**S1 File**

**Light Exposure Behaviour Assessment (LEBA): Long Form**

**Participant’s Instruction**

Please indicate how often you performed the following behaviours in the **past four weeks.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Items** | Never | Rarely | Sometimes | Often | Always |
| 01 | I wear blue-ﬁltering, orange-tinted, and/or red-tinted glasses indoors during the day. |  |  |  |  |  |
| 02 | I wear blue-ﬁltering, orange-tinted, and/or red-tinted glasses outdoors during the day. |  |  |  |  |  |
| 03 | I wear blue-ﬁltering, orange-tinted, and/or red-tinted glasses within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 04 | I spend 30 minutes or less per day (in total) outside. *(Reverse-scored)* |  |  |  |  |  |
| 05 | I spend between 30 minutes and 1 hour per day (in total) outside. |  |  |  |  |  |
| 06 | I spend between 1 and 3 hours per day (in total) outside. |  |  |  |  |  |
| 07 | I spend more than 3 hours per day (in total) outside. |  |  |  |  |  |
| 08 | I spend as much time outside as possible. |  |  |  |  |  |
| 09 | I go for a walk or exercise outside within 2 hours after waking up. |  |  |  |  |  |
| 10 | I use my mobile phone within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 11 | I look at my mobile phone screen immediately after waking up. |  |  |  |  |  |
| 12 | I check my phone when I wake up at night. |  |  |  |  |  |
| 13 | I look at my smartwatch within 1 hour before attempting to fall asleep |  |  |  |  |  |
| 14 | I look at my smartwatch when I wake up at night. |  |  |  |  |  |
| 15 | I dim my mobile phone screen within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 16 | I use a blue-ﬁlter app on my computer screen within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 17 | I use as little light as possible when I get up during the night. |  |  |  |  |  |
| 18 | I dim my computer screen within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 19 | I use tunable lights to create a healthy light environment. |  |  |  |  |  |
| 20 | I use LEDs to create a healthy light environment. |  |  |  |  |  |
| 21 | I use a desk lamp when I do focused work. |  |  |  |  |  |
| 22 | I use an alarm with a dawn simulation light. |  |  |  |  |  |
| 23 | I turn on the lights immediately after waking up. |  |  |  |  |  |

**Scoring**

(Note: R = reverse-scored item)

LEBA captures light exposure-related behaviours on a 5-point Likert type scale ranging from 1 to 5 (1 = never; 2 = rarely; 3 = sometimes; 4 = often; 5 = always; for reversed-scored item: 1 = always; 2 = often; 3 = sometimes; 4 = rarely; 5 = never). The score of each factor is calculated by the summation of scores of items belonging to the corresponding factor.

|  |  |
| --- | --- |
| **Factor Name** | **Sore** |
| F1: Wearing blue light ﬁlters | 01+02+03 |
| F2: Spending time outdoors | 04(R)+05+06+07+08+09 |
| F3: Using phone and smartwatch in bed | 10+11+12+13+14 |
| F4: Using light before bedtime | 15+16+17+18 |
| F5: Using light in the morning and during daytime | 19+20+21+22+23 |

**S2 File**

**Light Exposure Behaviour Assessment (LEBA): Short Form**

**Participant’s Instruction**

Please indicate how often you performed the following behaviours in the **past four weeks.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Items | Never | Rarely | Sometimes | Often | Always |
| 01 | I wear blue-ﬁltering, orange-tinted, and/or red-tinted glasses indoors during the day. |  |  |  |  |  |
| 02 | I wear blue-ﬁltering, orange-tinted, and/or red-tinted glasses outdoors during the day. |  |  |  |  |  |
| 03 | I wear blue-ﬁltering, orange-tinted, and/or red-tinted glasses within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 04 | I spend 30 minutes or less per day (in total) outside.  *(Reverse-scored)* |  |  |  |  |  |
| 05 | I spend between 30 minutes and 1 hour per day (in total) outside. |  |  |  |  |  |
| 06 | I spend between 1 and 3 hours per day (in total) outside. |  |  |  |  |  |
| 07 | I spend more than 3 hours per day (in total) outside. |  |  |  |  |  |
| 08 | I spend as much time outside as possible. |  |  |  |  |  |
| 09 | I go for a walk or exercise outside within 2 hours after waking up. |  |  |  |  |  |
| 10 | I use my mobile phone within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 11 | I look at my mobile phone screen immediately after waking up. |  |  |  |  |  |
| 12 | I check my phone when I wake up at night. |  |  |  |  |  |
| 15 | I dim my mobile phone screen within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 16 | I use a blue-ﬁlter app on my computer screen within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 18 | I dim my computer screen within 1 hour before attempting to fall asleep. |  |  |  |  |  |
| 19 | I use tunable lights to create a healthy light environment. |  |  |  |  |  |
| 20 | I use LEDs to create a healthy light environment. |  |  |  |  |  |
| 22 | I use an alarm with a dawn simulation light. |  |  |  |  |  |

**Scoring**

(Note: R = reverse-scored item)

LEBA captures light exposure-related behaviours on a 5-point Likert type scale ranging from 1 to 5 (1 = never; 2 = rarely; 3 = sometimes; 4 = often; 5 = always; for reversed-scored item: 1 = always; 2 = often; 3 = sometimes; 4 = rarely; 5 = never). The score of each factor is calculated by the summation of scores of items belonging to the corresponding factor.

|  |  |
| --- | --- |
| **Factor Name** | **Sore** |
| F1: Wearing blue light ﬁlters | 01+02+03 |
| F2: Spending time outdoors | 04(R)+05+06+07+08+09 |
| F3: Using phone and smartwatch in bed | 10+11+12 |
| F4: Using light before bedtime | 15+16+18 |
| F5: Using light in the morning and during daytime | 19+20+22 |

**Supplementary Tables**

**Supplementary Table 1**

*List of instruments measuring related constructs to LEBA.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | Number of items | Description | Relevant items | Scale type |
| Visual Light Sensitivity Questionnaire-8 (Verriotto et al., 2017) | Eight-item | To assess the presence and severity of photosensitivity symptoms | None | 5-point Likert scale |
| Office Light Survey (Eklund & Boyce, 1996) | 30-item | To assess electrical lighting environment in office | Item 29 | Mixed response format |
| Harvard Light Exposure Assessment Questionnaire (Bajaj et al., 2011) | One-item | To assess … | None | Semi-quantitative |
| Hospital Lighting Survey (Dianat et al., 2013) | 23-item | To assess light environment in a hospital | Item 16,17 | 5-point Likert scale |
| Morningness-Eveningness Questionnaire (Horne & Ostberg, 1976) | 19-item | To ….. | item 1,2,8,13,14 | Mixed response format |
| Munich Chronotype Questionnaire (Roenneberg et al., 2003) | 17-item | To understand individuals phase of entrainment | Time spent outdoors | Mixed response format |
| Sleep Practices and Attitudes Questionnaire (Grandner et al., 2014) | 16-subscale | To assess practice, behaviour and attitude related to sleep | Activities in bed and sleep environment subscales | 5-point Likert scale |
| The Pittsburgh Sleep Quality Index  (Buysse et al., 1989) | Nine-item | To assess sleep quality and sleeping pattern | item 1-4 | Mixed response format |
| Self-Rating of Biological Rhythm Disorder for Disorder for Adolescents (Xie et al., 2022) | 29-item | To assess four dimensions of biological rhythm disorder in adolescents | Item 3,6,22-25 and 29 | 5-point Likert scale |
| Photosensitivity Assessment Questionnaire (PAQ) (Bossini et al., 2006) | 16-tem | To assess “photophobia" and "photophilia" | All items | Binary response option |

**Supplementary Table 2**

*Geographical location of the participants (n =690).*

|  |  |  |
| --- | --- | --- |
|  | Time zone and country name | Number of Participants |
| 1 | Africa/Ceuta (UTC +01:00) | 2 |
| 2 | Africa/Douala (UTC +01:00) | 1 |
| 3 | Africa/Johannesburg (UTC +02:00) | 5 |
| 4 | Africa/Khartoum (UTC +02:00) | 2 |
| 5 | Africa/Lagos (UTC +01:00) | 1 |
| 6 | America/Adak (UTC -09:00) | 2 |
| 7 | America/Anchorage (UTC -08:00) | 3 |
| 8 | America/Araguaina (UTC -03:00) | 2 |
| 9 | America/Argentina/Buenos\_Aires (UTC -03:00) | 5 |
| 10 | America/Argentina/Cordoba (UTC -03:00) | 2 |
| 11 | America/Argentina/Jujuy (UTC -03:00) | 1 |
| 12 | America/Bahia (UTC -03:00) | 2 |
| 13 | America/Blanc-Sablon (UTC -04:00) | 1 |
| 14 | America/Bogota (UTC -05:00) | 2 |
| 15 | America/Boise (UTC -06:00) | 4 |
| 16 | America/Cayman (UTC -05:00) | 1 |
| 17 | America/Chicago (UTC -05:00) | 30 |
| 18 | America/Costa\_Rica (UTC -06:00) | 2 |
| 19 | America/Cuiaba (UTC -04:00) | 1 |
| 20 | America/Denver (UTC -06:00) | 6 |
| 21 | America/Detroit (UTC -04:00) | 6 |
| 22 | America/Edmonton (UTC -06:00) | 14 |
| 23 | America/Fortaleza (UTC -03:00) | 1 |
| 24 | America/Guatemala (UTC -06:00) | 1 |
| 25 | America/Guayaquil (UTC -05:00) | 2 |
| 26 | America/Halifax (UTC -03:00) | 1 |
| 27 | America/Indiana/Indianapolis (UTC -04:00) | 3 |
| 28 | America/Indiana/Tell\_City (UTC -05:00) | 1 |
| 29 | America/Kentucky/Louisville (UTC -04:00) | 3 |
| 30 | America/Los\_Angeles (UTC -07:00) | 37 |
| 31 | America/Martinique (UTC -04:00) | 1 |
| 32 | America/Mexico\_City (UTC -06:00) | 2 |
| 33 | America/Moncton (UTC -03:00) | 2 |
| 34 | America/Monterrey (UTC -06:00) | 1 |
| 35 | America/New\_York (UTC -04:00) | 63 |
| 36 | America/North\_Dakota/Center (UTC -05:00) | 1 |
| 37 | America/North\_Dakota/New\_Salem (UTC -05:00) | 1 |
| 38 | America/Panama (UTC -05:00) | 1 |
| 39 | America/Phoenix (UTC -07:00) | 7 |
| 40 | America/Resolute (UTC -05:00) | 1 |
| 41 | America/Santiago (UTC -03:00) | 8 |
| 42 | America/Sao\_Paulo (UTC -03:00) | 19 |
| 43 | America/Toronto (UTC -04:00) | 16 |
| 44 | America/Vancouver (UTC -07:00) | 6 |
| 45 | Antarctica/Macquarie (UTC +11:00) | 1 |
| 46 | Asia /Taipei City (UTC +08:00) | 3 |
| 47 | Asia/Amman (UTC +03:00) | 2 |
| 48 | Asia/Barnaul (UTC +07:00) | 1 |
| 49 | Asia/Dhaka (UTC +06:00) | 1 |
| 50 | Asia/Famagusta (UTC +02:00) | 1 |
| 51 | Asia/Ho\_Chi\_Minh (UTC +07:00),British - America/Tortola (UTC -04:00) | 2 |
| 52 | Asia/Hong\_Kong (UTC +08:00) | 2 |
| 53 | Asia/Jakarta (UTC +07:00) | 9 |
| 54 | Asia/Jerusalem (UTC +02:00) | 4 |
| 55 | Asia/Karachi (UTC +05:00) | 1 |
| 56 | Asia/Kathmandu (UTC +05:45) | 2 |
| 57 | Asia/Kolkata (UTC +05:30) | 38 |
| 58 | Asia/Kuala\_Lumpur (UTC +08:00) | 7 |
| 59 | Asia/Kuching (UTC +08:00) | 2 |
| 60 | Asia/Manila (UTC +08:00) | 6 |
| 61 | Asia/Novosibirsk (UTC +07:00) | 1 |
| 62 | Asia/Riyadh (UTC +03:00) | 1 |
| 63 | Asia/Seoul (UTC +09:00) | 1 |
| 64 | Asia/Shanghai (UTC +08:00) | 7 |
| 65 | Asia/Singapore (UTC +08:00) | 1 |
| 66 | Asia/Tokyo (UTC +09:00) | 3 |
| 67 | Asia/Tomsk (UTC +07:00) | 1 |
| 68 | Asia/Ulaanbaatar (UTC +08:00) | 1 |
| 69 | Asia/Vladivostok (UTC +10:00) | 1 |
| 70 | Asia/Yangon (UTC +06:30) | 1 |
| 71 | Asia/Yekaterinburg (UTC +05:00) | 1 |
| 72 | Atlantic/Canary (UTC) | 1 |
| 73 | Australia/Adelaide (UTC +10:30) | 2 |
| 74 | Australia/Brisbane (UTC +10:00) | 4 |
| 75 | Australia/Darwin (UTC +09:30) | 1 |
| 76 | Australia/Melbourne (UTC +11:00) | 5 |
| 77 | Australia/Perth (UTC +08:00) | 2 |
| 78 | Australia/Sydney (UTC +11:00) | 2 |
| 79 | East Africa/Dodoma (UTC +03:00) | 1 |
| 80 | Europe/Amsterdam (UTC +01:00) | 19 |
| 81 | Europe/Athens (UTC +02:00) | 3 |
| 82 | Europe/Belgrade (UTC +01:00) | 3 |
| 83 | Europe/Berlin (UTC +01:00) | 53 |
| 84 | Europe/Bratislava (UTC +01:00) | 2 |
| 85 | Europe/Brussels (UTC +01:00) | 4 |
| 86 | Europe/Bucharest (UTC +02:00) | 3 |
| 87 | Europe/Budapest (UTC +01:00) | 2 |
| 88 | Europe/Busingen (UTC +01:00) | 3 |
| 89 | Europe/Copenhagen (UTC +01:00) | 3 |
| 90 | Europe/Dublin (UTC) | 5 |
| 91 | Europe/Helsinki (UTC +02:00) | 9 |
| 92 | Europe/Istanbul (UTC +03:00) | 6 |
| 93 | Europe/Kiev (UTC +02:00) | 1 |
| 94 | Europe/Lisbon (UTC) | 2 |
| 95 | Europe/Ljubljana (UTC +01:00) | 3 |
| 96 | Europe/London (UTC) | 57 |
| 97 | Europe/Madrid (UTC +01:00) | 7 |
| 98 | Europe/Moscow (UTC +03:00) | 8 |
| 99 | Europe/Oslo (UTC +01:00) | 3 |
| 100 | Europe/Paris (UTC +01:00) | 22 |
| 101 | Europe/Prague (UTC +01:00) | 3 |
| 102 | Europe/Riga (UTC +02:00) | 2 |
| 103 | Europe/Rome (UTC +01:00) | 9 |
| 104 | Europe/Sofia (UTC +02:00) | 1 |
| 105 | Europe/Stockholm (UTC +01:00) | 4 |
| 106 | Europe/Tallinn (UTC +02:00) | 2 |
| 107 | Europe/Tirane (UTC +01:00) | 1 |
| 108 | Europe/Vienna (UTC +01:00) | 1 |
| 109 | Europe/Vilnius (UTC +02:00) | 5 |
| 110 | Europe/Warsaw (UTC +01:00) | 15 |
| 111 | Europe/Zagreb (UTC +01:00) | 2 |
| 112 | Europe/Zurich (UTC +01:00) | 21 |
| 113 | European /Skopje (UTC +01:00) | 1 |
| 114 | Iran /Tehran (UTC +0:30) | 3 |
| 115 | Pacific/Auckland (UTC +13:00) | 6 |
| 116 | Pacific/Chatham (UTC +13:45) | 1 |
| 117 | Pacific/Easter (UTC -05:00) | 1 |
| 118 | Pacific/Honolulu (UTC -10:00) | 2 |

**Supplementary Table 3.**

*Minimum average partial (MAP) method of factor number determination. MAP Statistics is the lowest in the 5th row indicating five factors are required.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| MAP  Statistic | df |  | RMSEA | BIC | SRMR |
| 0.01125 | 1080 | 4344.31 | 0.08 | -2199.54 | 0.09 |
| 0.01062 | 1033 | 3735.35 | 0.08 | -2523.72 | 0.08 |
| 0.01077 | 987 | 3065.44 | 0.07 | -2914.91 | 0.07 |
| 0.01042 | 942 | 2661.78 | 0.07 | -3045.92 | 0.06 |
| 0.0093 | 898 | 2237.56 | 0.06 | -3203.53 | 0.06 |
| 0.0094 | 855 | 2040.02 | 0.06 | -3140.53 | 0.05 |
| 0.0097 | 813 | 1861.69 | 0.05 | -3064.37 | 0.04 |
| 0.0100 | 772 | 1620.64 | 0.05 | -3057.00 | 0.04 |

**Supplementary Table 4**

*Factor loadings and communality of the retained in EFA with six factors. One factor emerged with only two items.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Items | PA1 | PA2 | PA3 | PA4 | PA5 | PA6 | Communality |
| Item 16 | .99 |  |  |  |  |  | .01 |
| Item 36 | .94 |  |  |  |  |  | .10 |
| Item 17 | .80 |  |  |  |  |  | .33 |
| Item 11 |  | .82 |  |  |  |  | .30 |
| Item 10 |  | .81 |  |  |  |  | .34 |
| Item 12 |  | .64 |  |  |  |  | .53 |
| Item 08 |  | -.48 |  |  |  |  | .75 |
| Item 07 |  | .47 |  |  |  |  | .74 |
| Item 09 |  | .33 |  |  |  |  | .88 |
| Item 33 |  |  | .97 |  |  |  | .02 |
| Item 32 |  |  | .77 |  |  |  | .31 |
| Item 35 |  |  | .54 |  |  |  | .59 |
| Item 31 |  |  | .49 |  |  |  | .67 |
| Item 03 |  |  |  | .84 |  |  | .27 |
| Item 27 |  |  |  | .81 |  |  | .33 |
| Item 40 |  |  |  | .69 |  |  | .47 |
| Item 46 |  |  |  |  | .65 |  | .48 |
| Item 45 |  |  |  |  | .57 |  | .65 |
| Item 04 |  |  |  |  | .48 |  | .67 |
| Item 25 |  |  |  |  | .40 |  | .76 |
| Item 01 |  |  |  |  | .35 |  | .87 |
| Item 26 |  |  |  |  | .35 |  | .84 |
| Item 37 |  |  |  |  |  | -.8 | .32 |
| Item38 |  |  |  |  |  | .39 | .76 |
| % Of Variance | 11 | 10 | 9 | 9 | 6 | 5 | - |

*Note.* Only loading higher than.30 is reported.

**Supplementary Table 5**

*Demographics Characteristics of the native and non-native English Speakers*

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Overall 1  (N= 262) | Native English Speakers1 (N=129) | Non-native English Speakers1 |
| Age | 32.89 (13.66) | 34.08 (15.32) | 31.74 (11.77) |
| Sex |  |  |  |
| Female | 136 (52%) | 80 (62%) | 56 (42%) |
| Male | 121 (46%) | 48 (37%) | 73 (55%) |
| Other | 5 (1.9%) | 1 (.08%) | 4 (3.0%) |
| Occupational Status |  |  |  |
| Work | 161 (61%) | 76 (59%) | 85 (64%) |
| School | 52 (20%) | 27 (21%) | 25 (19%) |
| Neither | 49 (19%) | 26 (20%) | 23 (17%) |
| Occupational Setting |  |  |  |
| Home Office/Home schooling | 109 (42%) | 50 (39%) | 59 (44%) |
| Face-to-face work/Face-to-face schooling | 41 (16%) | 22 (17%) | 19 (14%) |
| Combination of home and face-to-face work/schooling | 53 (20%) | 23 (18%) | 30 (23%) |
| Neither (no work or school, or in vacation) | 59 (23%) | 34 (26%) | 25 (19%) |

1 Mean (SD); n (%)

**Supplementary Table 6**

Items discrimination and response category difficulty thresholds of 23 items in LEBA (n =690)

| Items | a | b1 | b2 | b3 | b4 | Item Discrimination  Category |
| --- | --- | --- | --- | --- | --- | --- |
| **F1: Wearing blue light ﬁlters** | | | | | |  |
| Item 16 | 28.13 | 0.78 | 0.90 | 1.06 | 1.40 | Very High |
| Item 36 | 4.49 | 0.94 | 1.08 | 1.23 | 1.40 | Very High |
| Item 17 | 2.81 | 0.97 | 1.11 | 1.38 | 1.62 | Very High |
| **F2: Spending time outdoors** | | | | | |  |
| Item 11 | 3.27 | -0.79 | 0.65 | 1.54 | 2.31 | Very High |
| Item 10 | 3.07 | -1.27 | -0.09 | 0.82 | 2.00 | Very High |
| Item 12 | 1.72 | -0.67 | 0.44 | 1.28 | 2.11 | Very High |
| Item 07 | 1.09 | -0.50 | 0.73 | 1.63 | 2.97 | Moderate |
| Item 08 | 1.19 | -2.26 | -0.48 | 0.64 | 1.91 | Moderate |
| Item 09 | 0.91 | -2.63 | -0.96 | 1.11 | 3.49 | Moderate |
| **F3: Using phone and smartwatch in bed** | | | | | |  |
| Item 27 | 2.21 | -1.88 | -1.19 | -0.73 | 0.30 | Very High |
| Item 03 | 3.03 | -1.24 | -0.77 | -0.20 | 0.66 | Very High |
| Item 40 | 1.55 | -0.51 | 0.46 | 1.32 | 2.22 | High |
| Item 30 | 0.49 | 3.27 | 3.74 | 4.64 | 6.52 | Low |
| Item 41 | 0.51 | 3.87 | 4.78 | 6.39 | 8.91 | Low |
| **F4: Using light before bedtime** | | | | | |  |
| Item 32 | 1.62 | -1.03 | -0.78 | -0.42 | 0.16 | High |
| Item 35 | 1.37 | -1.09 | -0.98 | -0.75 | -0.40 | High |
| Item 38 | 0.40 | -7.48 | -5.56 | -4.23 | -0.90 | Low |
| Item 33 | 12.31 | -0.66 | -0.48 | -0.24 | 0.13 | Very High |
| **F5: Using light in the morning and during daytime** | | | | | |  |
| Item 46 | 2.22 | 0.68 | 0.89 | 1.38 | 2.17 | Very High |
| Item 45 | 1.51 | 0.30 | 0.55 | 1.17 | 1.91 | High |
| Item 25 | 0.52 | -1.37 | -0.04 | 1.89 | 4.22 | Low |
| Item 04 | 0.84 | 2.44 | 2.80 | 3.18 | 3.67 | Moderate |
| Item 01 | 0.39 | -0.91 | 1.52 | 3.25 | 5.53 | Low |

*Note.* a = item discrimination parameter; b(1-4) = response category difficulty parameter

**Supplementary Table 7**

Item discrimination, response category difficulty thresholds and fit statistics of the 18 items in short LEBA (n=690)

| Items | a | b1 | b2 | b3 | b4 | Signed | df | RMSEA | p |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **F1: Wearing blue light ﬁlters** | | | | | |  |  |  |  |
| Item 16 | 28.13 | 0.78 | 0.90 | 1.06 | 1.40 | 2.02 | 6.00 | 0.00 | 0.92 |
| Item 36 | 4.49 | 0.94 | 1.08 | 1.23 | 1.40 | 39.07 | 13.00 | 0.05 | 0.00 |
| Item 17 | 2.81 | 0.97 | 1.11 | 1.38 | 1.62 | 25.58 | 13.00 | 0.04 | 0.02 |
| **F2: Spending time outdoors** | | | | | |  |  |  |  |
| Item 11 | 3.27 | -0.79 | 0.65 | 1.54 | 2.31 | 55.03 | 27.00 | 0.04 | 0.00 |
| Item 10 | 3.07 | -1.27 | -0.09 | 0.82 | 2.00 | 53.19 | 30.00 | 0.03 | 0.01 |
| Item 12 | 1.72 | -0.67 | 0.44 | 1.28 | 2.11 | 34.39 | 42.00 | 0.00 | 0.79 |
| Item 07 | 1.09 | -0.50 | 0.73 | 1.63 | 2.97 | 67.45 | 46.00 | 0.03 | 0.02 |
| Item 08 | 1.19 | -2.26 | -0.48 | 0.64 | 1.91 | 140.90 | 46.00 | 0.05 | 0.00 |
| Item 09 | 0.91 | -2.63 | -0.96 | 1.11 | 3.49 | 131.19 | 45.00 | 0.05 | 0.00 |
| **F3: Using phone and smartwatch in bed** | | | | | | |  |  |  |
| Item 27 | 2.12 | -1.91 | -1.21 | -0.74 | 0.31 | 16.41 | 11.00 | 0.03 | 0.13 |
| Item 03 | 3.24 | -1.22 | -0.76 | -0.20 | 0.65 | 15.09 | 11.00 | 0.02 | 0.18 |
| Item 40 | 1.57 | -0.50 | 0.45 | 1.30 | 2.20 | 9.92 | 9.00 | 0.01 | 0.36 |
| **F4: Using light before bedtime** | | | | | |  |  |  |  |
| Item 32 | 1.60 | -1.04 | -0.79 | -0.42 | 0.16 | 41.33 | 15.00 | 0.05 | 0.00 |
| Item 35 | 1.34 | -1.10 | -0.99 | -0.76 | -0.41 | 41.71 | 14.00 | 0.05 | 0.00 |
| Item 33 | 15.66 | -0.66 | -0.48 | -0.24 | 0.13 | 46.89 | 14.00 | 0.06 | 0.00 |
| **F5: Using light in the morning and during daytime** | | | | | | |  |  |  |
| Item 46 | 2.34 | 0.66 | 0.88 | 1.36 | 2.12 | 19.00 | 15.00 | 0.02 | 0.21 |
| Item 45 | 1.51 | 0.30 | 0.55 | 1.17 | 1.91 | 15.05 | 15.00 | 0.00 | 0.45 |
| Item 25 | 0.49 | -1.45 | -0.04 | 1.99 | 4.46 | 31.60 | 15.00 | 0.04 | 0.01 |

*Note.* a = item discrimination parameter; b(1-4) = response category difficulty parameter

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**Supplementary Figures**

Table

Description automatically generated with medium confidence

*Sup.Fig.1.* Summary descriptives and response pattern of EFA sample. All items violated normality assumptions

Table

Description automatically generated

*Sup.Fig.2.* Summary descriptives and response pattern of CFA sample

Diagram

Description automatically generated

*Sup. Fig.3.* Item information curves for all items of LEBA. The red boxed five items (1, 25, 38, 30,41) had relatively flat information

curves.

Diagram, histogram

Description automatically generated

*Sup.Fig.4*. Person fit of the five fitted IRT models (a) Wearing blue light filters (b) Spending time outdoors (c) Using phone and smartwatch in bed (d) Using light before bedtime (e) Using light in the morning and during daytime. Most of the Zh values are higher than -2.