1 2	22. É desobediente em casa.
0 1 2	23. É desobediente na escola.
0 1 2	24. Não come bem.
0 1 2	25. Não se dá bem com outras crianças.
0 1 2	26. Não parece sentir-se culpado(a) depois de se comportar mal.
0 1 2	27. Sente ciúme com facilidade.
0 1 2	28. Come ou bebe coisas que não são próprias para comer/beber (descreva-as) ______________________________
0 1 2	29. Tem medo de determinados animais, situações ou lugares, sem incluir a escola (descreva-os) _______________________________
0 1 2	30. Tem medo de ir a escola
0 1 2	31. Tem medo de pensar ou fazer alguma coisa má.
0 1 2	32. Acha que deve ser perfeito(a).
0 1 2	33. Sente ou queixa-se de que ninguém gosta dele(a).
0 1 2	34. Acha que os outros o perseguem.
0 1 2	35. Sente-se pior que os outros.
0 1 2	36. Tem tendência a cair muito.
0 1 2	37. Mete-se em muitas brigas.
0 1 2	38. As pessoas riem dele.
0 1 2	39. Anda com crianças que se metem em brigas.
0 1 2	40. Ouve sons ou vozes que não estão presentes (descreva-os) ________________________________
0 1 2	41. É impulsivo, ou age sem pensar.
0 1 2	42. Gosta de estar sozinho (a).
0 1 2	43. Mente.
0 1 2	44. Rói as unhas.
0 1 2	45. É nervoso (a), muito excitado (a) ou tenso (a).
0 1 2	46. Tem movimentos nervosos/tiques (descreva-os)______________________
0 1 2	47. Tem pesadelos.
0 1 2	48. As outras crianças não gostam dele(a).
0 1 2	49. Tem prisão de ventre.
0 1 2	50. Tem medo de tudo.
0 1 2	51. Sente tonturas.
0 1 2	52. Sente-se muito culpado.
0 1 2	53. Come muito
0 1 2	54. Cansa-se muito
0 1 2	55. Tem peso excessivo.
	56. Tem problemas físicos sem causa conhecida do ponto de vista médico:
0 1 2	a) Sofrimentos ou dores
0 1 2	b) Dores de cabeça
0 1 2	c) Enjôo
0 1 2	d) Problemas com os olhos (descreva-os) ________________________________
0 1 2	e) Problemas de pele
0 1 2	f) Dores de estômago ou câimbras
0 1 2	g) Vômitos
0 1 2	h) Outros (descreva-os) _________________________ _____________________________

0 = NÃO É VERDADEIRA(tanto quanto sabe) 1 = ALGUMAS VEZES VERDADEIRA 2 = FREQUENTEMENTE VERDADEIRA

0 1 2 57. Ataca fisicamente outras pessoas.

0 1 2 58. Tira coisas do nariz, da pele ou de outras partes do corpo (descreva-as)
____

0 1 2 59. Brinca com seus órgãos sexuais em público.

0 1 2 60. Brinca muito com seus órgãos sexuais.

0 1 2 61. Os seus trabalhos escolares são fracos.

0 1 2 62. É desastrado (a) ou tem falta de coordenação.

0 1 2 63. Prefere brincar com crianças mais velhas.

0 1 2 64. Prefere brincar com crianças mais novas.

0 1 2 65. Recusa-se a falar.

0 1 2 66. Repete várias vezes as mesmas ações, compulsões (descreva-as)
____

0 1 2 67. Foge de casa.

0 1 2 68. Grita muito.

0 1 2 69. É reservado (a) e guarda as coisas para si mesmo (a).

0 1 2 70. Vê coisas que não estão presentes (descreva-as)
____

0 1 2 71. Mostra-se pouco à vontade ou facilmente embaraçado (a).

0 1 2 72. Provoca incêndios.

0 1 2 73. Tem problemas sexuais (descreva-os)______________________________

0 1 2 74. Gosta de se exibir, fazer palhaçadas.

0 1 2 75. É tímido (a), ou envergonhado (a)

0 1 2 76. Dorme menos que a maioria das crianças.

0 1 2 77. Dorme mais que a maioria das crianças durante o dia e/ou durante a noite (descreva)
____

0 1 2 78. Faz porcarias ou brinca com as fezes.

0 1 2 79. Tem problemas de linguagem ou dificuldades de articulação (descreva-os)
____

0 1 2 80. Fica de olhar parado.

0 1 2 81. Rouba coisas em casa.

0 1 2 82. Rouba coisas fora de casa.

0 1 2 83. Acumula coisas que não precisa (descreva-as)
____

0 1 2 84. Tem comportamentos estranhos (descreva-os)
____

0 1 2 85. Tem idéias estranhas (descreva-as)
____

0 1 2 86. É teimoso (a), mal humorado (a) ou irritado.

0 1 2 87. Muda de humor repentinamente (alegre/triste)

0 1 2 88. Se aborrece com facilidade.

0 1 2 89. É desconfiado.

0 1 2 90. Fala palavrões.

0 1 2 91. Fala em matar-se.

0 1 2 92. Fala ou caminha quando está dormindo (descreva)
____

0 1 2 93. Fala muito.

0 1 2 94. Perturba os outros freqüentemente.

0 1 2 95. Tem crises de raiva/temperamento exaltado.

0 1 2 96. Pensa muito em sexo.

0 1 2 97. Ameaça as pessoas.

0 1 2 98. Chupa o dedo.

0 1 2 99. Preocupa-se muito com a limpeza ou a elegância.

0 1 2 100. Tem problemas para dormir (descreva-os)
____

0 1 2 101. Falta à escola sem necessidade (“mata aula”)

0 1 2 102. É pouco ativo (a) move-se com lentidão, tem falta de energia.

0 1 2 103. É infeliz, triste ou deprimido (a).

0 1 2 104. Fala muito alto.

0 1 2 105. Usa álcool ou drogas sem ser para fins medicinais (descreva-as)
____

0 1 2 106. Comete atos de vandalismo.

0 1 2 107. Urina-se durante o dia.

0 1 2 108. Urina na cama.

0 1 2 109. Anda sempre a choramingar.

0 1 2 110. Deseja ser do sexo oposto.

0 1 2 111. Isola-se, não cria relações afetivas com os outros.

0 1 2 112. Preocupa-se muito.

113. Por favor escreva quaisquer problemas do seu filho ou filha que não tenham sido mencionados na lista acima:

0 1 2 ____

0 1 2 ____

0 1 2 ____

POR FAVOR, CERTIFIQUE-SE QUE RESPONDEU TODAS AS QUESTÕES.

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