ARTICLE

An assessment of chronotype and social jetlag among Filipinos

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Abstract—Chronotype is a measure of an individual's timing of sleep and wakefulness. It describes the relationship between an external time and a person's internal biological time. The chronotype has been used to characterize human circadian trait. Differences in chronotypes are believed to be related to genetic variation, location, geographic and cultural factors. Determination of chronotype using quantitative approaches has been done in Europe for more than a decade now through the Munich Chronotype Questionnaire (MCTQ). In this approach, the chronotype is quantified by the midpoint time between the start and end of sleep during free days, corrected for sleep duration on work days. The calculated time classifies whether an individual has an early or late chronotype. In the Philippines, there is no existing data for chronotypes as well as social jetlag – the discrepancy between an individual's internal time and social clock. In this study, we provide a quantitative description of chronotypes and social jetlag among Filipinos. We present preliminary results based on the 895 non-shift worker respondents of the PhilMCTQ, a language variant of the MCTQ for the Philippine population. Using this set of data, we determined the association of chronotype and social jetlag against certain factors, i.e., age, gender, self-assessed exposure to natural light, type of location (whether living in the urban or rural area), travel time to/from work, sleep duration, and body mass index. Observations concerning the relationship of chronotype and gender, age and social jetlag that have been previously reported in other populations are also seen in our data. Increased social jetlag has been observed among people with late chronotypes among our respondents. There were also some differences in chronotypes between genders, age groups, dwelling locations and consumers of stimulants (i.e., beer, liquor and cigarettes). Both Metro City and Non-Metro City residents similarly experience social jetlag. The data show that as commuting time becomes longer, social jetlag slightly increases. Differences in social jetlag have been observed between age groups and certain stimulants (e.g., smoking, coffee drinking) have been shown to be associated with social jetlag. Other factors such as gender, dwelling location, time spent outdoors and body mass index did not show sufficient evidence of association or correlation with social jetlag among the study participants.

Keywords—Filipinos, Philippines, chronotype, social jetlag, sleep duration, chronobiology, circadian system, PhilMCTQ, MCTQ

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INTRODUCTION

Individuals differ in their chronotype or timing of sleep and wakefulness due to variations in the relationship between their external and internal clocks (Roenneberg et al. 2003). In layman's language, differences between individuals concerning their chronotypes is indicated by the social labels "lark" or "owl" - "larks" being those who naturally wake up early in the morning (on average around 4 a.m.), just when the "owls" are just about to fall asleep (Phillips 2009). These differences in human chronotype are attributed to genetic variation (Young and Kay 2001) and location (Roenneberg et al. 2007a) which may as well be affected by geographic and cultural factors. In Europe, chronotype has been shown to have correlations with age and gender (Roenneberg et al. 2007a) and may even represent a biological marker for the end of adolescence (Roenneberg et al. 2004). The chronotype data of German residents suggests that sun time, more than the social time, affects the human biological clock (Roenneberg et al. 2007b). Studies in other countries show that majority of humans are sleep-deprived during the workweek (Roenneberg et al. 2003) and tend to sleep longer during free days. This phenomenon is like a weekly jetlag to individuals – termed as *social jetlag* (Wittmann et al. 2006), meaning the discrepancy between an individual's internal time and the socially enforced work schedule. Correlations of social jetlag with consumption of stimulants (Wittmann et al. 2006) and even with obesity (Roenneberg et al. 2012) have been shown in studies made in Europe. In the Philippines, to our knowledge, there is no existing data for chronotypes yet. There is no study that determines quantitative characteristics of the biological clock of Filipinos, which may vary from other populations.

The Philippines' economic growth in the past ten years has been accompanied by a quick rise in the business process outsourcing (BPO) industry leading to the employment of more shift workers. This opportunity has led to an increased number of individuals who are trying to balance out a number of clocks - their individual biological clock (internal time), solar clock (sun time) and work clock (social time). This situation has also paved way for the Filipinos' search for more information on sleep and biological time in relation to health, well-being and the shift work situation in the Philippines.

Determining the distribution of the Filipino chronotypes and its association with other factors (such as gender, age, etc.) will help a Filipino be aware of his/her individual chronotype and of ways to improve one's sleep/wake behavior, health and productivity. The study of the Filipino chronotype is also an important component in shift work research in the Philippines (Lozano-Kühne et al. 2012). We therefore aim in this study to characterize the Filipino chronotype and determine the prevalence of social jetlag among Filipinos using a language variant of the Munich ChronoType Questionnaire (MCTQ) (Roenneberg et al. 2003) for Filipinos called PhilMCTQ. This paper presents the preliminary results based on the 859 non-shift worker respondents of the PhilMCTQ. We determine the distribution of the respondents' chronotype and social jetlag. We also present the association of these variables against factors such as gender, age, self-assessed exposure to natural light, type of location (whether living in the urban or rural area), travel time to/from work, sleep duration, and body mass index (BMI).

This paper is divided into five major sections: 1) Review of Literature, 2) Methodology, 3) Results, 4) Discussion, and 5) Conclusion and Recommendation. The Results section of this paper is further divided into eight parts: 1) Characteristics of the study participants, 2) Distribution of Filipino chronotypes, 3) Social Jetlag of Filipinos, 4) Sleep Duration, 5) Age, 6) Type of Location: Metro City vs. Non-Metro City, 7) Stimulants, and 8) Body Mass Index.

REVIEW OF LITERATURE

The biological circadian clock is an approximately 24-hour temporal programme endogenous in living systems that persists even in temporal isolation. It controls physiology at many levels, from gene expression to complex functions, including sleep, digestion and performance of daily activity. This internal timing system enables living organisms to anticipate environmental changes and to synchronize with external rhythmic time cues (i.e., zeitgebers) such as occurrence of day and night. We sense our biological clock most vividly when we experience jetlag (Roenneberg et al. 2003). When we travel to another time zone, our internal clock persists and we find our functions not in synchrony with the solar clock of our new location. However, the internal clock eventually synchronizes or entrains with the external time or new time zone.

The circadian clock's response to external stimuli, such as change of location with transmeridian travel or imposition of a shifting work schedule in the case of humans, depend on "clock" genes which are associated with the period length of the circadian rhythm in constant conditions (for references, see Roenneberg et al. 2007a; Young and Kay 2001). Experiments on animals (Pittendrigh and Daan 1976) and humans (Klerman 2001; Wever 1979) show distribution of free running periods (endogenous period or cycle of an internal clock) around species-specific mean. Even under entrained conditions, the individual differences of the circadian clock is affected by the genetic variations (Ebisawa et al. 2001; Hamet and Tremblay 2006; Jones et al. 1999; Katzenberg et al. 1998; Toh et al. 2001). Individuals may respond to the same stimulus differently due to variations in the relationship between external and internal time, called the *phase of entrainment*. These variations in the phase of entrainment between individuals are referred to as different *chronotypes* (Roenneberg et al. 2003), which we may appreciate as the differences in humans' preferred timing of sleep and wakefulness.

In order to understand the difference in human chronotypes, and the complex synchrony of the circadian clock with various external time givers, the group of Roenneberg developed a questionnaire, the Munich ChronoType Questionnaire (MCTQ) (Roenneberg et al. 2003). The MCTQ provides quantitative assessment of an individual's chronotype with great precision. Unlike the "morningness-eveningness" questionnaire (MEQ) (Horne et al. 1976) which used questions that are mostly subjective, relating sleep and activity times to a personal "feeling best rhythm" to the habits of other people (e.g., "I get up later than most people"; Smith et al. 2002), or hypothetical situations (e.g., "Approximately, what time would you get up if you were entirely free to plan your day?"; Terman et al. 2001), the MCTQ asks people simple questions about their sleep and activity times (e.g., when do you go to bed, how long do you need to fall asleep, when do you wake up, etc.) separately for work and free days. This allows for quantitative determination of chronotype that could be of use for genetic or epidemiological analysis. The MCTQ has been validated against the widely used MEQ (Horne et al. 1976), showing high correlations (Zavada et al. 2005). It has also been validated with highly significant correlations by sleep-logs, actimetry, and by correlations to biochemical rhythms such as those of melatonin and cortisol (Roenneberg et al. 2007a).

Studies utilizing the MCTQ have been conducted to quantify chronotype and associate it with various variables such as gender, age, time spent outdoors, alcohol consumption, BMI, etc. In 2003, an initial study based on 500 participants from Germany and Switzerland was made. During this time, the chronotype was described as the mid-sleep on free days (MSF; the half-way point between sleep-onset and sleep-end). Results showed that: a) individual sleep times show large differences between work and free days, except for extreme early types, b) during the workweek, late chronotypes accumulate considerable sleep debt, for which they compensate on free days by lengthening their sleep by several hours, c) for all chronotypes, the amount of time spent outdoors in broad daylight significantly affects the timing of sleep. Increased self-reported light exposure advances sleep (Roenneberg et al. 2003).

By 2004, the MCTQ database comprised of data from approximately 25,000 respondents. Analysis showed relationships of chronotype with age and gender. Chronotype, indicated by the mid-sleep on free days corrected for the sleep-debt accumulated during the workweek (MSFsc, for reference, see Roenneberg et al. 2003, 2007a; Wittmann et al. 2006), was demonstrated to have a relationship with age and gender. The general tendency of females to develop earlier than males seemed to be suggested by the observation from the data that women reach their maximum lateness earlier (19.5y) than men (20.9y). Men continue to be of later chronotype than women until around the age of 50. Age-wise, children usually have early chronotypes and progress to have late chronotypes during development, reaching a maximum in their 'lateness' at around the age of 20. Afterwards, they tend to have earlier chronotypes again as they advance in age (Roenneberg et al., 2004). When the MCTQ database reached N = 55,000, the age and sex-dependency of chronotype still prevailed. A study comparing the sleep-wake-behavior from East to West of Germany suggested that the human circadian clock was predominantly synchronized or entrained by sun time rather than by social time (Roenneberg et al., 2007b). Sleep duration was also shown to have strong dependency on chronotype when analysed separately for work and free days (Roenneberg et al. 2007a).

The significant differences between timing on work and free days led to the introduction of the term "social jetlag", first coined in 2006 by Roenneberg through MCTQ-based studies. Social jetlag was defined as the discrepancy between social and biological time, or between work and free days (Wittmann et al. 2006). Correlation seen between chronotype and smoking, which was seen to be significantly higher in late chronotypes, was attributed as a consequence of social jetlag and not just by chronotype alone (Wittmann et al. 2006). A recent study of the data from 65,000 individuals who completed MCTQ showed that, beyond sleep duration, social jetlag is also associated with increased BMI. This association demonstrated that living "against the clock" might be a factor contributing to the epidemic of obesity (Roenneberg et al. 2012).

The growing database of MCTQ has led to epidemiological research on human circadian clocks based on quantitative measures. Associations of human chronotype with age, gender, and exposure to natural light have validated results previously found through experiments made on animals that focus on differences in temporal behavior due to genetic variations. And now, this genetic variation of the circadian clocks is being challenged all the more by the fast pace of industrialization and technology that allows human activity to proceed irrespective of time differences. The so-called "globalization of work" is keenly experienced in the Philippines where the rising Business Process Outsourcing (BPO) industry poses a need for more shift workers. How does the working time necessary for work in the industry affect the health and well being of Filipinos? This is one of the questions the PhilSHIFT Research Group (an interdisciplinary group in shift work research; http://philshift.upm.edu.ph/) aims to address. One of its efforts is to study chronotype variation among Filipinos using the Philippine MCTQ (PhilMCTQ). The data analyzed in this study come from participants of PhilSHIFT Filipino chronotype and social jetlag survey utilizing PhilMCTQ.

METHODOLOGY

This is a cross-sectional study concerning non-shift working Filipinos in the Philippines from year 2010 to 2012. The data analyzed in this study came from the PhilSHIFT survey of non-shift working Filipinos who answered the Philippine MCTQ (PhilMCTQ). The PhilMCTQ questionnaire is an adaptation of the Munich ChronoType Questionnaire (MCTQ) (Roenneberg et al. 2003), a validated tool that contains simple questions about sleep times during work and free days. The data collection was done from July 2010 to July 2012.

Participants were directly asked in the questionnaire if they have been doing shift work for the past three months. Of the respondents during this period, only non-shift workers with regular work schedule were included in this study. Note that being a housewife or househusband is considered as "work". "Work" in this study is not just formal paid employment. Housewives and house husbands are also included as part of the work force.

Participants were recruited through conferences, seminars, emails, social media and word of mouth. The data collection was done using the PhilMCTQ questionnaire (see Appendix) which was made available online, in stand-alone computers or in print.

A total of 1,157 volunteers from different parts of the Philippines responded to the study questionnaire during the indicated period. However, twenty-six percent of the participants were excluded in the study. These respondents may have not met the inclusion criteria of being a non-shift working Filipino residing in the Philippines, have not provided data for determining chronotype, or did not meet the criteria for valid data during data cleaning. The data was also cleaned for unrealistic information and those who do not work regular weekly schedules were excluded. Respondents who indicated that they use an alarm clock on free days were also excluded from the study due to the reason that chronotype is determined on days that an individual sleep and wake up freely, i.e., no social obligations. A total of 859 valid responses (341 male and 518 female) were included in the study after data cleaning. Among these, some data had been corrected because some respondents had used the a.m./p.m. format for the time input instead of the 24-hour format asked on the questionnaire, pounds (lbs) instead of kilograms (kg) for the unit for weight input and feet/inches instead of meters for the unit for height input.

Operational Definition of Variables

Chronotype reflects a relationship between internal and external time and may be evaluated quantitatively using the MCTQ, a validated questionnaire that includes questions on the time a person wakes up and sleeps during work days and free days. In this study, *chronotype* was determined with the use of PhilMCTQ, a language variant of MCTQ. The chronotype is quantified by calculating the midpoint between sleep onset and sleep end during free days (MSF), corrected for sleep duration on work days. This sleep-corrected mid-sleep on free days (MSFsc) is the predictor of the chronotype. Its unit of measure is in terms of local time (Wittmann, et al. 2006). Individuals with early chronotypes demonstrate a corrected mid-sleep time on free days (MSFsc) equal or earlier than 03:00 a.m.; on the other hand, those with a MSFsc later than 03:00 a.m are late chronotypes.

Related to this, the phenomenon of social jetlag indicates a discrepancy between work and free days or between social and biological time. *Social jetlag*, is measured by the absolute difference (ΔMS) between the time of mid-sleep on workdays (MSW) and mid-sleep on free days (MSF): $\Delta MS = |MSF - MSW|$ (Wittmann et al. 2006).

We investigated the association of chronotype (MSFsc) and social jetlag (ΔMS) with independent variables such as age (biological age in years reported by the participant at the time the questionnaire was answered), gender (either male or female), time spent outdoors (a self-estimated average number of minutes a day spent outdoor without a roof over one's head) and work travel time (the length of time, in minutes, to commute to work and from work). We also looked at the effects of the respondent's type of residence (location) to the temporal behavior of individuals. Here we classified the location as Metro City (urban areas including Metro Manila, Metro Cebu and Metro Davao) or Non-Metro City (other towns not classified under Metro City). For the list of terminologies used in this study and their definition, see Table 1.

PhilMCTQ gathers data on stimulant intake and some body measurements used for health indices. We assessed self-estimated number of stimulants consumed over a period of time. This includes cigarettes, beer, wine, liquor, coffee, tea, softdrinks and also intake of sleep medication. The units of consumption measured per unit of time (i.e., per day, week or month) are as follows: Cigarette (1 unit = 1 stick); Beer (1 unit = 0.33 L); Wine (1 unit = 0.2 L); Liquor/Whisky/Gin (1 unit = 2cl); Coffee (1 unit = 1 cup); Tea (1 unit = 1 cup); Softdrinks (1 unit = 1 can); Sleep medications (1 unit = 1 pill or drops, etc.). In the analysis, the units of consumption of stimulants were standardized per month.

Since the PhilMCTQ asked for height and weight, we could derive the Body Mass Index (BMI) which is used to measure obesity. The BMI is defined as weight in kilogram divided by the square of the height in meters. Based on World Health Organization's suggested BMI values for Asians, obesity is defined as follows: less than 18.5 kg/m^2 (underweight); 18.5 to 23 kg/m^2 (normal or optimum); more than 23 kg/m^2 to 27.5 kg/m^2 (overweight); and more than 27.5 kg/m^2 (obese) (WHO Expert Consultation 2004).

Data Processing and Analysis

All responses to the PhilMCTQ questionnaire were stored online in the Worldwide Experimental Platform (WEP) database. Data for the study period was validated according to the inclusion criteria of the study, and were checked and analyzed using Microsoft Excel and R Software (version 3.0.2). Variables such as the body mass index, chronotype and social jetlag were derived from the raw data according to the definitions above. Frequencies, percentages, means and standard deviations were calculated to describe the study variables. Chi-Square test of association, t-test, analysis of variance and correlation tests were applied where appropriate. The significance level was set to alpha (α) = 0.05 and Tukey's method was used for cases with multiple comparison. Kernel density plots were constructed to graphically compare distributions.

TABLE 1. List of terminologies and definition.

Term	Definition
MSW	Mid-sleep on work days measured by the midpoint between sleep onset and sleep end during work days. (unit: local time)
MSF	Mid-sleep on free days measured by the midpoint between sleep onset and sleep end during work days. (unit: local time)
MSFsc	Sleep-corrected mid-sleep on free days measured by the midpoint between sleep onset and sleep end during free days, corrected for sleep duration on work days. (unit: local time)
Chronotype	Individual relationship between internal and external time measured by the MSFsc. (unit: local time)
Social Jetlag	Discrepancy between work and free days measured by the absolute difference (ΔMS) between the time of mid-sleep on workdays (MSW) and mid-sleep on free days (MSF): $\Delta MS = \|MSF - MSW\|$ (Wittmann et al., 2006). (unit: hours)
SDw	Sleep duration on work days. (unit: hours)
SDf	Sleep duration on free days. (unit: hours)
SDweek	Sleep duration average over the week, for both work and free days. (unit: hours)
BMI	Body mass index measured by weight in kilogram divided by the square of the height in meters. (unit: kg/m^2)
Time Spent Outdoors on work days	Self-estimated average number of minutes a day spent outdoor without a roof over one's head during work days. (unit: minutes)
Time Spent Outdoors on free days	Self-estimated average number of minutes a day spent outdoor without a roof over one's head during free days. (unit: minutes)
Work travel time	Length of time, in minutes, to commute to work and from work. (unit: minutes)
Type of Location	Respondent's type of residence (location) classified as Metro City (Metro Manila, Metro Cebu, and Metro Davao) or Non-Metro City (other towns not classified under Metro City).

RESULTS

Characteristics of the study participants

On the average, the study participants are 23 years old (SD = ± 7.7 years). The youngest respondent is 15 years old and the oldest is 70 years old (Figure 1). Of the 859 respondents, 518 (60%) are females, while 341 (40%) are males. There is no significant difference in the average age of males and females. Both gender groups have an average age of 22.9 years old.

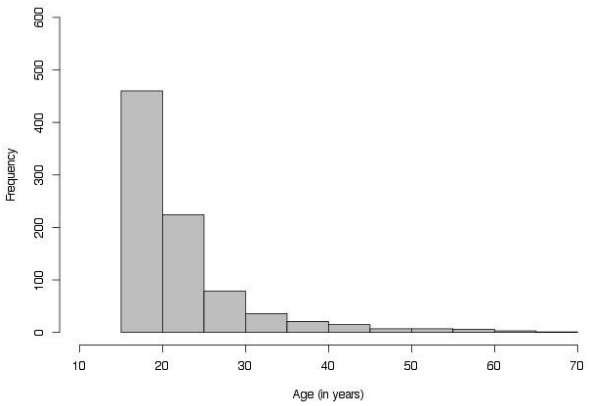

Figure 1. Distribution of participants by age (in years), n=859.

Majority of participants are from the Luzon island (95.3%), probably due to the reason that participants from the Visayas and Mindanao islands got to know about the study only mainly through emails. By region, most of the participants are from the National Capital Region (NCR, 41.9%), followed by Region IVA (CALABARZON, 26.2%) and Region III (Central Luzon, 11.3%). Participants were further classified whether they come from a metro city area (i.e., Metro Manila, Metro Cebu or Metro Davao), or not. There are more non-metro city dwellers, 489 respondents (56.9%), than city dwellers, 370 respondents (43.1%), among the participants.

Table 2 and 3 show the travel time to and from work, and time spent outdoors of the study participants. Three participants are excluded from the analyses that involve the variable travel time to and from work because they reportedly need more than 3 hours to go to work or go back home. They probably travel once a week or a month and stay at the work place the whole time until they go back home again. The mean travel time going to work, excluding the 3 outliers from the analysis, is 39 minutes, and the mean travel time back to home is 41 minutes. The

self-reported time the participants spend outdoors, on average, is 130 minutes on work days and 128 minutes on free days.

TABLE 2. Travel time to and from work.

Travel Time	Mean travel time (in minutes)	Standard Deviation	Minimum	Maximum
To Work	40	40	0	480
From Work	42	41	0	480
Without the outliers				
To Work	39	33	0	180
From Work	41	36	0	180

TABLE 3. Time spent outdoors.

Outdoors during	Mean time spent outdoors (in minutes)	Standard Deviation	Minimum	Maximum
Work days	130	161	0	1080
Free days	128	159	0	1260

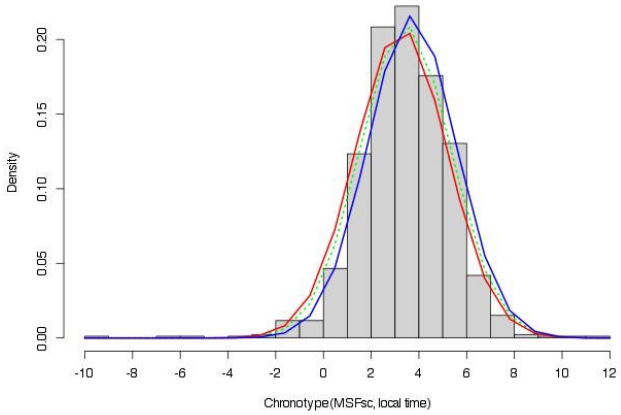

Figure 2. Distribution of chronotype for all participants (fitted green curve), male participants (fitted blue curve), and female participants (fitted red curve).

TABLE 4. Distribution of participants by chronotype.

Chronotype (local time)	No. of Respondents	Percent (%)
10:00 p.m. and earlier	6	0.7
10:01 p.m. to 11:00 p.m.	10	1.2
11:01 p.m. to 12:00 a.m.	10	1.2
12:01 a.m. to 01:00 a.m.	39	4.5
01:01 a.m. to 02:00 a.m.	107	12.5
02:01 a.m. to 03:00 a.m.	179	20.8
03:01 a.m. to 04:00 a.m.	190	22.1
04:01 a.m. to 05:00 a.m.	152	17.7
05:01 a.m. to 06:00 a.m.	112	13.0
06:01 a.m. to 07:00 a.m.	36	4.2
07:01 a.m. to 08:00 a.m.	13	1.5
08:01 a.m. and later	5	0.6
TOTAL	**859**	

Distribution of Filipino chronotypes

The histogram (with fitted green curve) in Figure 2 shows the distribution of chronotype among all the participants. The chronotype value (MSFsc, in local time) is on the x-axis wherein 0 corresponds to midnight, -1 is the 11 p.m. before midnight, and 1 is the 1 a.m. right after midnight. The mean MSFsc for all participants is 03:26 a.m. (SD=1 hour and 54 minutes). The blue curve, which is the fitted distribution for the males, is slightly shifted to the right (towards later chronotypes) compared to the red curve for the females. The mean chronotype for males is 3:42 a.m., 23 minutes later than the mean chronotype for females, 3:19 a.m. This shows significant difference on chronotype between genders ($p = <0.0001$). Table 4 shows the distribution of participants by chronotype. 59.1% of the participants belong to the late chronotype (i.e., with MSFsc after 3:00 a.m.). The most common chronotype (22.1% of all participants) when using one-hour-bins of MSFsc times falls within the range "3:01 a.m. to 4:00 a.m.". 60.6% of the participants have chronotypes within the range "2:01 a.m. to 5:00 a.m.".

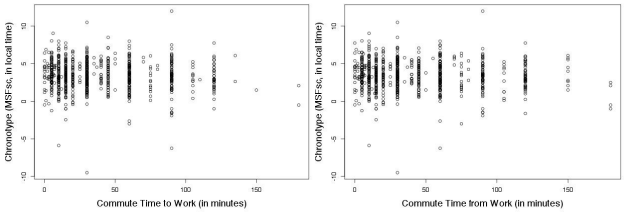

Figure 3. Chronotype and Time to Commute to and from Work.

Analyzing for correlations between the chronotype and previously discussed variables, the scatter plot graphs on Figure 3 do not show any correlation between chronotype and commuting times (r=-0.06 for travelling to work, and r=-0.05 for travelling from work). The correlation of chronotype and time spent outdoors for both work days and free days (Figure 4) also do not show any noticeable linear upward or downward trend (r=0.06 for work days, and r=-0.03 for free days).

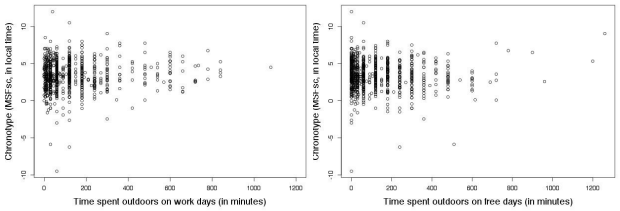

Figure 4. Chronotype and time spent outdoors of participants on workdays and free days.

Social Jetlag of Filipinos

In this set of survey participants, the average number of hours of social jetlag is 1 hour and 46 minutes (SD=±1 hour 16 minutes). Figure 5 shows the distribution of the hours of social jetlag with fitted distribution of the males (blue curve) and females (red curve). Between genders, there is no significant difference in the social jetlag. On the average, females have a social jetlag of 1 hour and 47 minutes while males have 1 hour and 44 minutes.

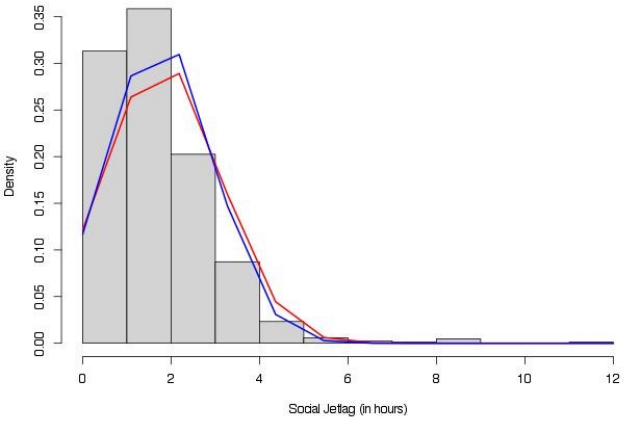

Figure 5. Distribution of all participants by social jetlag with fitted distribution of the male (blue curve) and female (red curve) participants.

In the correlation of social jetlag and commuting times (to and from work, Figure 6), a weak positive correlation (r=0.14 for both graphs; $p < 0.5$) was observed. As commuting time becomes longer, social jetlag slightly increases. This is however not visually obvious in Figure 6.

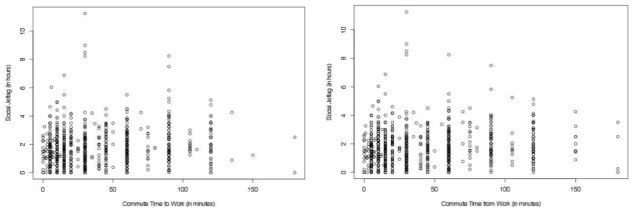

Figure 6. Social jetlag with time to commute to work and from work.

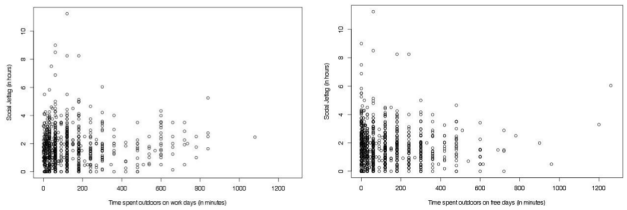

Figure 7. Social jetlag and time spent outdoors of participants on work days and free days.

In Figure 7, we see randomly scattered points in the graph of social jetlag with the time (duration) spent outdoors of respondents both on work days and on free days. The computed *Pearson r coefficient* values are 0.05 and -0.01 respectively. Statistical tests show no significant correlation between social jetlag and time spent outdoors.

Figure 8 shows the boxplot of social jetlag by chronotype. The boxplot represents the averages for every hour of chronotype (MSFsc). Except for the chronotypes earlier than 12 midnight (0 value on the x-axis), an increasing trend is observed for social jetlag - the later the chronotype, the higher is the observed value of social jetlag.

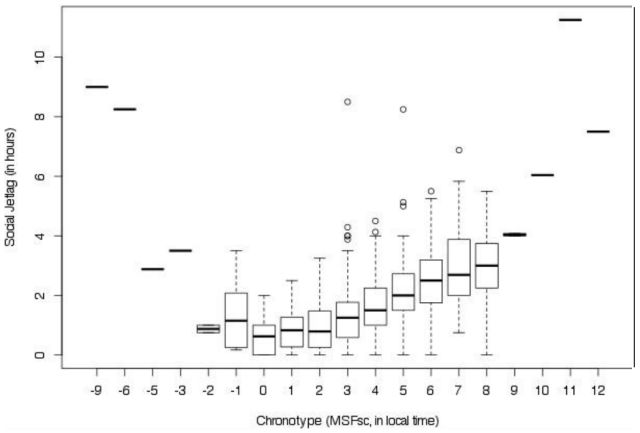

Figure 8. Mean social jetlag grouped by chronotype (MSFsc) of 1-hour bins.

Sleep Duration

The average sleep duration on work days of the respondents is 6 hours and 17 minutes. This is shorter by 1 hour and 59 minutes than the average sleep duration on free days, which is 8 hours and 16 minutes. The participants sleep longer during free days, as seen on Figure 9, where the distribution of sleep duration on free days is shifted to the right compared to the distribution of sleep duration on work days. The average sleep duration for the whole week, including both work and free days, is 6 hours and 49 minutes for both male and female groups. There is no difference between genders.

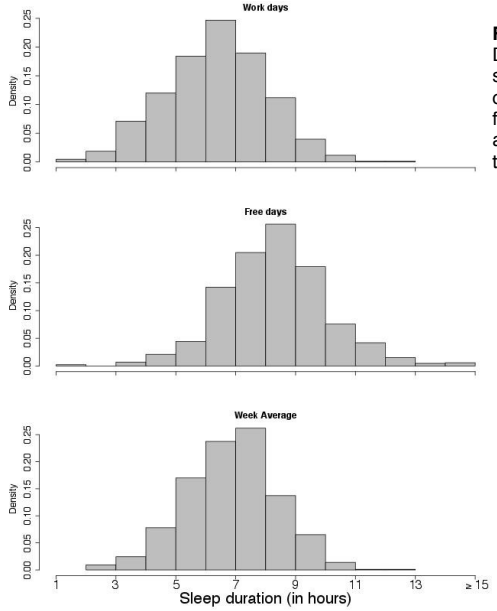

Figure 9. Distribution of sleep duration on work days, free days, and averaged for the week.

Age

Across age groups, there is a trend of decreasing social jetlag (see Figure 10). The average social jetlag for the age groups 15 to 34 is higher than the rest of the age groups. However, this was not shown to be significant after adjustment for multiple testing.

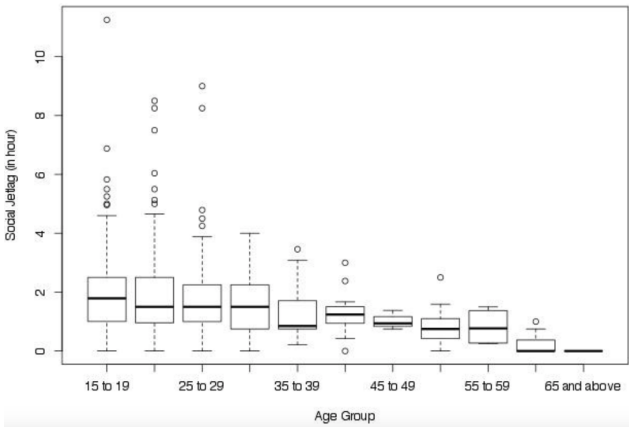

Figure 10. Mean social jetlag grouped by age of five years.

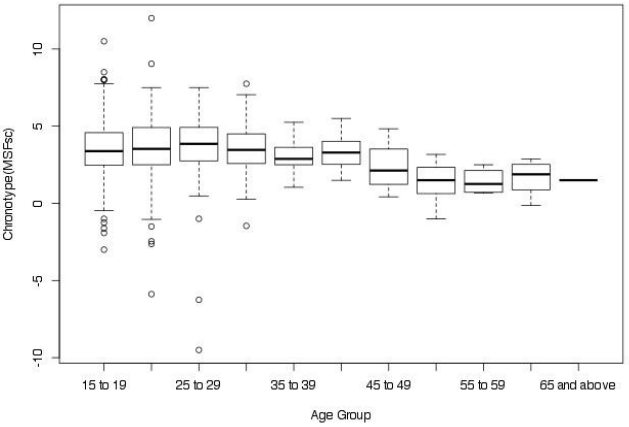

Figure 11. Mean chronotype grouped by age of five years.

Figure 11 shows the chronotype data by age, averaged over groups of five years. Earlier chronotypes are noted in the older age groups. Comparison of mean chronotype data across age groups show that there is significant difference between the age groups "15 to 19 years old" (mean MSFsc = 3:27 a.m.) and "50 to 54 years old" (mean MSFsc = 1:21 a.m.), age groups "20 to 24 years old" (mean MSFsc = 3:34am) and "50 to 54", and age groups "25 to 29" (mean MSFsc = 3:34am) and "50 to 54 years old" ($p<0.05$).

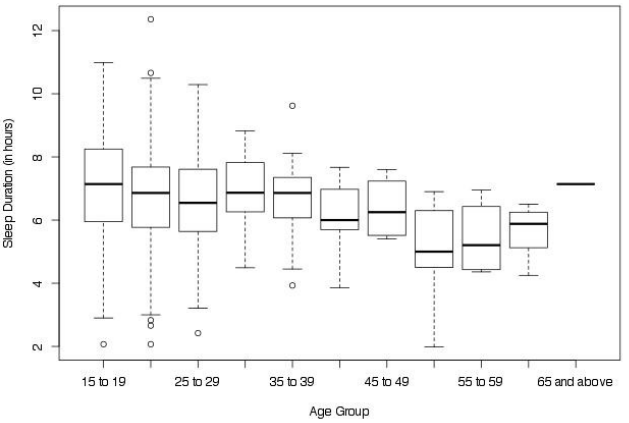

Figure 12. Sleep duration averaged over the week grouped by age of five years.

There is also a trend of decreasing sleep duration by age group (see Figure 12), except for the age group "65 and above" for which there had only been a single participant. Younger age groups have longer sleep duration than the older groups.

Type of Location: Metro City vs. Non-Metro City

Groupings by type of location, i.e., Metro City and Non-Metro City, show significant differences on several study variables. Table 5 shows the mean values for each study variable. 370 of the 859 participants (43.1%) reside either in Metro Manila, Metro Cebu, or Metro Davao (Metro City). The mean age of the Metro City group is 25, while the mean age for the Non-Metro City is 21. The Metro City dwellers have later chronotypes and shorter sleep duration both for work and free days. On the average, the chronotype of the participants from the Metro City is 3:43 a.m., which is 29 minutes later than the Non-Metro City group. The participants from the Metro City sleeps about 5 hours and 51 minutes during work days, and almost 2 hours longer on free days (7 hours and 57 minutes). Their average sleep in a week is 6 hours and 24 minutes. The participants who reside in a Non-Metro City location, on average, have significantly longer sleep. During work days, they sleep for 6 hours and 36 minutes; 8 hours and 30 minutes on free days, and 7 hours and 7 minutes for the week average. Thus, the Metro City residents have less sleep (about 43 minutes a day) than the Non-Metro City residents. In addition to shorter sleep duration, residents in the Metro City also apparently experience longer travel time to their workplace. The mean total travel time to and from work in the Metro City is 95 minutes, 23 minutes longer than the mean travel time of 72 minutes in the Non-Metro City.

TABLE 5. Mean (±SD) values by type of location, i.e., Metro City and Non-Metro City.

	Metro City	Non-Metro City	p-value
Number	370	489	
%	43.1%	56.9%	
Age (in years)	25 (±9)	21 (±6)	<0.001
MSW (in local time)	03:11 (±1:17)	02:41 (±1:16)	<0.001
MSF (in local time)	04:49 (±1:51)	04:10 (±2:06)	<0.001
Chronotype (MSFsc, in local time)	03:43 (±1:55)	03:14 (±1:52)	<0.001
Sleep Duration on work days (in hrs, mins)	5h 51m (±1h 34m)	6h 36m (±1h 45m)	<0.001
Sleep Duration on free days (in hrs, mins)	7h 57m (±1h 55m)	8h 30m (±1h 48m)	<0.001
Sleep Duration week average (in hrs, mins)	6h 24m (±1h 25m)	7h 7m (±1h 34m)	<0.001
Social Jetlag (in hrs, mins)	1h 50m (±1h 16m)	1h 43m (±1h 17m)	NS
Time Spent Outdoors on work days (in minutes)	142 (±173)	122 (±150)	NS
Time Spent Outdoors on free days (in minutes	124 (±137)	131 (±174)	NS
Work travel time (in minutes)	95 (±72)	72 (±79)	<0.001

Analysis shows no significant difference between the Metro City and Non-Metro City residents in terms of social jetlag. The participants from the Metro City have social jetlag of 1 hour and 50 minutes, while the participants from Non-Metro City have slightly less, at 1 hour and 43 minutes. The self-reported duration spent outdoors, recorded separately for work and free days, also do not show significant difference. During work days, Metro City residents stay outdoors slightly longer than the Non-Metro City residents. Metro City residents spend 142 minutes outdoors on average, while the Non-Metro City residents spend 122 minutes. During free days, the Non-Metro City residents stay outdoors longer (131 minutes) than the Metro City residents (124 minutes).

Stimulants

The self-estimated number of stimulants consumed over a period of time inquired by PhilMCTQ concerned cigarettes, beer, wine, liquor, coffee, tea, softdrinks and also intake of sleep medication. Table 6 shows the number of consumers for each type of stimulant who reside in the Metro City and Non-Metro City locations, however the total number of responses may vary between each category since some participants did not answer all the questions. Among the stimulants listed on the questionnaire, tea is the only type of stimulant that shows significant difference between the two types of location. When grouped by gender, bivariate analysis shows significant differences for those who consume cigarettes, beer, liquor, coffee, and tea. Table 7 shows a summary of the number of consumers of stimulants by gender.

TABLE 6. Consumption of stimulants by type of location.

	Number of respondents (n)	Metro City	Non-Metro City	Total
Smoker	848	41 (11%)	53 (11%)	94 (11%)
Drinks				
Beer	847	108 (30%)	144 (30%)	252 (30%)
Wine	846	69 (19%)	85 (18%)	154 (18%)
Liquor	845	70 (19%)	129 (27%)	199 (24%)
Coffee	841	264 (73%)	337 (70%)	601 (71%)
Tea**	841	94 (26%)	64 (13%)	158 (19%)
Softdrink	841	292 (80%)	398 (83%)	690 (82%)
Takes sleep medications	840	5 (1.4%)	9 (1.9%)	14 (1.7%)

** significantly correlated with type of location (p<0.01)

TABLE 7. Consumption of Stimulants by Gender

	Number of respondents (n)	Male	Female	Total
Smoker**	848	57 (17%)	37 (7%)	94 (11%)
Drinks				
Beer**	847	136 (41%)	116 (23%)	252 (30%)
Wine	846	67 (20%)	87 (17%)	154 (18%)
Liquor**	845	97 (29%)	102 (20%)	199 (24%)
Coffee**	841	217 (66%)	384 (75%)	601 (71%)
Tea**	841	47 (14%)	111 (22%)	158 (19%)
Softdrink	841	267 (81%)	423 (83%)	690 (82%)
Takes sleep medications	840	3 (0.9%)	11 (2.2%)	14 (1.7%)

** significantly correlated with gender (p<0.01)

TABLE 8. Mean chronotype per stimulant.

	Mean Chronotype (MSFsc, local time)		p-value
	No	Yes	
Smoker?	3:21 (±1:49)	4:07 (±2:22)	<0.01
Drinks...			
Beer?	3:16 (±1:51)	3:50 (±1:58)	<0.001
Wine?	3:23 (±1:50)	3:42 (±2:11)	NS
Liquor?	3:20 (±1:52)	3:46 (±2:00)	<0.01
Coffee?	3:28 (±1:54)	3:25 (±1:54)	NS
Tea?	3:23 (±1:51)	3:38 (±2:09)	NS
Softdrinks?	3:12 (±1:49)	3:29 (±1:55)	NS
Takes sleep Medications?	3:26 (±1:53)	3:32 (±3:02)	NS

TABLE 9. Mean social jetlag per stimulant

	Mean Social Jetlag (hours)		p-value
	No	Yes	
Smoker?	1.70 (±1.25)	2.28 (±1.36)	<0.001
Drinks...			
Beer?	1.73 (±1:31)	1.85 (±1.18)	NS
Wine?	1.74 (±1.20)	1.87 (±1.55)	NS
Liquor?	1.72 (±1.26)	1.91 (±1.31)	NS
Coffee?	1.92 (±1.33)	1.71 (±1.25)	0.04
Tea?	1.76 (±1.26)	1.80 (±1.32)	NS
Softdrinks?	1.77 (±1.34)	1.77 (±1.26)	NS
Takes sleep Medications?	1.76 (±1.26)	2.12 (±2.08)	NS

Table 8 shows the mean chronotypes of the stimulant consumers (Yes) and non-consumer (No), and Table 9 shows the mean social jetlag. In general, the respondents who consume stimulants have later chronotypes and more social jetlag than those who do not consume stimulants. The respondents who smoke, and drink beer and liquor have significantly later chronotypes. Bivariate analysis (see Table 9) of social jetlag and stimulants showed significant relationship of social jetlag with smoking habit ($p < 0.001$) and drinking coffee (0.04). Smokers have more social jetlag than non-smokers, while coffee drinkers have less social jetlag than non-coffee drinkers.

Body Mass Index

We also looked into the statistical relationship of the body mass index (BMI) with our study variables. In the analyses that concerned BMI, we included the respondents that have BMI values from 12 to 65.5 (N=854). The mean BMI of the participants is 22.1 (±5.8) - a value considered normal according to the World Health Organization's recommended cut-off for Asians. Twelve-percent (12%) of the participants are categorized as obese (BMI > 27.5) and 22% are underweight (BMI <18.5). Figure 13 and Table 10 show the distribution of the participants according to their BMI.

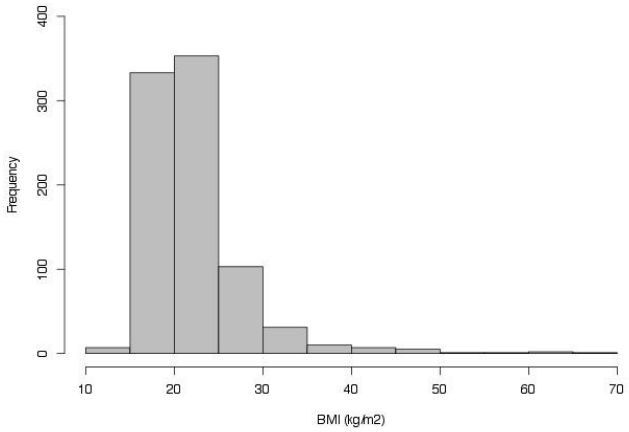

Figure 13. Histogram of Body Mass Index.

TABLE 10. Classification of participants according to BMI

	BMI range	n	%
Underweight	< 18.5	188	22%
Normal	18.5 to 23	412	48%
Overweight	>23 to 27.5	153	18%
Obese	>27.5	101	12%

The average BMI of female participants is 21.7, while for male participants is 22.7. The mean BMI of male participants is significantly higher (p=0.01267) than the female participants. Comparing participants from the Metro City and Non-Metro City, the Metro City dwellers are slightly overweight (mean BMI = 23.7) compared to the Non-Metro City dwellers (mean BMI = 21.0). The difference in BMI between the two groups is also statistically significant ($p<0.001$).

Comparing chronotype and social jetlag across BMI categories, the statistical test did not show significant difference (see Figures 14 and 15). However, for the average sleep duration in a week, statistical analysis showed that the underweight respondents have significantly longer sleep duration than the normal, overweight and obese groups (see Figure 16).

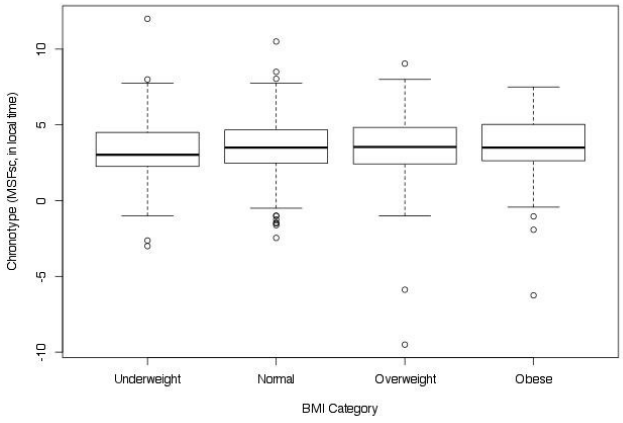

Figure 14. Mean chronotype by BMI category.

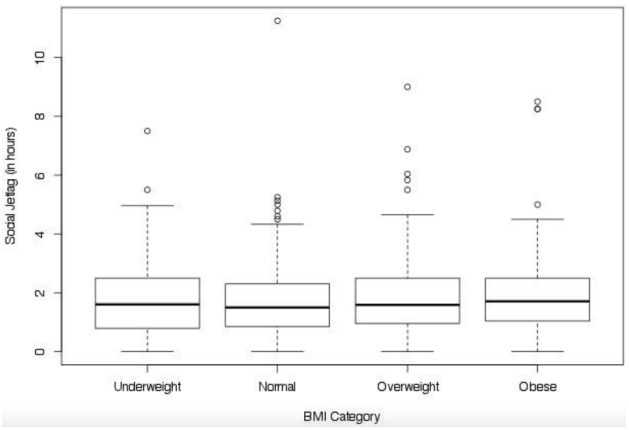

Figure 15. Mean social jetlag by BMI category.

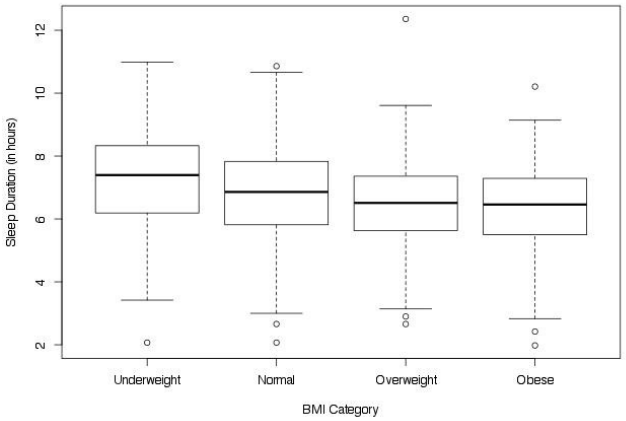

Figure 16. Mean sleep duration by BMI category.

DISCUSSION

This study shows that chronotype is related to gender and age. On the average, males have later chronotypes than females, and the earlier chronotypes are noted in the older age groups. This is consistent with the result presented in Roenneberg et al. (2004) which shows that males tend to have later chronotypes than the females starting from the age of adolescence until the age of 50. Roenneberg et al. (2004), had also shown that children are of early chronotypes. They become late chronotypes around the teenage years and then become early chronotypes again around the age of 50. The youngest participant in our dataset is 15 years old. Though we noticed similar pattern of chronotypes in other studies with respect to age, our research focused on non-shift workers and therefore cannot compare results with international studies on subjects of very young age.

The mean chronotype of our participants is 03:26 a.m. This is 48 minutes earlier than the average chronotype of MCTQ respondents from Germany, Switzerland, the Netherlands and Austria shown in Roenneberg et al. (2007a). We have also noted a difference with the sleep duration of the respondents from the Philippines and the European residents. On work days, the Philippine residents have approximately 1 hour shorter sleep duration than the European residents in the study of Roenneberg et al. (2007a). In terms of commuting time, our data shows that as commuting time to/from work (or school) becomes longer, social jetlag slightly increases. Most likely, the commuting time is one of the reasons why our participants have shorter sleep duration on work days. Allotting more time for commuting leads to increased social jetlag.

Participants who are Metro City residents have later chronotypes (29 minutes later) and shorter sleep duration (43 minutes shorter) than the Non-Metro City residents. One factor that probably affects this phenomenon is the time it takes an individual to travel to and from work. On average, the Metro City residents commute to and from work 23 minutes longer. They consume more time to commute because of traffic congestion. This possibly reduces the time in a day left for their sleep. Despite the significant differences between the chronotype, sleep duration, and commuting time to/from work between the two types of locations, the analysis shows no significant difference between the mean social jetlag. In general, the Metro City residents cope with these conditions (later chronotype, shorter sleep duration, and longer commute time) both on work and free days, showing almost the same amount of social jetlag with the Non-Metro City residents.

The analysis on self-reported duration spent outdoors recorded separately for work days and free days do not show significant correlation with chronotype and social jetlag. When grouped by type of location, time spent outdoors also does not

show any significant difference between locations. However, we have observed that during work days, the Metro City residents stay outdoors slightly longer than the Non-Metro City residents. In contrast, during free days the Metro City residents stay outdoors shorter. Metro City residents stay outdoors longer during work days probably because of the longer commute time. The public transport system in the Philippines is not that efficient in many areas. Commuting would entail waiting along the street for jeepney, tricycle, bus, or cab for no one knows how long. The considerable amount of time and energy exerted by Metro City residents during work days is a huge factor in forcing Filipinos to stay at home on weekends. Also, for many Filipinos in the Metro City area, a popular family bonding activity on free days is going to the malls (indoor shopping centers). There are only a few open parks in the Metro City where people can have peaceful quality time with their families compared to cities in Europe. It appears that social time, the effects of living in the Metro City, is a dominant entraining factor in the Philippines, more than the sun time. The self-reported time spent outdoors of the participants is not correlated with chronotype, nor with social jetlag. Filipinos spend more time outdoors during work days than on free days and prefer to rest at home or go to the malls on their free days.

With respect to the consumption of stimulants, the differences observed are more between genders rather than between locations. Metro City dwellers and Non-Metro City dwellers are similar in habits, except for drinking tea which is observed more in the city. Differences in stimulant consumption are seen between gender groups. In addition to drinking tea, drinking coffee, wine, beer, liquor and smoking differ between males and females. Participants who consume stimulants have later chronotypes, especially those who drink beer and liquor and smoke. One would therefore expect to see more late chronotypes among the male group. They are also expected to experience more social jetlag because of their stimulant consumption. However, our data did not show significant differences in social jetlag between genders.

CONCLUSION AND RECOMMENDATION

This initial study on chronotype and social jetlag among non-shift working Filipinos hopes to understand the workings of the Filipino biological clock. The observed mean chronotype (MSFsc) of 3:26 a.m. falls under the category of late chronotypes. This means that majority of non-shift working Filipinos who are not sleep-deprived would go to bed on free days before midnight and wake up voluntarily before 8:00 o'clock. Compared to central Europe with chronotype around 4:00 a.m., the observed chonotype among Filipinos is earlier. However, compared to India with an MSFsc centered around 3:00 a.m., the chronotype of non-shift working Filipinos is relatively "late" (Roenneberg 2012). The results of this study show significant differences in chronotypes between genders, age groups, dwelling locations and consumers of stimulants (i.e., beer, liquor and cigarettes) among Filipinos. Males have later chronotypes compared to females. Younger workers have been observed to also have later chronotypes than older workers. Metro City dwellers (Metro Manila, Metro Cebu, and Metro Davao) have later chronotypes, shorter sleep duration, and longer commuting time to and from work than those who reside in Non-Metro City locations.

Filipino non-shift workers experience social jetlag, measured to be an average of 1 hour and 46 minutes discrepancy in their time of mid-sleep between work days and free days. As commuting time becomes longer, social jetlag slightly increases. Both the Metro City and Non-Metro City residents similarly experience social jetlag. This shows how the Metro City residents are coping with their situation both on work days and free days compared to the Non-Metro City residents. They are sleep-deprived and are getting used to it. How this affects the health of Metro City residents is an interesting question that can be explored in future studies.

Differences in social jetlag have been also observed between age groups. Similar with chronotype, smoking has been shown to be significantly associated with increased social jetlag. On the other hand, coffee drinkers have lesser social jetlag than non-coffee drinkers. Other factors such as gender, dwelling location, time spent outdoors and body mass index did not show sufficient evidence of association or correlation with social jetlag.

This preliminary study is based on the initial set of the PhilMCTQ data on non-shift working Filipinos. The results observed among the participants might be different from the general Filipino population. The PhilSHIFT Research Group recognizes the fact that though efforts have been exerted to reach out to all non-shift workers in the Philippines, the study participants during the period of study are mostly those who could access the online questionnaire and might differ in characteristics than the targeted population. In addition, confounding effects have not been explored in the study to be able to draw strong conclusions on the relationship of stimuli and other factors with chronotype and social jetlag. Non-significant statistical tests in some correlation analyses in this preliminary study may not be due to absence of correlation at all, but may be due to lack of power to detect the relationship with the given dataset. It would also be interesting to further explore the differences between Metro City and non-Metro City dwellers. PhilSHIFT is currently conducting further data collection to include a larger number of study participants and to also characterize the biological clock of Filipino shift-workers using additional data collection strategies (e.g., field interviews). Future studies will also explore a wider range of age distribution and other variables that could possibly affect chronotype and social jetlag and help improve sleep/wake behavior, health and productivity of the Philippine population. A further direction would also be to compare observations about the chronotype and these factors between non-shift working Filipinos and shift working Filipinos. The shift working population in the Philippines is increasing with the addition of new industries such as business process outsourcing. The observations from non-shift workers may be considered a baseline or reference when looking at the supposed effects of shift work on internal timing and health.

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CONFLICTS OF INTEREST

All authors declare no conflict of interest.

CONTRIBUTIONS OF INDIVIDUAL AUTHORS

RSG, GFM, RBC, JPLK and ERM contributed to the planning, content and revision of the paper. RSG and JPLK contributed to the analysis of the PhilMCTQ data. RSG, JPLK and GFM wrote the paper.

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Appendix. The Philippine Munich Chronotype Questionnaire (PhilMCTQ)

Personal Data

Date: (date and time)

Name:

Email:

Age:

Gender:

Female Male

Height: cm

Weight: kg

Country:

City:

Postal Code:

To find out more about the geographic, cultural and genetic influences on chronotype, we would appreciate your answers to the following two questions. If you feel they are too personal, just choose "I cannot answer this question." from among the options; but our studies would really benefit from this information.

In what country have you spent most of your childhood?

What is your ethnic background?

Personal Data(en) ©2008 Till Roenneberg, & Martha Merrow, LMU Munich

Work Details

In the last three months, I worked as a shift worker.

No Yes (please continue with "My work schedules are...").

My usual work schedule ...

... starts at : o'clock.

... ends at : o'clock.

My work schedules are ...

very flexible a little flexible rather inflexible very inflexible

I travel to work ...

within an enclosed vehicle (e.g. car, bus, underground).

not within an enclosed vehicle (e.g. on foot, by bike).

I work at home.

For the commute to work I need h min .

For the commute from work I need h min .

Work(en) ©2008 Till Roenneberg, & Martha Merrow, LMU Munich

Work Days

Please use 24-hour time scale (e.g. 23:00 instead of 11:00 pm)!

I go to bed at : o'clock.

Note that some people stay awake for some time when in bed!

I actually get ready to fall asleep at : o'clock.

I need minutes to fall asleep.

I wake up at : o'clock.

with an alarm clock

without an alarm clock

After minutes, I get up.

Chronotype(en)©2008 Till Roenneberg, & Martha Merrow, LMU Munich

Free Days

I go to bed at : o'clock.

Note that some people stay awake for some time when in bed!

I actually get ready to fall asleep at : o'clock.

I need minutes to fall asleep.

continued on the next page

continuation of Appendix

I wake up at : o'clock.

with an alarm clock

without an alarm clock

After minutes, I get up.

Comment Field: Please leave a comment if you currently have NO possibility of freely choosing your sleep times
(e.g. because of pet(s), child(ren) etc.). Use this field also to provide additional information, if the system asks for it:

Chronotype(en)©2008 Till Roenneberg, & Martha Merrow, LMU Munich

Time Spent Outdoors

On average, I spend the following amount of time outdoors in daylight (without a roof above my head):

on workdays h min

on free days h min

Outdoors(en) ©2008 Till Roenneberg, & Martha Merrow, LMU Munich

Stimulants

Please give approximate/average amounts! Make sure you change the default choice from "per day" to another alternative, if you, for example, drink only one glass of wine per week!

I smoke cigarettes per ...

day week month

I drink glasses of beer (0.33 l) per ...

day week month

I drink glasses of wine (0.2 l) per ...

day week month

I drink glasses of liquor/whiskey/gin (2 cl) etc. per ...

day week month

I drink cups of coffee per ...

day week month

I drink cups of black tea per ...

day week month

I drink cans of caffeinated drinks (soft-drinks) per ...

day week month

I take portions of sleep medication (pills, drops, etc.) per ...

day week month

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Project Finalisation

Dear Participant,

Thank you for completing our questionnaire and for helping us understand the biological clock in real life!

You will soon receive a message to your e-mail address, with a PDF file attached containing a personal evaluation of your chronotype. To open PDF files you need Acrobat Reader.

If our response email does not contain a PDF file, the transmission is most likely being blocked by your server. In the case of transmission problems, you can contact us under the following address: mesdruiz@post.upm.edu.ph