How to Measure Sleep Duration More Adequately?
An Exercise

Ki-Soo Eun

Seoul National University

eunkisoo@gmail.com

Research Interests:

1. Effect of changing measurements of sleep duration in a series of survey (Health and Nutrition Survey)

2. Comparison of measurement of sleep duration between 24-hour time diary and 48-hour time diary (Time Use Survey)

Interest in Sleep Duration

- Health scientists: The relation between sleep duration and health outcomes such as obesity, hypertension, diabetes and so on.

- Time use researchers: Sleep as a social phenomenon affected by individual, familial and social factors; as a part of personal care in most time use research

Validity and Reliability of Measurement of Sleep Duration in Health Data

## **N**ational **H**ealth and **N**utrition **E**xamination **S**urvey in Korea

National Health and Nutrition Examination Survey, 1998-2016

Wave	Year	Male	Female	Sub-total	Total
Wave 1	1998	19,038	20,022	39,060	39,060
Wave 2	2001	18,492	19,386	37,878	37,878
Wave 3	2005	16,356	17,789	34,145	34,145
Wave 4	2007	2,097	2,497	4,594	24,871
	2008	4,370	5,374	9,744	
	2009	4,843	5,690	10,533	
Wave 5	2010	4,115	4,843	8,958	25,534
	2011	3,867	4,651	8,518	
	2012	3,634	4,424	8,058	
Wave 6	2013	3,645	4,373	8,018	22,948
	2014	3,385	4,165	7,550	
	2015	3,381	3,999	7,380	
Wave 7	2016	3,665	4,485	8,150	8,150

Two measurements of sleep duration in Korean NHNES

- 1998-2015: How many hours on average do you sleep a day?

  _____ hour

  – Self-reported daily average sleep duration in integer (HOUR)

- 2016

1) Weekday
  - Bedtime   _____ hour _____ minute
  - Wake up time   _____ hour _____ minute

2) Weekend
  - Bedtime   _____ hour _____ minute
  - Wake up time   _____ hour _____ minute

Average Sleep Duration by Age and Sex in Korea, 2010-2016: NHNES
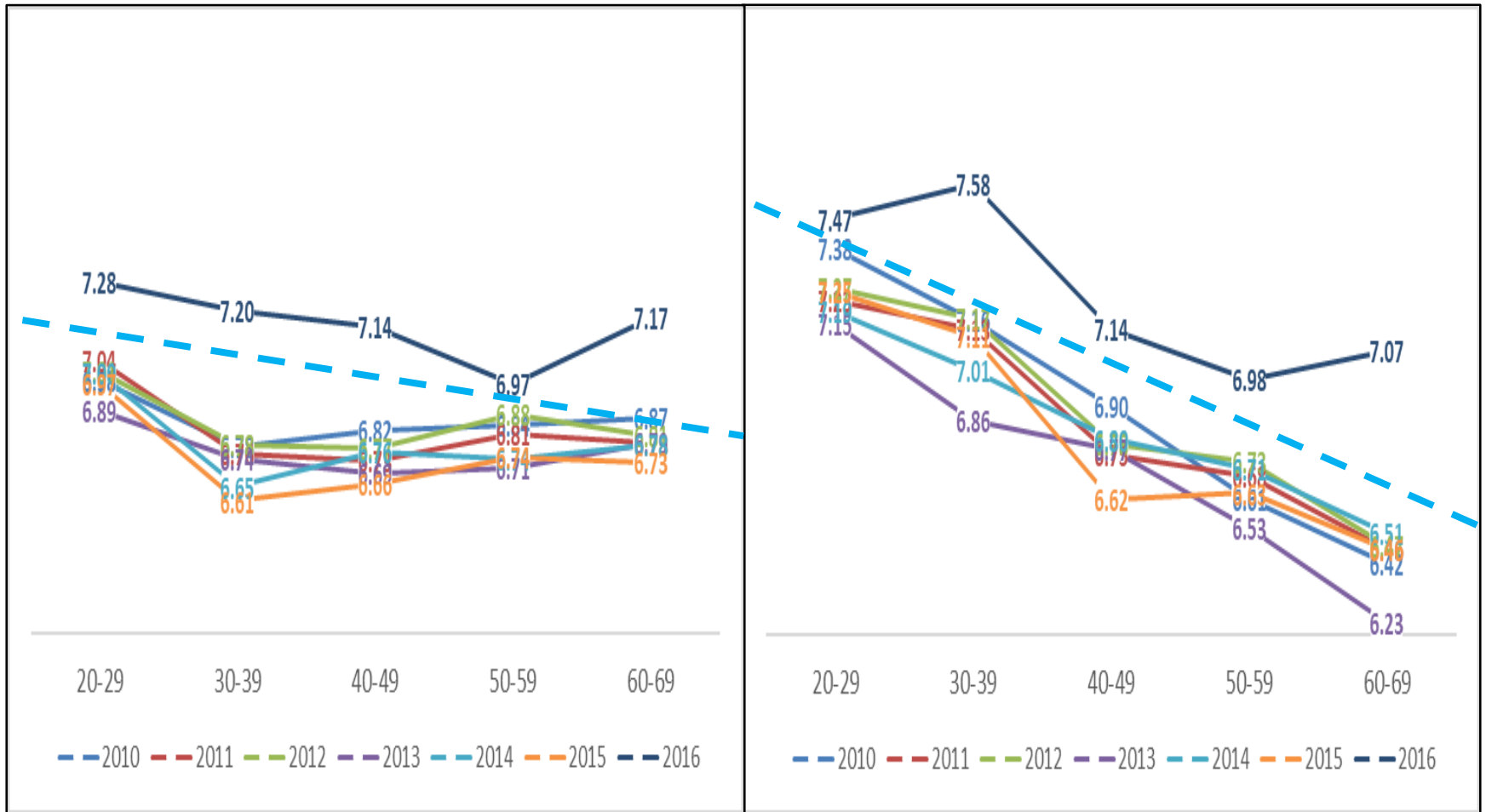
Man   Woman

Valid and Reliable?

# How to improve measurement of sleep duration using KTUS?

Korean Time Use Survey

- Conducted every 5 years since 1999
- 4 waves: 1999, 2004, 2009, and 2014
- Household members aged 10 and over
- 2 consecutive 24-hour time diaries every 10 minutes: Tues-Wed, Thurs-Fri, Fri-Sat, Sat-Sun, Sun-Mon
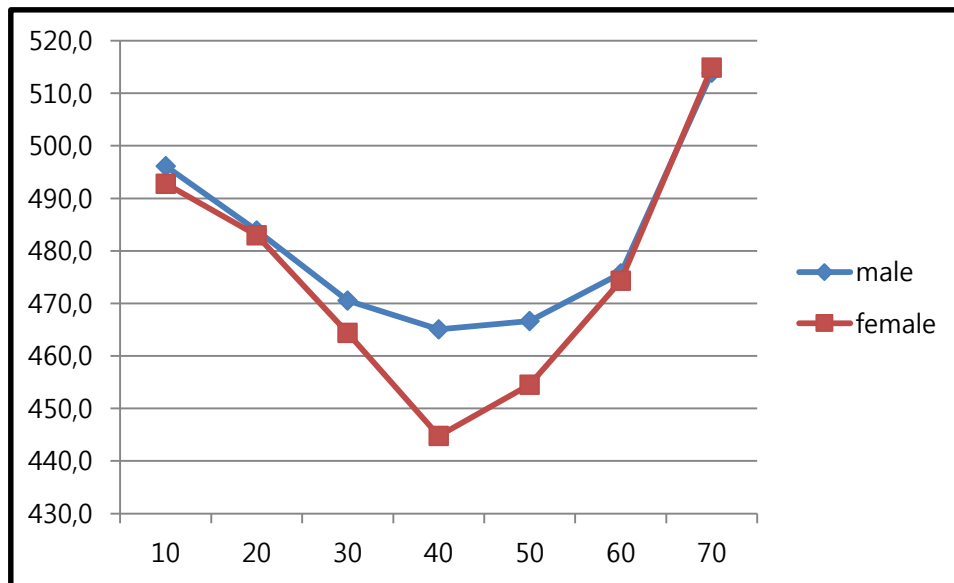
Sleep Duration by 24-Hour Time Diary

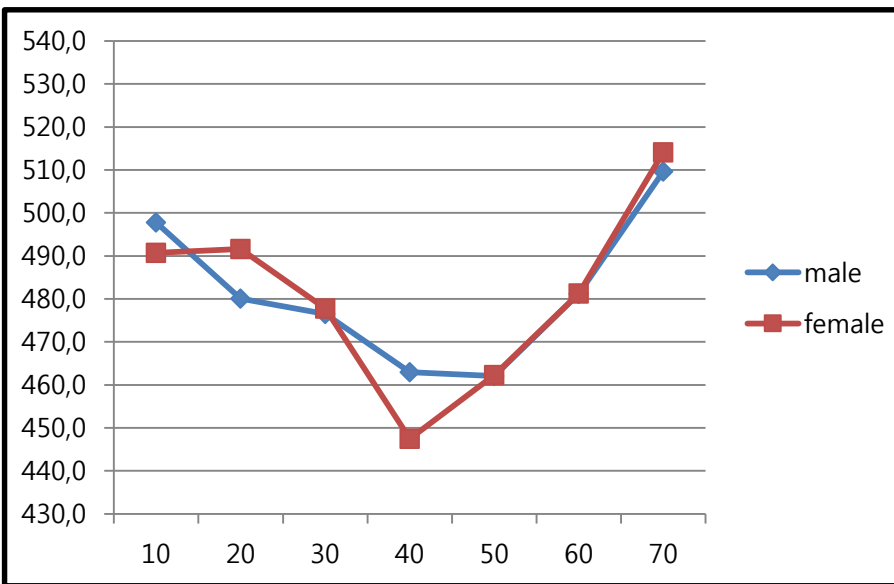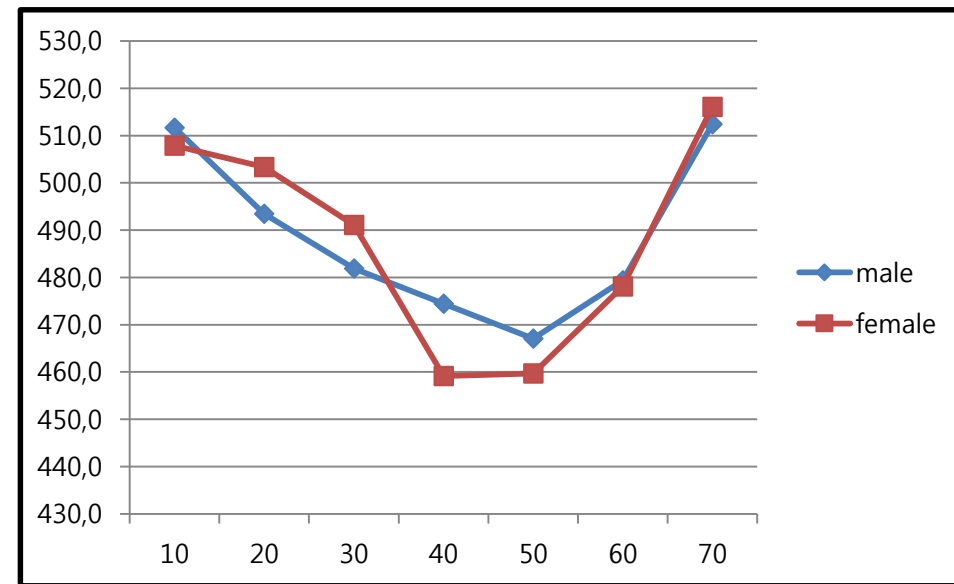# Average Sleep Duration by Age and Sex in Korea: Time Use Survey
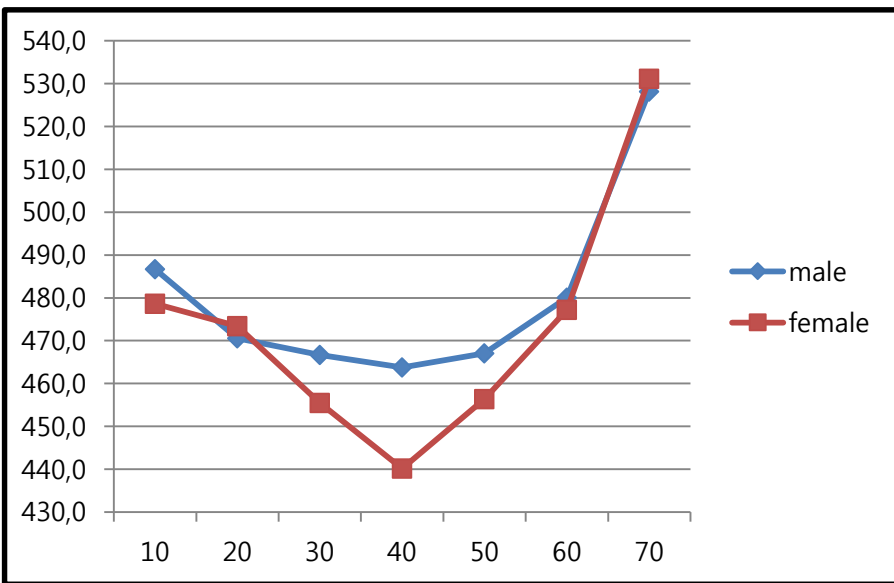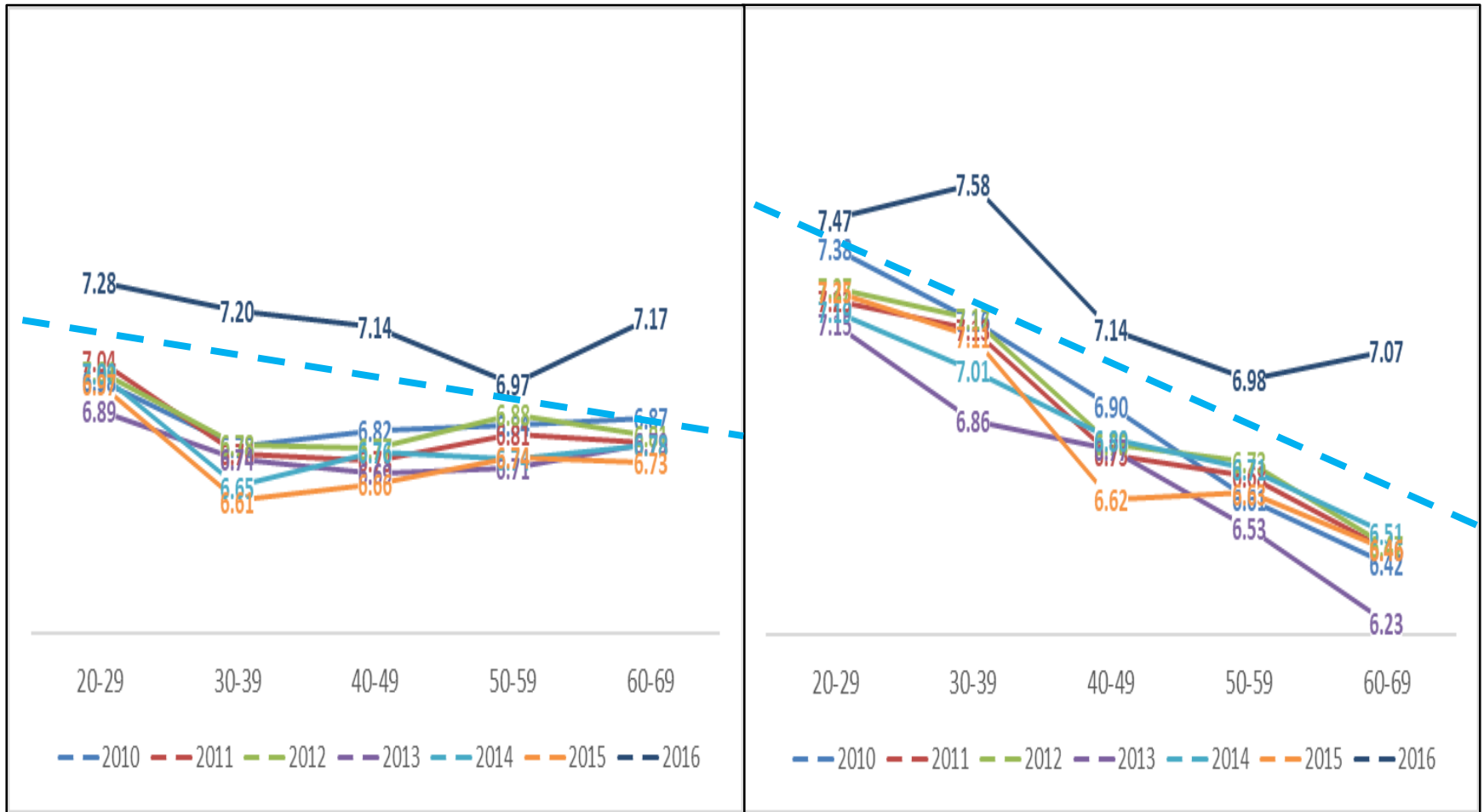
Average Sleep Duration by Age and Sex in Korea, 2010-2016: NHNES

Man

Woman

Average Bedtime and Wake Up Time with 48-Hour Time Diary

Average Bedtime by Age, Sex and Day: 48-Hour Data
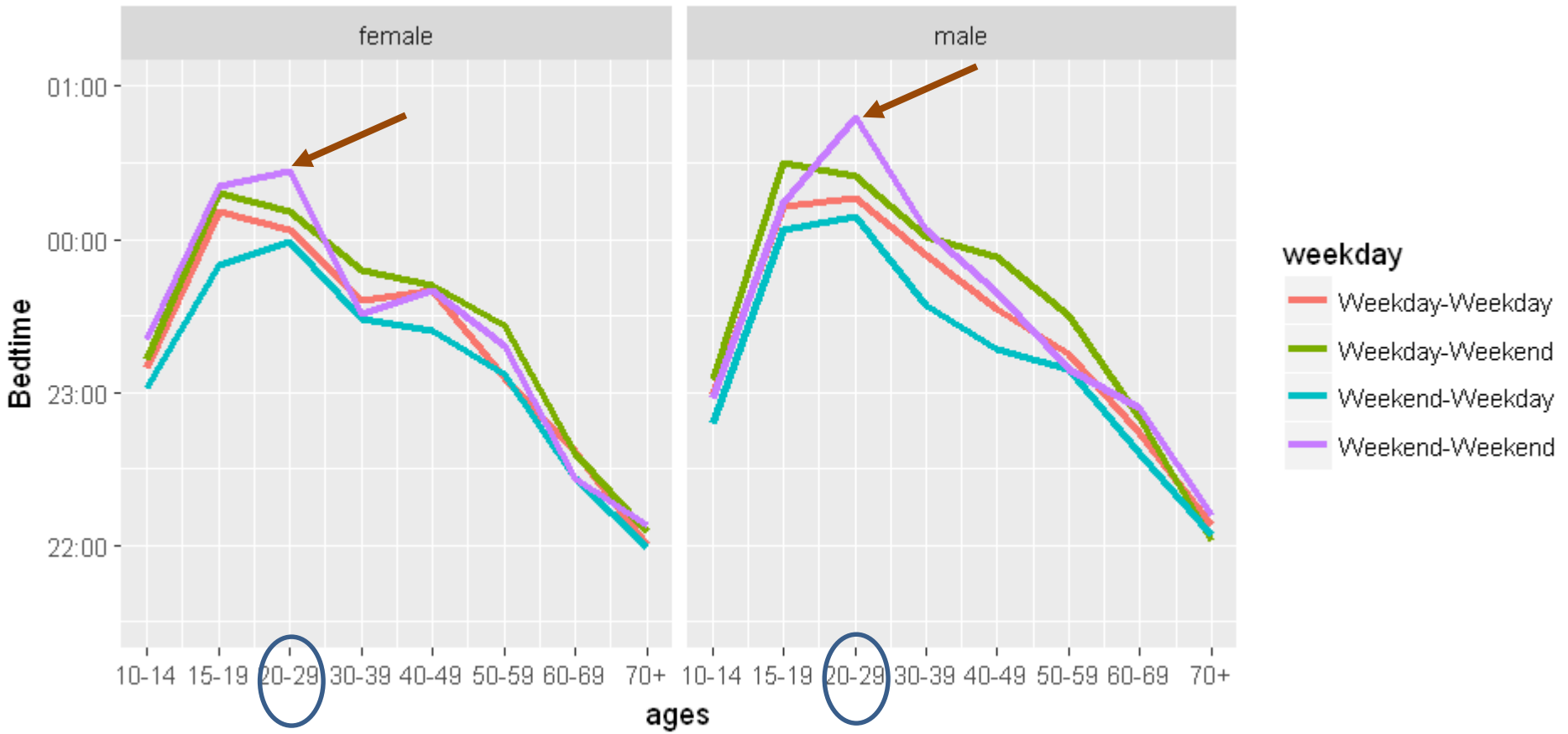
Average Wake Up Time by Age, Sex and Day: 48-Hour Data
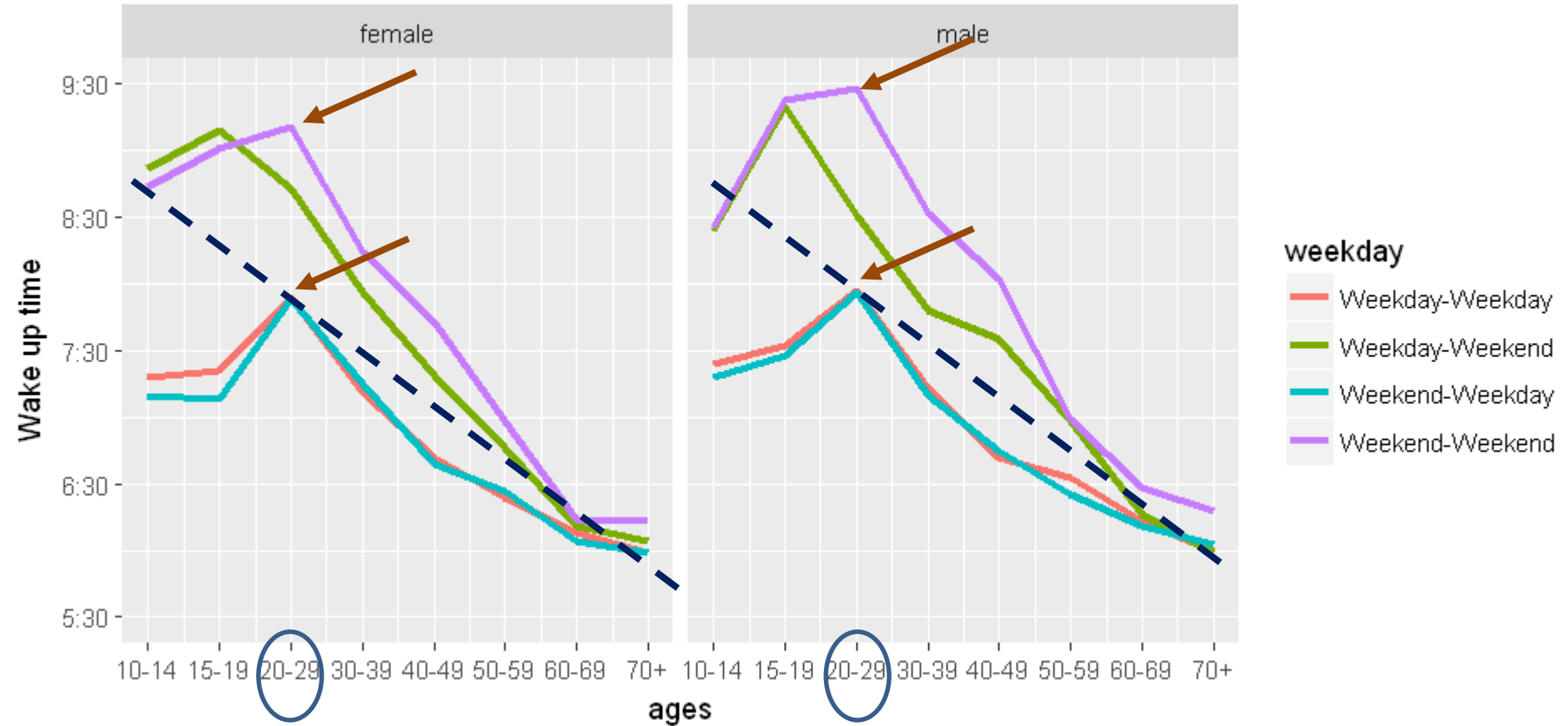
Sleep Duration Based on 48-Hour Time Diary

Average Sleep Duration as a Difference between Bedtime and Wake Up Time: 48-Hour Data
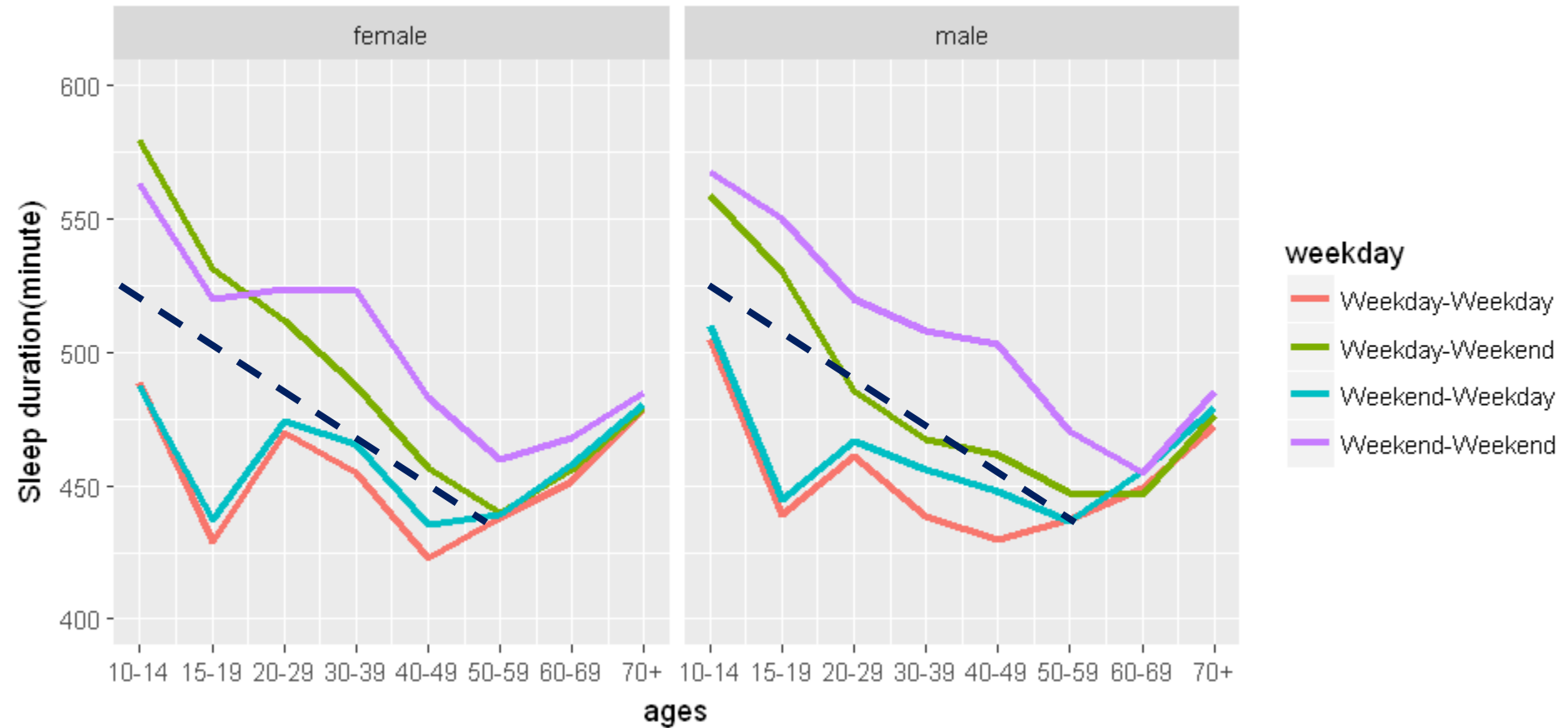
Different Measurements of Average Sleep Duration for Those Who Ever Experienced Sleep Disruption
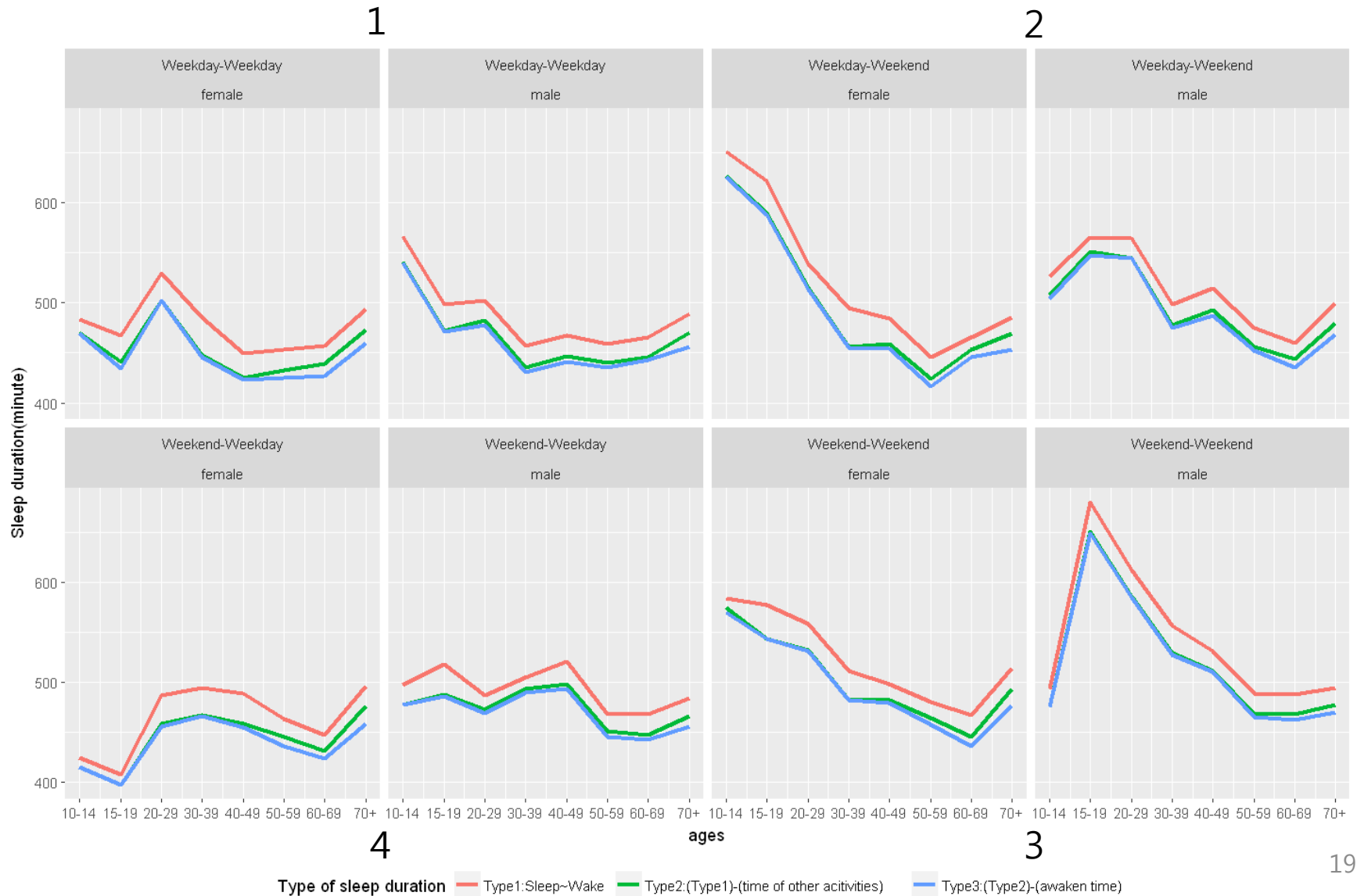
Sleep Quality

Basically, TUS cannot or does not measure sleep quality.

- Between bedtime and wake up time,

- Pattern 1: No disruption during sleep

- Pattern 2: Wake up and hard to sleep before resuming sleep

- Pattern 3: Wake up, do other activity and sleep again

- Pattern 4: Wake up, do multiple activities and sleep again

- When compared to Pattern 1, sleep quality of Patterns 2-4 may be lower.

Sleep Quality by Age, Sex and Day
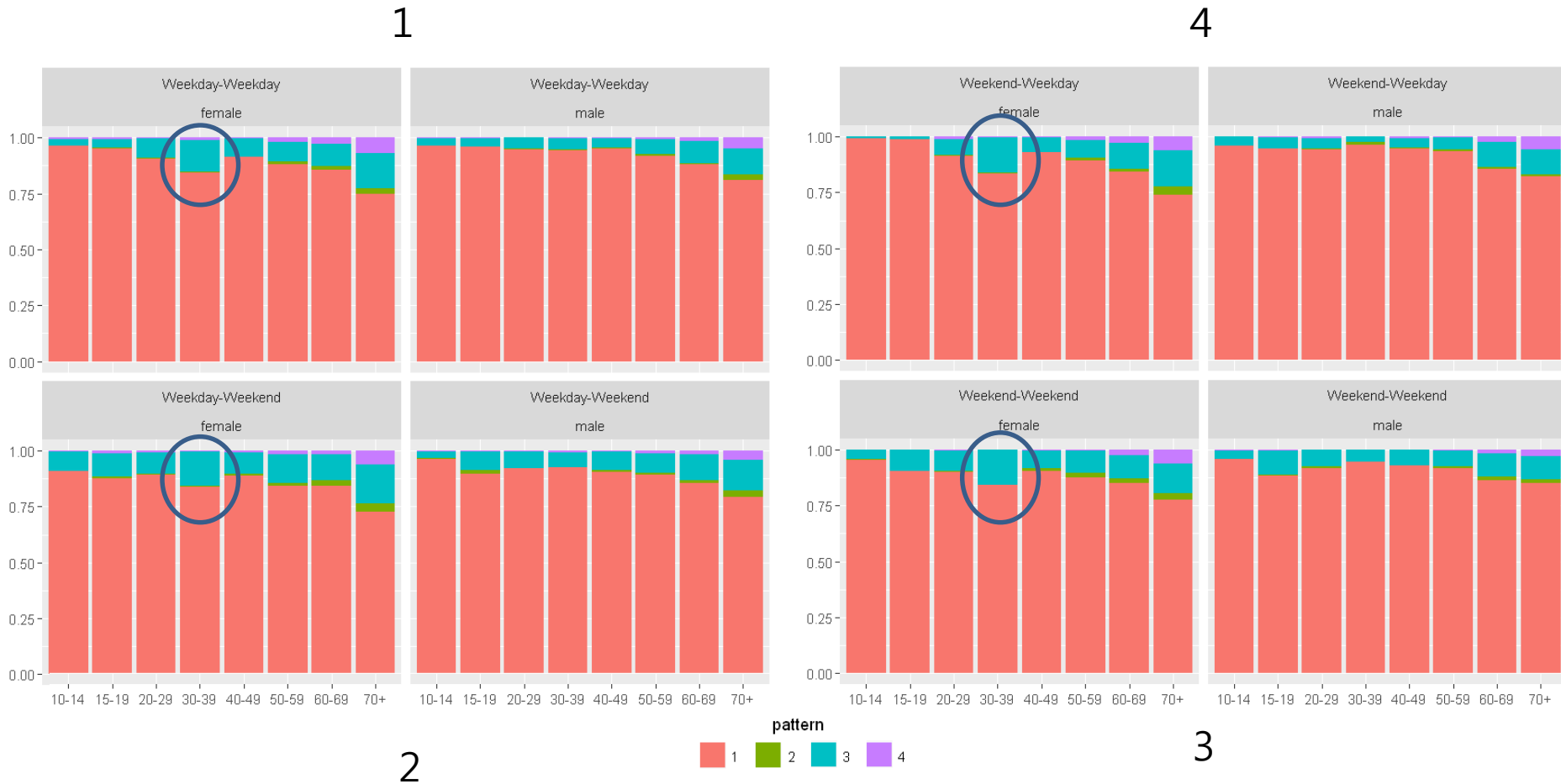
Pattern 3: Wake up, do other activity and sleep again

Sleep Quality by Age, Sex and Day

Weekday-Weekday & Female	pattern 1	pattern 2	pattern 3	pattern 4
10-14	351 (96.16)	0 (0.00)	12 (3.29)	2 (0.55)
15-19	343 (95.01)	2 (0.55)	14 (3.88)	2 (0.55)
20-29	600 (90.63)	2 (0.30)	59 (8.91)	1 (0.15)
30-39	778 (84.38)	4 (0.43)	130 (14.10)	10 (1.08)
40-49	1003 (91.18)	2 (0.18)	91 (8.27)	4 (0.36)
50-59	829 (88.10)	10 (1.06)	84 (8.93)	18 (1.91)
60-69	516 (85.43)	12 (1.99)	58 (9.60)	18 (2.98)
70+	550 (74.63)	19 (2.58)	116 (15.74)	52 (7.06)

Weekday-Weekday & Male	pattern 1	pattern 2	pattern 3	pattern 4
10-14	391 (96.31)	0 (0.00)	14 (3.45)	1 (0.25)
15-19	413 (96.05)	0 (0.00)	16 (3.72)	1 (0.23)
20-29	520 (94.55)	3 (0.55)	27 (4.91)	0 (0.00)
30-39	793 (94.29)	3 (0.36)	42 (4.99)	3 (0.36)
40-49	938 (95.04)	6 (0.61)	38 (3.85)	5 (0.51)
50-59	815 (91.68)	8 (0.90)	58 (6.52)	8 (0.90)
60-69	464 (88.21)	1 (0.19)	52 (9.89)	9 (1.71)
70+	391 (81.12)	11 (2.28)	56 (11.62)	24 (4.98)

Weekday-Weekend & Female	pattern 1	pattern 2	pattern 3	pattern 4
10-14	167 (90.76)	0 (0.00)	16 (8.70)	1 (0.54)
15-19	157 (87.71)	1 (0.56)	19 (10.61)	2 (1.12)
20-29	287 (89.41)	1 (0.31)	30 (9.35)	3 (0.93)
30-39	369 (83.86)	2 (0.45)	67 (15.23)	2 (0.45)
40-49	447 (89.04)	4 (0.80)	46 (9.16)	5 (1.00)
50-59	420 (84.34)	5 (1.00)	65 (13.05)	8 (1.61)
60-69	295 (84.29)	9 (2.57)	40 (11.43)	6 (1.71)
70+	322 (72.85)	16 (3.62)	76 (17.19)	28 (6.33)

Weekday-Weekend & Male	pattern 1	pattern 2	pattern 3	pattern 4
10-14	182 (96.30)	1 (0.53)	5 (2.65)	1 (0.53)
15-19	173 (89.64)	3 (1.55)	16 (8.29)	1 (0.52)
20-29	216 (92.31)	0 (0.00)	17 (7.26)	1 (0.43)
30-39	373 (92.56)	0 (0.00)	26 (6.45)	4 (0.99)
40-49	404 (90.38)	5 (1.12)	36 (8.05)	2 (0.45)
50-59	406 (89.43)	3 (0.66)	40 (8.81)	5 (1.10)
60-69	257 (85.38)	4 (1.33)	35 (11.63)	5 (1.66)
70+	243 (79.15)	9 (2.93)	43 (14.01)	12 (3.91)

Sleep Quality by Age, Sex and Day

Weekend-Weekend & Female	pattern 1	pattern 2	pattern 3	pattern 4
10-14	180 (95.24)	1 (0.53)	8 (4.23)	0 (0.00)
15-19	172 (90.53)	0 (0.00)	18 (9.47)	0 (0.00)
20-29	279 (90.00)	1 (0.32)	29 (9.35)	1 (0.32)
30-39	384 (84.03)	1 (0.22)	72 (15.75)	0 (0.00)
40-49	478 (90.53)	5 (0.95)	42 (7.95)	3 (0.57)
50-59	436 (87.37)	11 (2.20)	49 (9.82)	3 (0.60)
60-69	268 (85.08)	6 (1.90)	33 (10.48)	8 (2.54)
70+	285 (77.66)	11 (3.00)	48 (13.08)	23 (6.27)

Weekend-Weekend & Male	pattern 1	pattern 2	pattern 3	pattern 4
10-14	160 (95.81)	0 (0.00)	6 (3.59)	1 (0.60)
15-19	172 (88.21)	1 (0.51)	21 (10.77)	1 (0.51)
20-29	227 (91.53)	2 (0.81)	19 (7.66)	0 (0.00)
30-39	380 (94.76)	0 (0.00)	20 (4.99)	1 (0.25)
40-49	458 (92.71)	1 (0.20)	34 (6.88)	1 (0.20)
50-59	440 (91.86)	3 (0.63)	34 (7.10)	2 (0.42)
60-69	242 (86.12)	5 (1.78)	29 (10.32)	5 (1.78)
70+	207 (84.84)	5 (2.05)	25 (10.25)	7 (2.87)

Weekend-Weekday & Female	pattern 1	pattern 2	pattern 3	pattern 4
10-14	196 (98.99)	0 (0.00)	2 (1.01)	0 (0.00)
15-19	171 (98.84)	0 (0.00)	2 (1.16)	0 (0.00)
20-29	259 (91.20)	1 (0.35)	21 (7.39)	3 (1.06)
30-39	387 (83.59)	1 (0.22)	73 (15.77)	2 (0.43)
40-49	508 (92.87)	1 (0.18)	36 (6.58)	2 (0.37)
50-59	426 (89.31)	5 (1.05)	39 (8.18)	7 (1.47)
60-69	250 (84.18)	4 (1.35)	34 (11.45)	9 (3.03)
70+	291 (73.86)	15 (3.81)	63 (15.99)	25 (6.35)

Weekend-Weekday & Male	pattern 1	pattern 2	pattern 3	pattern 4
10-14	206 (95.81)	0 (0.00)	9 (4.19)	0 (0.00)
15-19	180 (94.74)	0 (0.00)	9 (4.74)	1 (0.53)
20-29	249 (94.32)	1 (0.38)	12 (4.55)	2 (0.76)
30-39	394 (96.33)	4 (0.98)	11 (2.69)	0 (0.00)
40-49	449 (94.53)	3 (0.63)	19 (4.00)	4 (0.84)
50-59	444 (93.28)	4 (0.84)	25 (5.25)	3 (0.63)
60-69	233 (85.66)	2 (0.74)	30 (11.03)	7 (2.57)
70+	200 (82.30)	2 (0.82)	27 (11.11)	14 (5.76)

Conclusion

- Problems

1) Pattern of sleep duration in NHNES by different measurements of sleep duration (--2015 vs. 2016)

2) Pattern of sleep duration based on different measurements between NHNES and TUS

- Validity and reliability of sleep measurement

1) NHNES(- 2015): reliable but not valid

2) NHNES(2016...2017, 2018): Wait to see validity and reliability

3)KTUS: valid and reliable?

Conclusion

- Can try to measure sleep duration with 24-hour and 48-hour time diaries.
- Can see different patterns of sleep duration by pairs of weekday and weekend days, and by age and sex.
- Can try to distinguish people of different quality of sleep
- This is an exercise to better measure sleep duration and sleep quality using time-use survey data.