“Sleep well, our tough heroes!” – In adolescence, greater mental toughness is related to better sleep schedules

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Short title: Mental toughness and sleep

All authors declare no conflicts of interests, and the study has been conducted without external funding.

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Acknowledgements

We thank Nick Emler (Surrey, UK) for proofreading the manuscript.

Abstract

Mental toughness (MT) is understood as the display of confidence, commitment, challenge and control. The aim of the present study was to explore the extent to which greater MT is associated with subjectively assessed sleep among adolescents.

A total of 284 adolescents (M=18.26 years) completed a series of questionnaires assessing mental toughness, psychological functioning and sleep.

Greater MT was significantly associated with better sleep quality, shorter sleep onset latency, fewer awakenings after sleep onset, and longer sleep duration. **Greater MT was also associated with less perceived stress and less depressive symptoms. MT was directly and indirectly associated with sleep quality**

Mentally tough adolescents report good sleep quality and sleep schedules, along with psychological well-being.

Key-words: mental toughness; sleep quality; sleep quantity; depressive symptoms; stress; optimism; curiosity

Introduction

Adolescence is defined as the period of gradual transition between childhood and adulthood, with conceptually distinct physical changes marking puberty and maturation (Pinyerd & Zipf, 2005; Spear, 2000). Along with dramatic changes in physiology and neural networks (Giedd, Blumenthal, Jeffries, Castellanos, Liu, Zijdenbos, et al. 1999; Paus, Keshavan, & Giedd, 2008), adolescents have to face new challenges and assume responsibility for issues such as their academic and vocational careers, peer and intimate relationships, increased physical, emotional and financial independence from parents and siblings, use of psychoactive substances, extra-curricular employments and leisure-time activities such as sports participation and music (see Spear (2000) for extensive overview). Dealing with these issues is potentially stressful and, accordingly it is assumed that adolescent with better coping skills will deal more successfully with these challenges (Grant, Compas, Thurm, McMahon, & Gipson, 2004).

A psychological construct related to favorable stress management is mental toughness. Mental toughness (MT) is a relatively new area of academic research (Gucciardi & Gordon, 2011), and a cognitive strength variable known to be associated with good performance both in elite sport (Crust & Azadi, 2012) and, more recently, also in non-elite sport (Gerber, Kalak, Lemola, Clough, Pühse, Ellioth, et al., 2012; Gerber, Kalak, Lemola, Clough, Perry, Pühse, et al., in press; Gerber, Brand, Feldmeth, Lang, Elliot, Holsboer-Trachsler, et al., 2013). Mental toughness has been

conceptualized in **various ways in the scientific literature (see Jones & Parker (2013) for review). Researchers have established links between mental toughness and hardiness, which was previously associated with stress resilience (Maddi, 2006), and may toughness attributes resemble those in resilience scales (Ahern, Kiehl, Sole, & Byers, 2006).**

In the present study, we used the 4C model of mental toughness defined as performing well in challenging situations ('Challenges usually bring out the best in me.'), commitment ('I don't usually give up under pressure.'), control [emotional control: 'Even when under considerable pressure I usually remain calm.'; life control: 'I generally feel in control.') and confidence [interpersonal confidence: 'I usually take charge of a situation when I feel it is appropriate.'; confidence in ability: 'I am generally confident in my own abilities.']; cf. Clough, Earle, & Sewell 2002). In previous studies (Gerber, et al., 2012, 2013, in press) we have been able to validate the German version of the Mental Toughness Questionnaire 48 (MTQ48; Clough, et al., 2002) and to show, in a large sample of adolescents and young adults, 1) that the construct of mental toughness (MT) is not limited to high performing elite sportsmen and women (Gerber, et al., 2012, 2013, in press), 2) that MT is associated with increased stress resilience (Gerber, et al., 2012, in press, and 3) that MT remains stable over time (Gerber, et al., 2013), suggesting therefore that MT is related to successful stress management and to psychological well-being.

With regard to this last construct, numerous studies have indicated that, independent of age, there is a bi-directional relation between

psychological well-being and sleep (cf. Haario, Rahkonen, Laaksonen, Lahelma, & Lallukka, 2013). For adolescents, sleep and sleep regulation play a crucial role in both well-being and development (Brand & Kirov, 2011; Colrain & Baker, 2011; Jan, Reiter, Bax, Ribary, Freeman, & Wasdell, 2010; Owens, Spirito, McGuinn, & Nobile, 2000). Thus, Lemola et al. (2012, in press) were able to show that dispositional optimism was associated with better sleep quality and longer sleep duration among children and adults. By contrast, sleep disturbances have been reported in more than 25% of adolescents worldwide; poor sleep in adolescence has become a significant public mental and physical health problem (Laberge, Tremblay, Vitaro, & Montplaisir, 2000; Owens et al., 2000). Cross-sectional (Kaneita, Ohida, Osaki, Tanihata, Minowa, Suzuki, et al., 2007; Lund, Reider, Whiting, & Prichard, 2010) and longitudinal studies (Roberts, Roberts, & Duong, 2008; Touchette, Chollet, Galéra, Fombonne, Falissard, Boivin, & Melchior, 2012) have shown that acute and chronic sleep loss during development persist over time, with negative effects on adolescents' physical and mental health. At the same time poor psychological well-being may itself negatively impact on adolescents' sleep (Gregory & Sadeh, 2012; Owens et al., 2000).

To explain the association between poor sleep and psychological processes, it has been proposed that increased arousal and dysfunctional thoughts are directly involved in psychologically caused sleep disturbances (Carney & Edinger, 2006; Harvey, 2000, 2002; Riemann, Spiegelhalder, Feige, Voderholzer, Berger, Perlis, et al., 2010) whereas, for

instance, the absence of stress and worries are associated with favorable sleep.

In sum, the research reviewed above points to interrelations between low stress, favorable personality traits and restorative sleep. Consequently, it seems possible that high MT and good quality sleep will prove to be closely linked.

Accordingly, the main goal of the research reported here was to explore the association between mental toughness and sleep within a sample of adolescents. We believe that the present study can add to the current literature on mental toughness and sleep in an important way in showing a close association between MT (as a marker of psychological well-being) and sleep among non-elite sport adolescents.

The following two hypotheses were formulated. First, following Lemola et al. (2012, in press) we expected that higher scores for MT would be *directly* related to positive indicators of sleep quality. Second, following Gerber et al. (2012, 2013, in press) we anticipated that high MT **would *indirectly* related to sleep** via its association with stress and depressive symptoms.

Sample

A total of 292 adolescents participated in the study. Of these, five had >5% missing data and were therefore excluded from further analyses, as were two participants who systematically ticked only right-hand or only left-hand answer boxes and completed the questionnaire within a few

minutes. Of the remaining 284 participants (mean age = 18.26 years, *SD* = 4.17), 185 were female (65.2%; mean age = 17.83 years, *SD* = 3.57) and 99 were male (34.8%; mean age = 19.90 years, *SD* = 5.00; $t(282) = 2.37$, $p = .018$, $d = .28$). To recruit participants, the study was advertised electronically on the homepages of three high schools in the canton of Basel, a district of the German-speaking Northwestern part of Switzerland. Data were collected in spring 2012. Participants were informed about the purpose of the study and about the voluntary basis of their participation. They were also assured of the confidentiality of their responses, and written informed consent was obtained on the first page of the questionnaire. For children aged below 18 years informed consent was secured from their parents. All participants were able to complete the questionnaires within 25 minutes. The study was approved by the local ethics committee, and the entire study was performed in accordance with the ethical standards laid down in the Declaration of Helsinki.

Tested model

First, following the first hypothesis, we assumed a direct association between MT and sleep. Second, following the second hypothesis, we also assumed that MT was indirectly associated with sleep via perceived stress and depressive symptoms. Therefore, we tested a structural model in which MT was both directly and indirectly associated with sleep (see Figure 1).

Materials

Participants completed a series of questionnaires related to mental toughness, optimism, curiosity and exploratory behavior, depressive symptoms, perceived stress, and sleep (quality and quantity).

Mental toughness

Participants were asked to fill in the 48-item Mental Toughness Questionnaire (MTQ48; Clough et al., 2002; German version: Gerber et al., 2012, 2013, in press), which measures overall mental toughness and its six subcomponents: challenge (e.g. ‘Challenges usually bring out the best in me.’), commitment (e.g. ‘I don’t usually give up under pressure.’), emotional control (e.g. ‘Even when under considerable pressure I usually remain calm.’), life control (e.g. ‘I generally feel in control.’), interpersonal confidence (e.g. ‘I usually take charge of a situation when I feel it is appropriate.’) and ability confidence (e.g. ‘I am generally confident in my own abilities.’). Answers on the MTQ48 were given on five-point Likert-type scales ranging from 1 (= *strongly disagree*) to 5 (= *strongly agree*). Items were summed to obtain overall and subscale scores, with higher scores reflecting greater MT (Cronbach’s alpha = .89).

~~Curiosity and exploratory behavior~~

~~Kashdan et al’s (Kashdan, Rose, & Fincham, 2004) Curiosity and Exploration Inventory was employed to assess this dimension. Curiosity is conceptualized as a positive emotional-motivational system associated with the recognition, pursuit, and self-regulation of novelty and challenge. The inventory consists of seven items, and answers are given on 7-point~~

rating scales with the anchor points 1 (= *not at all true*) and 7 (= *completely true*). Higher scores indicate greater curiosity/exploration (Cronbach's alpha = .85).

Life Orientation Test – Optimism (LOT-R)

To assess optimism and favorable life orientation, Scheier et al's Life Orientation Test was employed (Scheier, Carver, & Bridges, 1994). It consists of six items focusing on optimism (e.g., "Also in hard times, I expect that all ends well"; answers are given on five-point Likert scales ranging from 1 (= *not at all*) to 5 (= *always*), with higher sum scores reflecting a greater optimism and life orientation (Cronbach's alpha = .86).

Perceived stress

General perceived stress was assessed with the 10-item Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). The PSS measures the degree to which respondents find their lives unpredictable, uncontrollable and overloaded. Answers are given on five-point Likert-type scales anchored at 1 (= *never*) and 5 (= *very often*). Four items were reverse scored. The mean was calculated in order to obtain an overall score, with higher scores reflecting greater perceived stress (Cronbach's alpha = .88.).

Depressive symptoms

The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Monck, & Erlbaum, 1961) was used to assess severity of depressive symptoms. It

consists of 21 items including a range of affective, behavioral, cognitive and somatic symptoms that are indicative of unipolar depression. Participants were asked to select from four alternative responses that reflect increasing levels of depressive symptomatology. Possible sum scores ranged from 0 to 63 with higher scores indicating more marked depressive symptoms (Cronbach's alpha = .88).

Assessment of sleep

To assess sleep, the Insomnia Severity Index (ISI; Bastien, Vallieres, & Morin, 2001) and an adaptation of the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) were used. The ISI (Bastien et al., 2001) is a 7-item screening measure for insomnia and an outcome measure for use in treatment research. The items, answered on 5-point rating scales (0 = *not at all*, 4 = *very much*), refer in part to DSM-IV (DSM-IV: *Diagnostic and Statistical Manual of Mental Disorders*; American Psychiatric Association, 2000) criteria for insomnia by measuring difficulty in falling asleep, difficulties remaining asleep, early morning awakenings, increased daytime sleepiness, impaired daytime performance, low satisfaction with sleep, and worrying about sleep. The higher the overall score, the more the respondent is assumed to suffer from insomnia (Cronbach's alpha = .83).

To assess sleep quantity and sleep-related psychological functioning, we administered a brief questionnaire based on the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). This asks for mean sleep duration (in hours and minutes), sleep onset latency (minutes) and

number of awakenings after sleep onset for the last ten school days. Additionally, participants reported, on eight-point Likert-scales, their tiredness during the day (8 = ***very*** *tired*), concentration during the day (8 = *very good concentration*), and mood at bed time (8 = *very good mood*), as well as mood on waking (8 = *very good mood*), sleep quality (8 = *very good sleep quality*), and feeling of being restored (8 = *completely restored*), using the same Likert scales (Cronbach's alpha = .87).

Daytime sleepiness

To assess daytime sleepiness, participants completed the Epworth Sleepiness Scale (ESS, Johns, 1991). Participants were asked about the likelihood of dozing off or falling asleep in specific situations (sitting and reading, watching TV, sitting inactive in a public place, as a passenger in a car for an hour without a break, lying down to rest in the afternoon, sitting and talking to someone, sitting quietly after a lunch). Answers are given on 4-point Likert scales ranging from 0 (= *no chance of dozing*) to 3 (= *high chance of dozing*), with a higher sum score reflecting a greater likelihood of dozing off **(Cronbach's alpha = .88).**

Statistical analysis

First, mean and sum scores of all dimensions were z-transformed. Next, to calculate the relation between the dimensions of MT and sleep parameters (sleep disturbance, sleep duration, sleep onset latency, awakenings after sleep onset, daytime sleepiness) a series of Pearson's correlations was calculated. Likewise, a series of Pearson's correlations

was computed to assess relations between scores for MT, ~~**optimism, curiosity and explorative behavior,**~~ perceived stress, and depressive symptoms. To calculate **both the direct and indirect relations of MT** on sleep disturbance via ~~**optimism, curiosity and explorative behavior,**~~ perceived stress and depressive symptoms, **a structural equation model (SEM)** was performed, using AMOS®.

To calculate the effects of daytime sleepiness, sleep onset latency, sleep duration and awakenings after sleep onset on sleep disturbance, a multiple regression analysis was performed.

The level of significance was set at alpha = .05. Except for the SEM, all statistical analyses were calculated with SPSS® 19.0 for Windows.

Results

Mental toughness and sleep

Table 1 shows the correlation matrix between the dimensions of mental toughness and the sleep parameters.

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Table 1

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Higher scores for MT were significantly associated with fewer sleep disturbances, decreased daytime sleepiness, shorter sleep onset latency, and fewer awakenings after sleep onset. Moreover, higher scores on MT

were also significantly associated with favorable sleep-related psychological functioning such as increased sleep quality, feeling of being restored and positive mood. No association, however, was observed between MT and sleep duration or tiredness in the evening.

We also note that all subcomponents of MT were statistically significantly associated with the sleep quality, sleep patterns and with sleep-related dimensions such as mood and concentration during the day.

Associations between mental toughness and other areas of psychological functioning

As shown in Table 2, higher scores for MT were associated ~~**with greater optimism, curiosity and exploration behavior, and**~~ with lower scores for depressive symptoms and perceived stress.

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Table 2

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Direct and indirect associations between mental toughness and sleep

To calculate both the direct and indirect associations between MT and sleep, a structural equation model (SEM) was performed.

With respect to the goodness of fit criteria as proposed by Hu and Bentler (1999) and McDonald and Ho (2002) (in [squared brackets]), the model represented a very good fit: χ^2/df=285.25 [<df; here: 6], AGFI=.**97** [≥0.95], PClose=0.**89** [>0.50], CFI=.**981** [>0.90], RMR=0.18 [<0.08] and RMSEA=.**010** [≤0.05].

The statistically significant and ***direct*** association between MT and sleep disturbances was β=-.53 (p<.001).

MT **was also indirectly associated with** sleep disturbances~~; first, with greater MT increasing optimism, curiosity and explorative behavior, which had a favorable influence on stress and depressive symptoms; second,~~ :

First, with greater MT both stress decreased and depressive symptoms decreased; second, both low depressive symptoms and low stress were negatively associated with increased sleep disturbances (Figure 1).

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Figure 1

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Sleep disturbances as a function of other aspects of sleep schedules

Results from the multiple regression analysis showed that sleep disturbances (ISI scores) were predicted (R=.602, R^2=.362) by greater daytime sleepiness (β=.22, p<.01), longer sleep onset latency (β=.35, p<.001), and more awakenings after sleep onset (β=.34, p<.01), but not by sleep duration (β=.05).

Discussion

The key findings of the present study are that, in a sample of adolescents, greater mental toughness (MT) was related to better subjective sleep quality, shorter sleep onset latency, fewer awakenings after sleep onset, and longer sleep duration. **MT was directly and indirectly associated with sleep quality**. The present data add to the literature in an important way in that we were able to show that MT is directly and indirectly related to restoring sleep.

Two hypotheses were formulated and each of these is considered in turn.

With the first hypothesis we anticipated that greater MT would be related to favorable sleep dimensions, and data confirmed this: higher MT was not only associated with better sleep quality, but also with sleep continuity parameters such as shorter sleep onset latency and fewer awakenings after sleep onset. In this respect, the pattern of results is in accord with a wealth of studies indicating an association between restoring sleep and psychological well-being in children and adolescents (cf. Gregory & Sadeh, 2012). Moreover, the present findings mirror previous research in that optimism (Lemola et al., 2012, in press), favorable personality traits (cf. Park, An, Jang, & Chung, 2012), and curiosity (Brand, Gerber, Beck, Hatzinger, Pühse, & Holsboer-Trachsler, 2010) all were positively related to sleep.

With the second hypothesis **we expected that greater MT would be associated directly and indirectly with sleep, and data again confirmed this expectation.** As shown in Figure 1, we note that increased MT was negatively associated with stress and depressive symptoms, two of the main reasons for sleep complaints with psychological causes (Riemann et al., 2010). Indeed, research has established links between MT and hardiness, which has previously been found to be associated with stress resilience, and this observation is in accord with the idea that resilience does not evolve from avoidance of adversity, but from successful dealing with negative stimuli (Masten, 2004). Importantly, stress has been proven to increase the risk for maladjustment and psychopathology during adolescence and early adulthood (Grant et al., 2004). In this respect, we would suggest that MT influences sleep positively via reduced stress (Gerber, et al., 2012, 2013, in press), reduced hyperarousal (Riemann, et al., 2010), reduced dysfunctional thoughts (Carney & Edinger, 2006; Harvey, 2000, 2002) and decreased depressive symptoms. As for the latter, by definition, depressive symptoms include those on emotional (e.g. helplessness), motivational (e.g. withdrawal), cognitive (e.g. dysfunctional thoughts), social (e.g., withdrawal from social contacts), and behavioral levels (e.g., avoidance and disengagement; cf. DSM-IV; **American Psychiatric Association, 2000**) and it is plausible that dysfunctional thoughts and maladaptive behavior are incompatible with the dispositions towards appraisal of high control, challenge, commitment and confidence, that characterize a mentally tough person. Future research might focus on the

relationship between MT on the one hand and physiological parameters such as cortisol secretion under baseline and challenge conditions and objectively assessed sleep on the other.

Despite the clarity of the findings, several considerations warrant against overgeneralization. First, the sample may be biased in that the participants were all recruited only from high schools. Second, with respect to sleep and psychological functioning, family functioning was not assessed even though older adolescents are not unaffected by the family context and family sleep (Kalak, Gerber, Kirov, Mikoteit, Puehse, Holsboer-Trachsler, & Brand, 2012). Third, no thorough psychiatric or medical examination was made; therefore, the pattern of results might be due to further latent, though unassessed variables. Fourth, sleep was assessed only subjectively, though questionnaires remain the gold standard in the assessment of sleep in large samples (cf. Wolfson, Carskadon, Acebo, Seiffer, Fallone, Labyak, et al., 2003). Last, the cross-**sectional study design does not allow any conclusions concerning the direction of influence, and** we are fully aware of the bi-directionality between psychological functioning and sleep; that is, **favorable or poor sleep has an impact on cognitive and emotional processing and behavior, whereas also cognitive and emotional processing and behavior influence sleep** (cf. Haario, et al., 2013).

Conclusions

Among a sample of participants in their late adolescence, greater mental toughness was associated with a broad range of favorable sleep

parameters such as high sleep quality, shortened sleep onset latency and fewer awakenings after sleep onset, along with high optimism, curiosity and lower scores of depressive symptoms and stress. Future long-term studies should help to disentangle the potential mutual influences between psychological functioning and sleep. Moreover, it is highly conceivable that improving adolescents' mental toughness may improve also adolescents' sleep.

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