**Supplementary File 1**

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

**Instructions to Participant**

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 using the mean score of the corresponding items.

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

**Supplementary File 2**

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

**Instructions to Participant**

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 using the mean score of the corresponding items.

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

**Supplementary Tables**

**Supplementary Table 1**

*List of instruments measuring related constructs to LEBA.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name** | **Number of all items** | **Description** | **Relevant items** | **Scale type** |
| Visual Light Sensitivity Questionnaire-8 (Verriotto et al., 2017) | 8 | To assess the presence and severity of photosensitivity symptoms | None | 5-point Likert scale |
| Office Light Survey (Eklund & Boyce, 1996) | 30 | To assess electrical lighting environment in office | Item 29 | Mixed response format |
| Harvard Light Exposure Assessment Questionnaire (Bajaj et al., 2011) | 1 | To assess an individual’s daily light exposure | None | Semi-quantitative |
| Hospital Lighting Survey (Dianat et al., 2013) | 23 | To assess light environment in a hospital | Items 16, 17 | 5-point Likert scale |
| Morningness-Eveningness Questionnaire (Horne & Ostberg, 1976) | 19 | To assess an individual’s chronotype | items 1, 2, 8, 13, 14 | Mixed response format |
| Munich Chronotype Questionnaire (Roenneberg et al., 2003) | 17 | To understand an individual’s phase of entrainment | Time spent outdoors | Mixed response format |
| Sleep Practices and Attitudes Questionnaire (Grandner et al., 2014) | 16 | 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) | 9 | To assess sleep quality and sleeping pattern | items 1-4 | Mixed response format |
| Self-Rating of Biological Rhythm Disorder for Disorder for Adolescents (Xie et al., 2022) | 29 | To assess four dimensions of biological rhythm disorder in adolescents | Items 3, 6, 22-25, 29 | 5-point Likert scale |
| Photosensitivity Assessment Questionnaire (PAQ) (Bossini et al., 2006) | 16 | 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  Statistic1 | 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 |

*Note. 1* Minimum average partial.

**Supplementary Table 4**

*Factor loadings and communality of the retained in EFA with six factors. One factor emerged with only two items (n=428).*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 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 (n=262).*

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Overall 1  (n= 262) | Native English Speakers1 (n=129) | Non-native English Speakers1  (n=133) |
| **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 | Item Discrimination  Category |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **F1: Wearing blue light ﬁlters** | | | | | |  |  |  |  |  |
| Item 16 | 28.13 | 0.78 | 0.90 | 1.06 | 1.40 | 2.02 | 6 | 0.00 | 0.92 | Very High |
| Item 36 | 4.49 | 0.94 | 1.08 | 1.23 | 1.40 | 39.07 | 13 | 0.05 | 0.00 | Very High |
| Item 17 | 2.81 | 0.97 | 1.11 | 1.38 | 1.62 | 25.58 | 13 | 0.04 | 0.02 | Very High |
| **F2: Spending time outdoors** | | | | | |  |  |  |  |  |
| Item 11 | 3.27 | -0.79 | 0.65 | 1.54 | 2.31 | 55.03 | 27 | 0.04 | 0.00 | Very High |
| Item 10 | 3.07 | -1.27 | -0.09 | 0.82 | 2.00 | 53.19 | 30 | 0.03 | 0.01 | Very High |
| Item 12 | 1.72 | -0.67 | 0.44 | 1.28 | 2.11 | 34.39 | 42 | 0.00 | 0.79 | Very High |
| Item 07 | 1.09 | -0.50 | 0.73 | 1.63 | 2.97 | 67.45 | 46 | 0.03 | 0.02 | Moderate |
| Item 08 | 1.19 | -2.26 | -0.48 | 0.64 | 1.91 | 140.90 | 46 | 0.05 | 0.00 | Moderate |
| Item 09 | 0.91 | -2.63 | -0.96 | 1.11 | 3.49 | 131.19 | 45 | 0.05 | 0.00 | Moderate |
| **F3: Using phone and smartwatch in bed** | | | | | | |  |  |  |  |
| Item 27 | 2.12 | -1.91 | -1.21 | -0.74 | 0.31 | 16.41 | 11 | 0.03 | 0.13 | Very High |
| Item 03 | 3.24 | -1.22 | -0.76 | -0.20 | 0.65 | 15.09 | 11 | 0.02 | 0.18 | Very High |
| Item 40 | 1.57 | -0.50 | 0.45 | 1.30 | 2.20 | 9.92 | 9 | 0.01 | 0.36 | High |
| **F4: Using light before bedtime** | | | | | |  |  |  |  |  |
| Item 32 | 1.60 | -1.04 | -0.79 | -0.42 | 0.16 | 41.33 | 15 | 0.05 | 0.00 | High |
| Item 35 | 1.34 | -1.10 | -0.99 | -0.76 | -0.41 | 41.71 | 14 | 0.05 | 0.00 | High |
| Item 33 | 15.66 | -0.66 | -0.48 | -0.24 | 0.13 | 46.89 | 14 | 0.06 | 0.00 | Very High |
| **F5: Using light in the morning and during daytime** | | | | | | |  |  |  |  |
| Item 46 | 2.34 | 0.66 | 0.88 | 1.36 | 2.12 | 19.00 | 15 | 0.02 | 0.21 | Very High |
| Item 45 | 1.51 | 0.30 | 0.55 | 1.17 | 1.91 | 15.05 | 15 | 0.00 | 0.45 | High |
| Item 25 | 0.49 | -1.45 | -0.04 | 1.99 | 4.46 | 31.60 | 15 | 0.04 | 0.01 | Low |

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

**References (Supplementary Materials)**

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**Supplementary Figures**

Table

Description automatically generated with medium confidence

*Sup.Fig.1.* Summary descriptive statistics and response pattern of EFA sample (n=428). All items violated normality assumptions

Table

Description automatically generated

*Sup.Fig.2.* Summary descriptive statistics and response pattern of CFA sample (n=262).

Diagram

Description automatically generated

*Sup. Fig.3.* Item information curves for all items of LEBA. The red boxed five items (1, 25, 30, 38, 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 smart-watch 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.