

台大公衛學院
抗2019-nCoV疫情說明會
發燒體溫下修之建議

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人類正常體溫在下降

- 目前正常體溫的建立，是1851年德國學者Carl Reinhold August Wunderlich 從25000個病人的上百萬個腋溫調查，建議： 37°C ($36.2\text{-}37.5$)為正常體溫。已有現代的許多(28個以上)研究發現人類的體溫在下降。
- 2017年英國醫學雜誌 (BMJ)的論文指出，現在測到的人類體溫，是在英國一家大的學術醫院，在2009-2014 年期間，在35488位非感染且未使用抗生素的門診病人，測量的口內體溫平均是 36.6°C (95% 信賴區間是 $35.7\text{-}37.3^{\circ}\text{C}$)。
- 2020年1月在eLife發表。由美國史丹福大學完成的研究，比較了兩三個世代群眾，從工業革命後到最近的人類正常體溫，歷經157年間，發現人類的體溫從當時的 37°C ，下降到2007-2017年。現在的口內體溫男性是降 0.59°C ，女性是降 0.32°C 。經矯正年齡高度體重後約每十年降 0.03°C 。
- 此次武漢肺炎(COVID-19)大部分病人皆有發燒之症狀，第一篇論文指出有20% 之病人體溫在 $37.3\text{-}38^{\circ}\text{C}$ 。(Huang et al, Lancet 2020 Jan. 24)
- 基於防疫視同作戰，對於發燒之病人以較嚴格之篩檢標準，是否要調整，值得檢視評估後，提出建議。



OPEN ACCESS

Individual differences in normal body temperature: longitudinal big data analysis of patient records

Ziad Obermeyer,^{1,2} Jasmeet K Samra,¹ Sendhil Mullainathan³

ABSTRACT

OBJECTIVE

To estimate individual level body temperature and to correlate it with other measures of physiology and health.

DESIGN

Observational cohort study.

SETTING

Outpatient clinics of a large academic hospital, 2009-14.

PARTICIPANTS

35 488 patients who neither received a diagnosis for infections nor were prescribed antibiotics, in whom temperature was expected to be within normal limits.

MAIN OUTCOME MEASURES

Baseline temperatures at individual level, estimated using random effects regression and controlling for ambient conditions at the time of measurement, body site, and time factors. Baseline temperatures were correlated with demographics, medical comorbidities, vital signs, and subsequent one year mortality.

8.2% of individual temperature variation. Despite this, unexplained temperature variation was a significant predictor of subsequent mortality: controlling for all measured factors, an increase of 0.149°C (1 SD of individual temperature in the data) was linked to 8.4% higher one year mortality ($P=0.014$).

CONCLUSIONS

Individuals' baseline temperatures showed meaningful variation that was not due solely to measurement error or environmental factors. Baseline temperatures correlated with demographics, comorbid conditions, and physiology, but these factors explained only a small part of individual temperature variation. Unexplained variation in baseline temperature, however, strongly predicted mortality.

Introduction

Have you ever felt cold, or warm, in a room where everyone else felt comfortable? This common experience about room temperature has some interesting lessons for body temperature and how we measure it. To know how warm or cold someone

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Cite this as: *BMJ* 2017;359:j5468
<http://dx.doi.org/10.1136/bmj.j5468>

Accepted: 23 November 2017

Major findings

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2017年

BMJ

36.6°C *

2009-2014年

35500人

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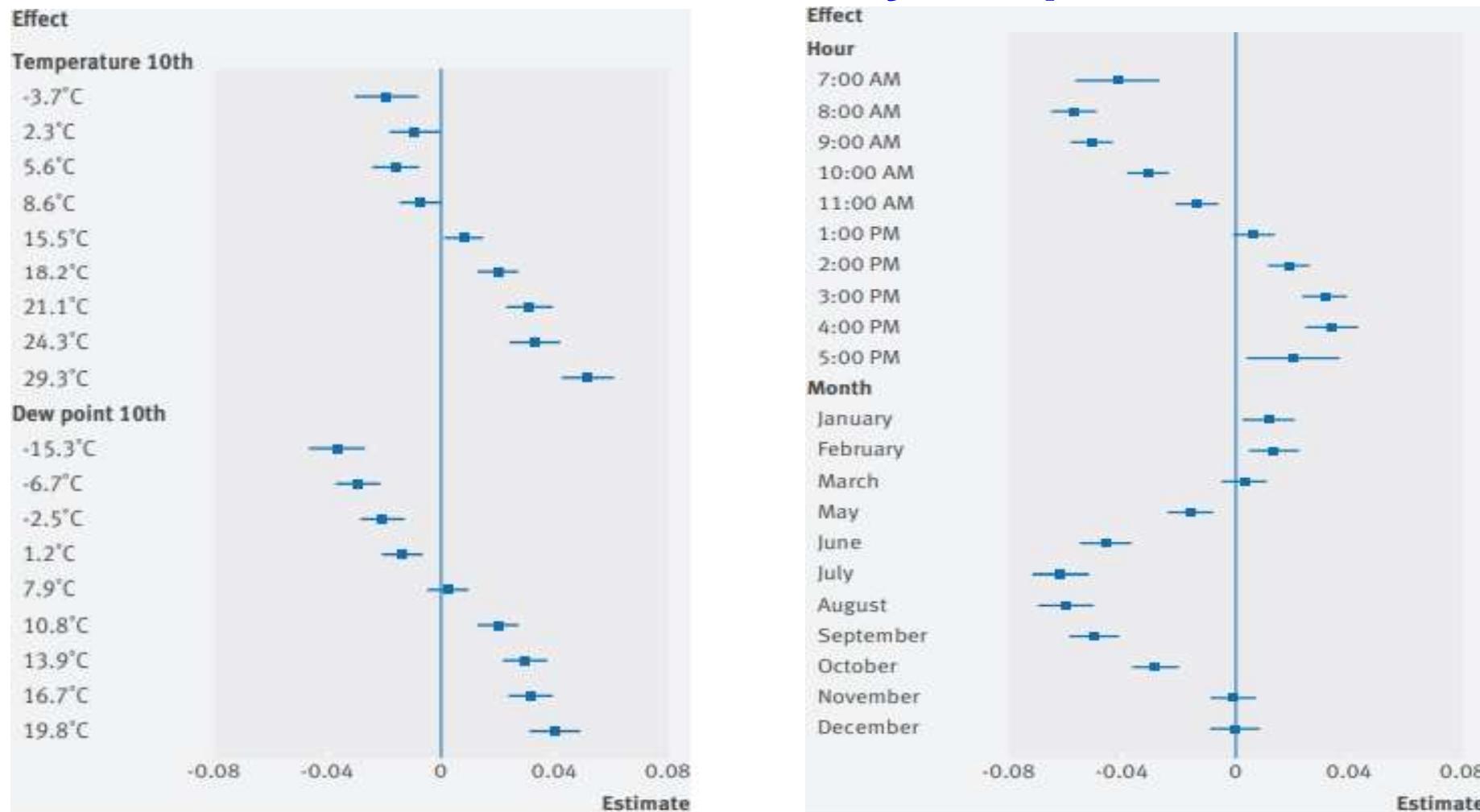
Baseline temperatures at individual level, estimated using random effects regression and controlling for ambient conditions at the time of measurement, body site, and time factors. Baseline temperatures were correlated with demographics, medical comorbidities, vital signs, and subsequent one year mortality.

RESULTS

In a diverse cohort of 35 488 patients (mean age 52.5 years, 64% women, 41% non-white race) with 243 50 temperature measurements, mean temperature was 36.6°C (95% range 35.7-37.3°C, 99% range 35.3-37.7°C). Several demographic factors were linked to individual level temperature, with older people the coolest (-0.021°C for every decade, P<0.001) and African-American women the hottest (versus white men: 0.052°C, P<0.001). Several comorbidities were linked to lower temperature (eg, hypothyroidism: -0.013°C, P=0.01) or higher temperature (eg, cancer: 0.020, P<0.001), as were physiological measurements (eg, body mass index: 0.002 per m/kg², P<0.001). Overall, measured factors collectively explained only

- Mean age 52.9 years.
- Mean temperature (oral)
 36.6°C (95% CI 35.7-37.3) $^{\circ}\text{C}$
- Lower and higher temperature linked to many diseases

Figure 1. Relation of temporal and environmental factors to measured body temperature.



Coefficients estimated by random effects regression are shown for ambient temperature, dew point, hour, and month, compared with reference categories: median temperature 10th (12.2°C), median dew point 10th (4.7°C), 12 pm, and April, respectively



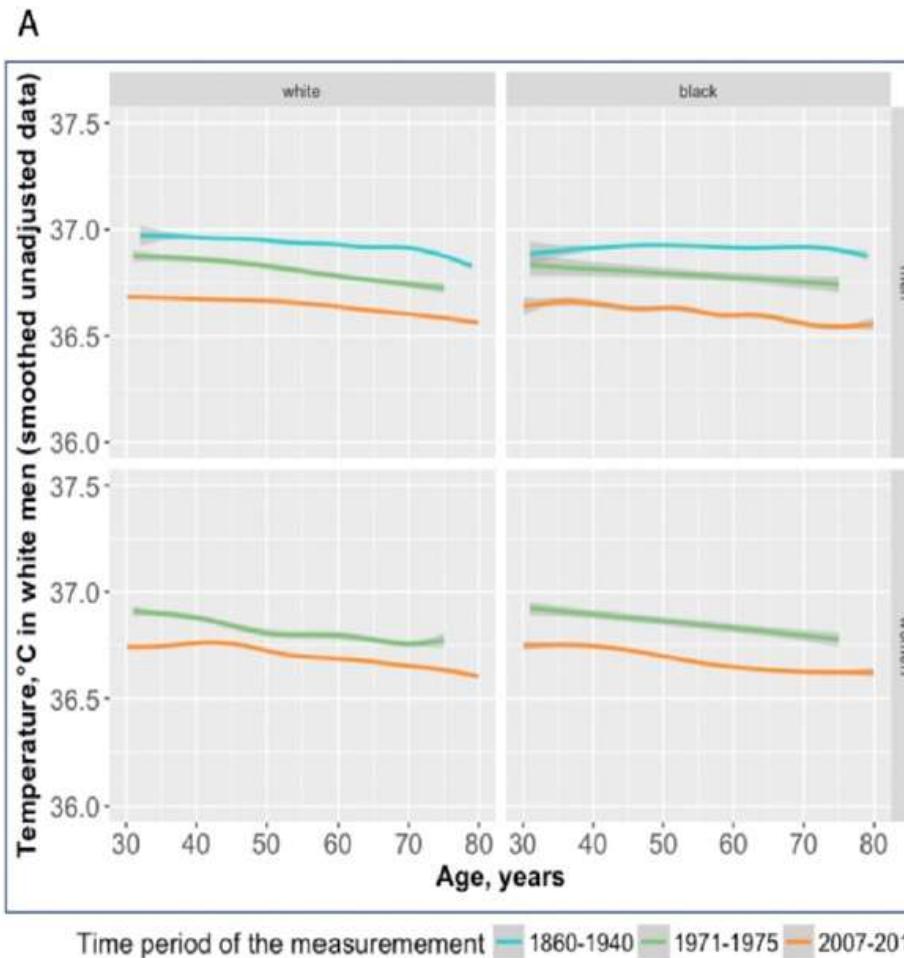
Decreasing human body temperature in the United States since the Industrial Revolution

Myroslava Protsiv¹, Catherine Ley¹, Joanna Lankester², Trevor Hastie^{3,4}, Julie Parsonnet^{1,5*}

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³Department of Statistics, Stanford University, Stanford, United States; ⁴Department of Biomedical Data Science, Stanford University, School of Medicine, Stanford, United States; ⁵Division of Epidemiology, Department of Health Research and Policy, Stanford University, School of Medicine, Stanford, United States

Figure 1. Body temperature measurements by age as observed in three different time periods: 1860–1940 (UAVCW), 1971–1975 (NHANES 1), and 2007–2017 (STRIDE).



B

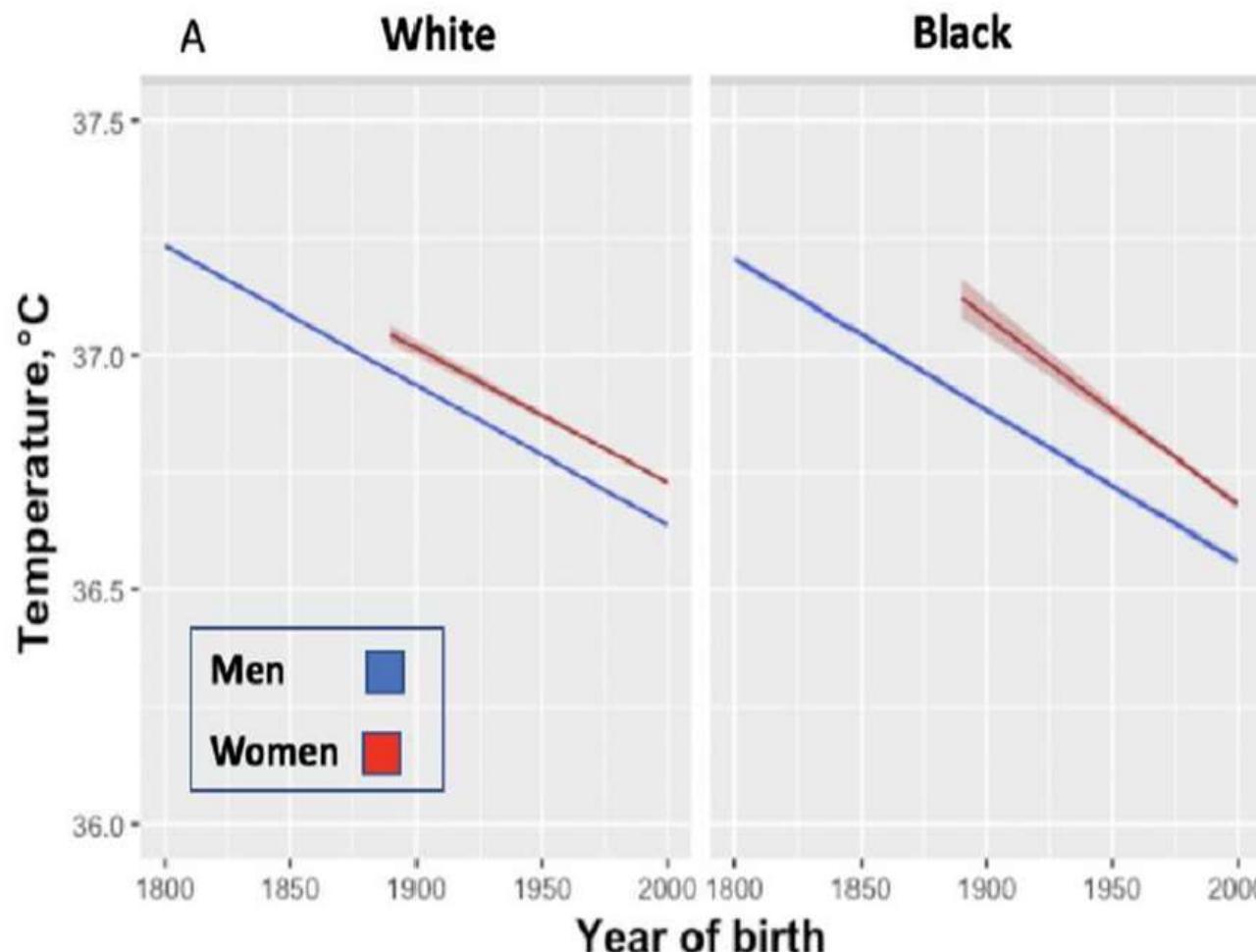
B	Coefficient (Standard error)				
	UAVCW 1860-1940	NHANES 1971-1975		STRIDE 2007-2017	
		Men	Women	Men	Women
Intercept	37.14 (0.025)	37.73 (0.18)	36.80 (0.18)	36.67 (0.02)	36.79 (0.02)
Age (yrs)	-0.003 (0.0001)	-0.003 (0.0005)	-0.003 (0.0006)	-0.003 (0.0001)	-0.004 (0.0001)
Weight (kg)	-0.0002 (0.0001)	0.0009 (0.0005)	0.0006 (0.0004)	0.001 (0.0001)	0.0007 (0.0001)
Height (cm)	0.0001 (0.0002)	-0.0003 (0.001)	-0.002 (0.001)	-0.002 (0.0001)	-0.001 (0.0001)
Ethnicity: Black	-0.021 (0.002)	-0.001 (0.023)	0.01 (0.02)	-0.06 (0.003)	-0.05 (0.002)
Ethnicity: Other	NA	0.118 (0.066)	0.054 (0.075)	-0.009 (0.002)	-0.0075 (0.002)
Time of day	NA	0.012 (0.016)	0.001 (0.002)	0.02 (0.0003)	0.02 (0.0002)
Adjusted R ²	0.01	0.05	0.03	0.05	0.05

C

C	Modeled temperature, Age 30 years, weight 70 kg and height 170 cm		
	UAVCW 1860-1940	NHANES 1971-1975	
		STRIDE 2007-2017	
Black Men	37.01 (37.01-37.02)	36.85 (36.83-36.88)	36.62 (36.61-36.63)
White Men	37.03 (37.03-37.04)	36.83 (36.80-36.86)	36.68 (36.68-36.68)
Black Women	NA	36.87 (36.82-36.92)	36.72 (36.71-36.72)
White Women	NA	36.86 (36.83-36.89)	36.77 (36.77-36.77)

(A) Unadjusted data (local regression) for temperature measurements, showing a decrease in temperature across age in white men, black men, white women, and black women, in the three cohorts. (B) Coefficients and standard errors from multivariate linear regression models for each cohort including age, weight, height, ethnicity group and time of day as available. Yellow cells are statistically significant at a p value of < 0.01, orange cells are of borderline significance (p<0.1 but >0.05), and remaining uncolored cells are not statistically significant. (C) Expected body temperature for 30 year old men and women with weight 70 kg and height 170 cm in each time period/cohort.

Figure 3. Modeled body temperature over time in three cohorts by birth year (black and white ethnicity groups).

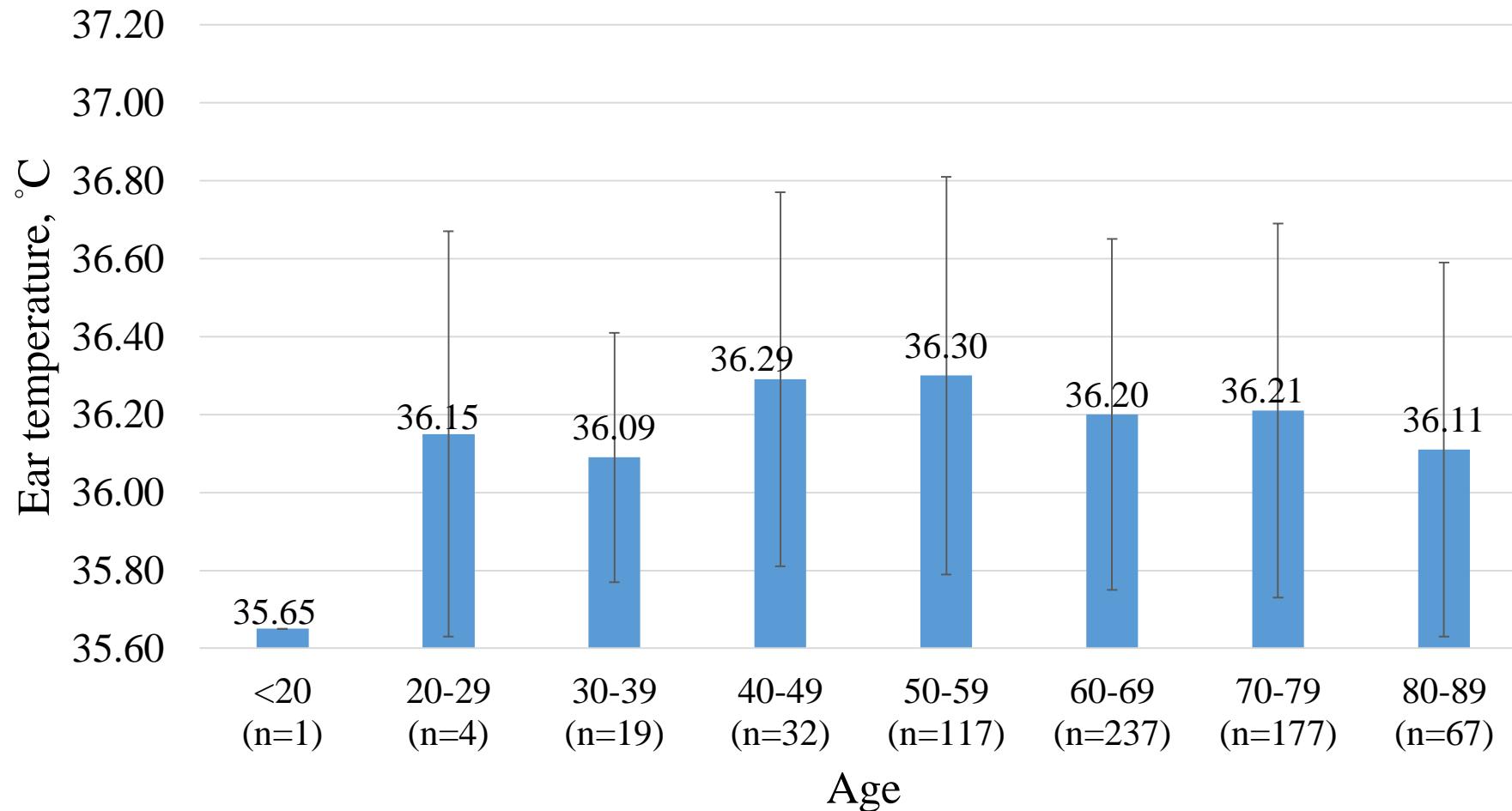


B	Coefficient (Standard error)			
	White		Black	
	Men	Women	Men	Women
Intercept	37.60 (0.020)	37.65 (0.030)	37.46 (0.039)	38.04 (0.068)
Age (yrs)	-0.0060 (0.0001)	-0.0066 (0.0001)	-0.0054 (0.0001)	-0.0086 (0.0003)
Weight (kg)	0.001 (0.0001)	0.0008 (0.0001)	0.0004 (0.0001)	0.0004 (0.0001)
Height (cm)	-0.0015 (0.0001)	-0.0012 (0.0001)	-0.0007 (0.0002)	-0.0019 (0.0003)
Birth year	-0.0030 (0.0001)	-0.0029 (0.0001)	-0.0032 (0.0001)	-0.0040 (0.0002)
Adjusted R ²	0.19	0.03	0.27	0.05

(A) Body temperature decreases by birth year in white and black men and women. No data for women were available for the birth years from 1800 to 1890. (B) Coefficients (and standard errors) used for the graph from multivariate linear regression including age, body weight, height and birth year. All cells are significant at greater than 99% significance level.

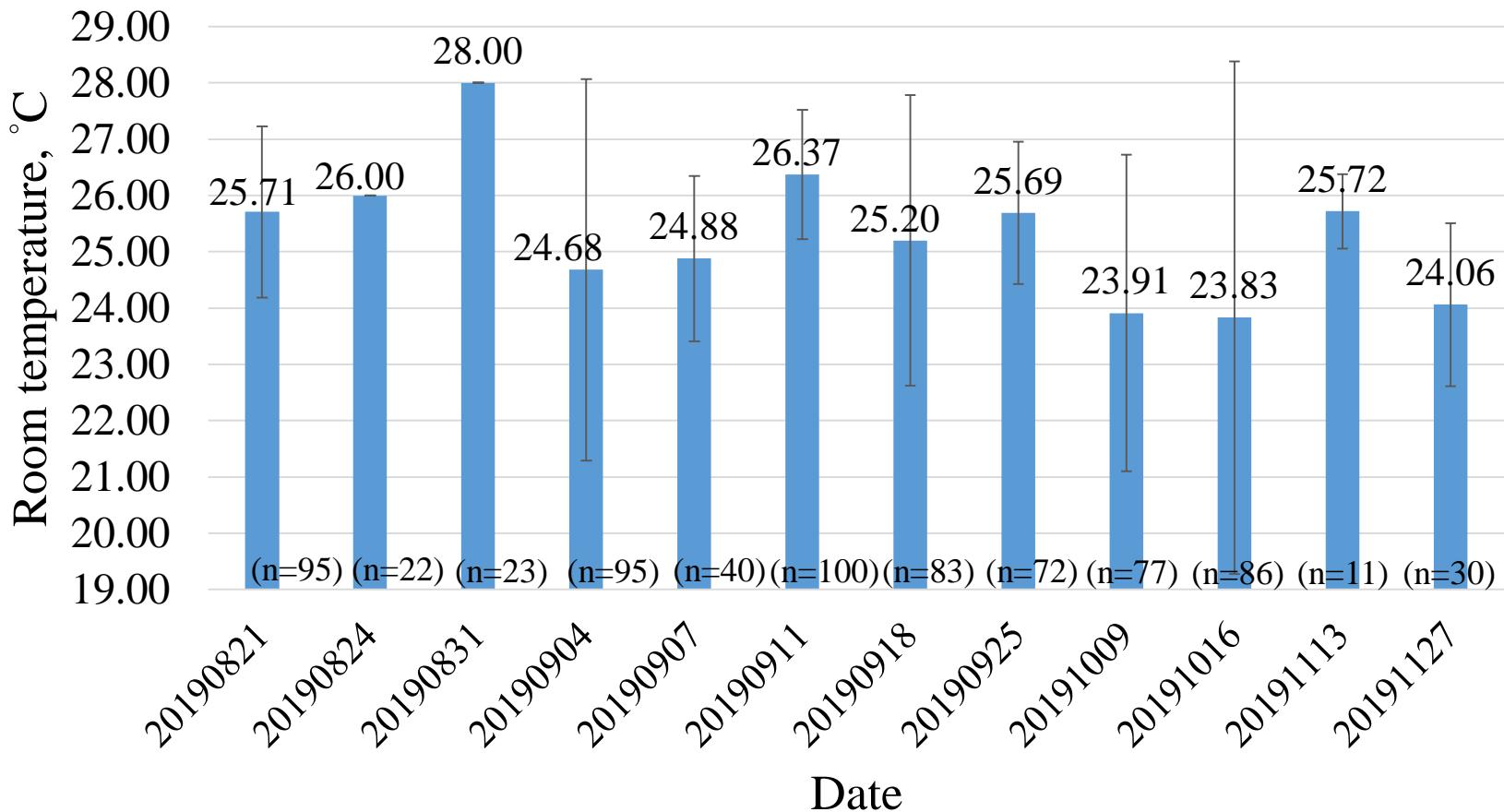
台大醫院內科門診非傳染疾病門診病人之 體(耳)溫分布圖 (依年齡組別) 2019年八月到十一月

(n=654；男性255位女性399位： 65.49 ± 12.22 歲)



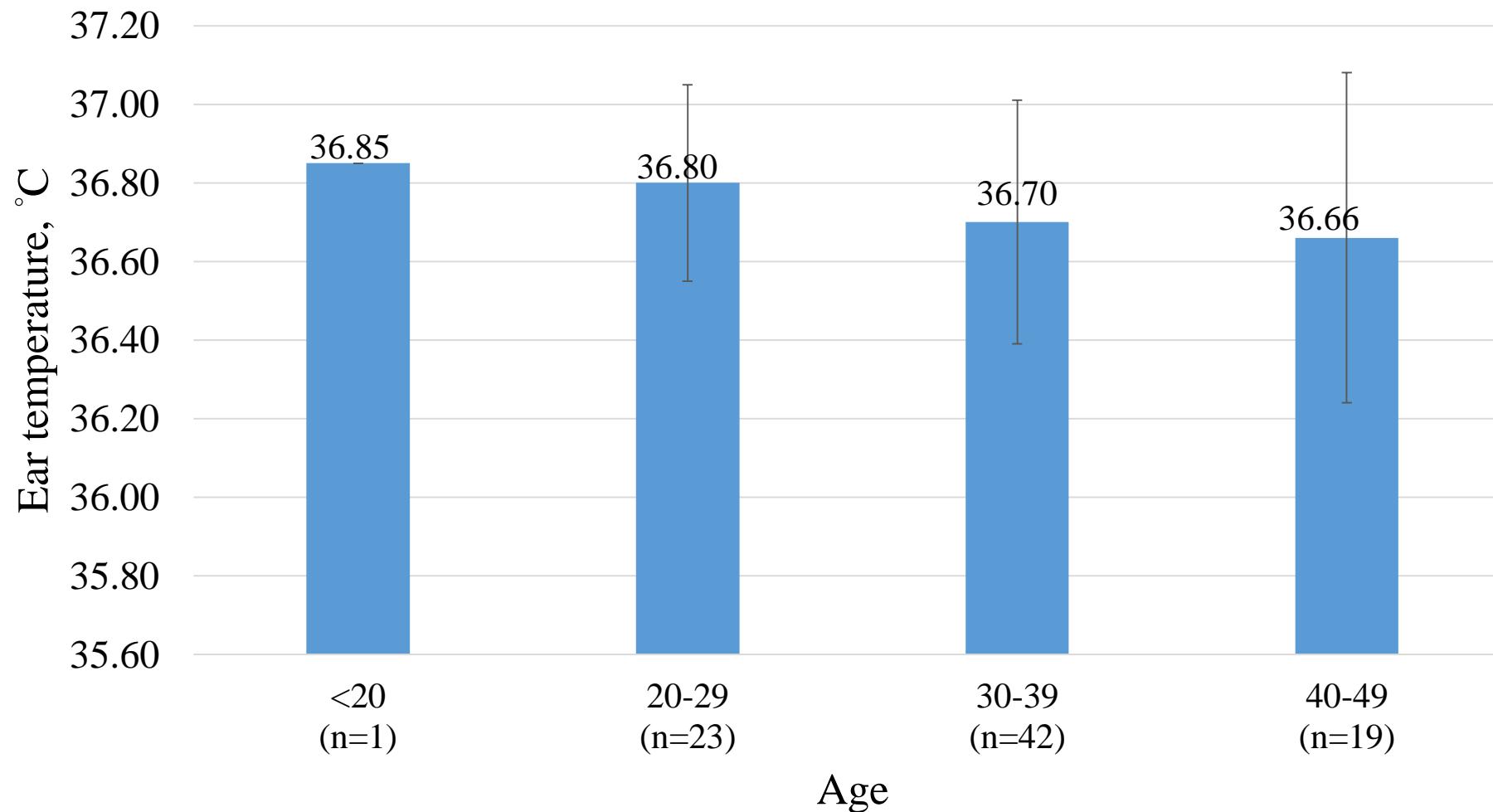
研究期間室內溫度測量

(Outpatients+YOTA, n=739)



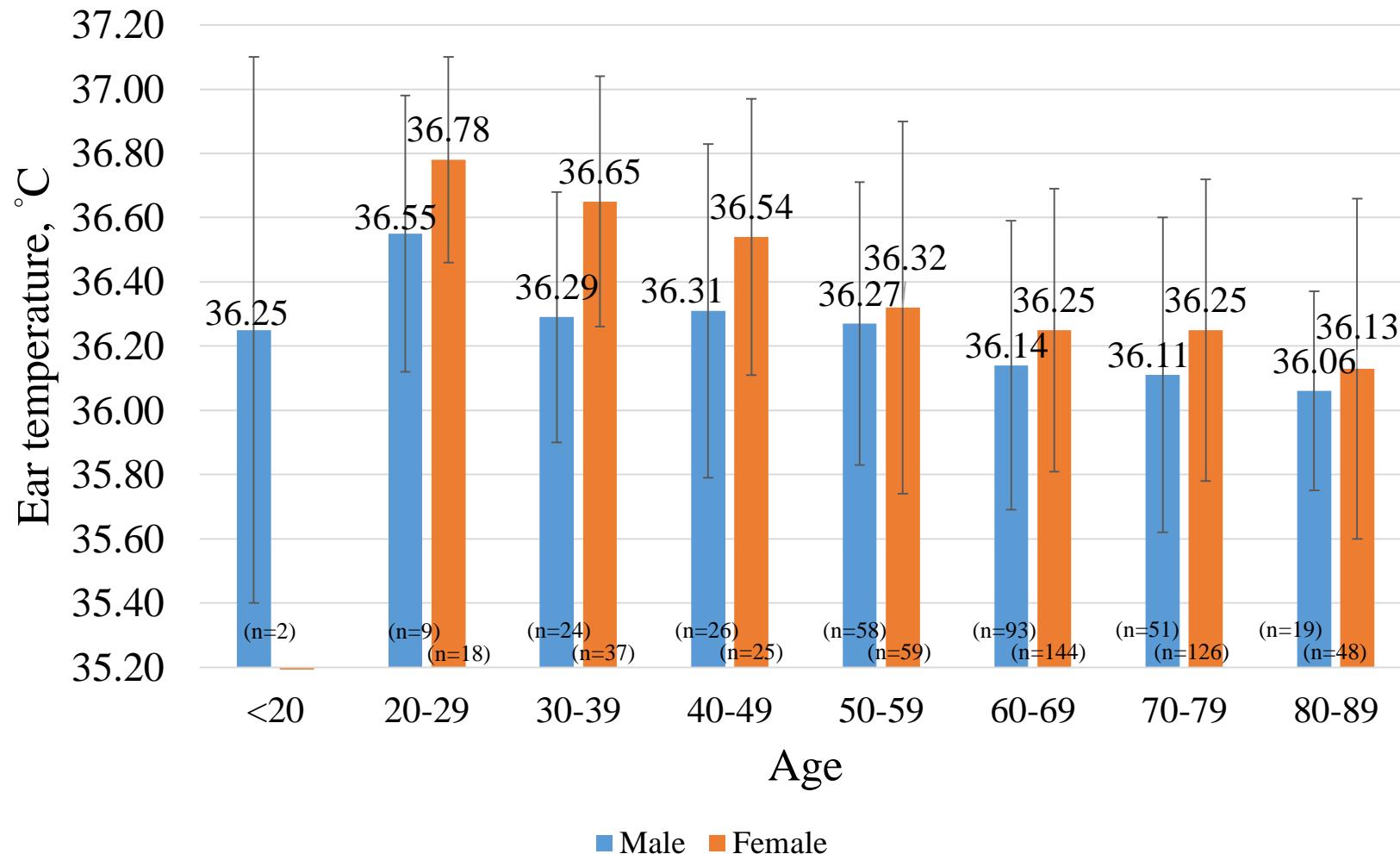
台大醫院參加YOTA研究之健康年輕成年人之體溫分布圖 (依年齡組別) 2019年 8/24-9/7

(YOTA, n=85) (女性58男性27位：平均年齡33.76 (6.36)歲)



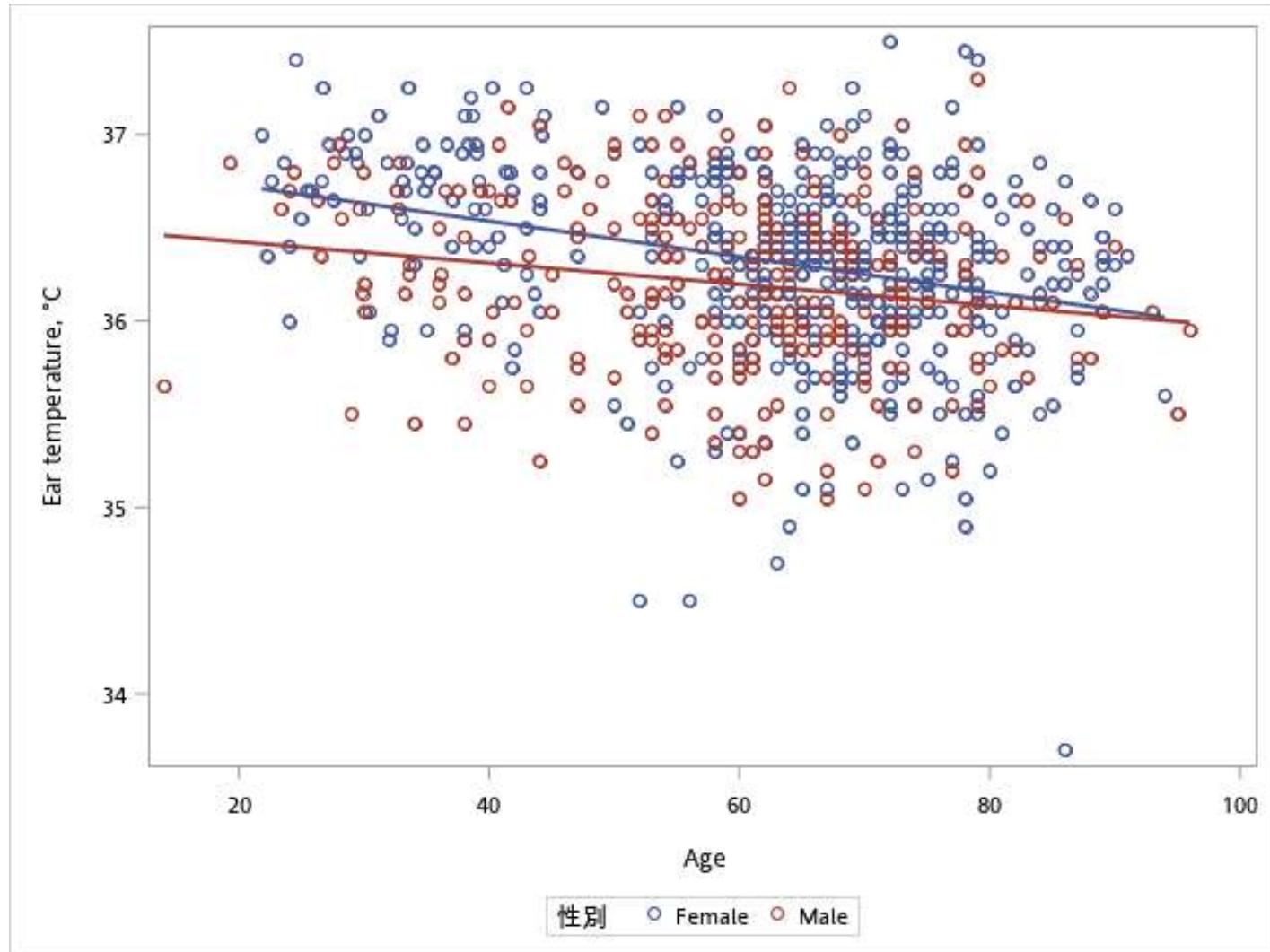
台大非傳染疾病病人及健康成年人之體 (耳)溫分布圖 (依性別及年齡組別)

(Outpatients + YOTA, n=739)



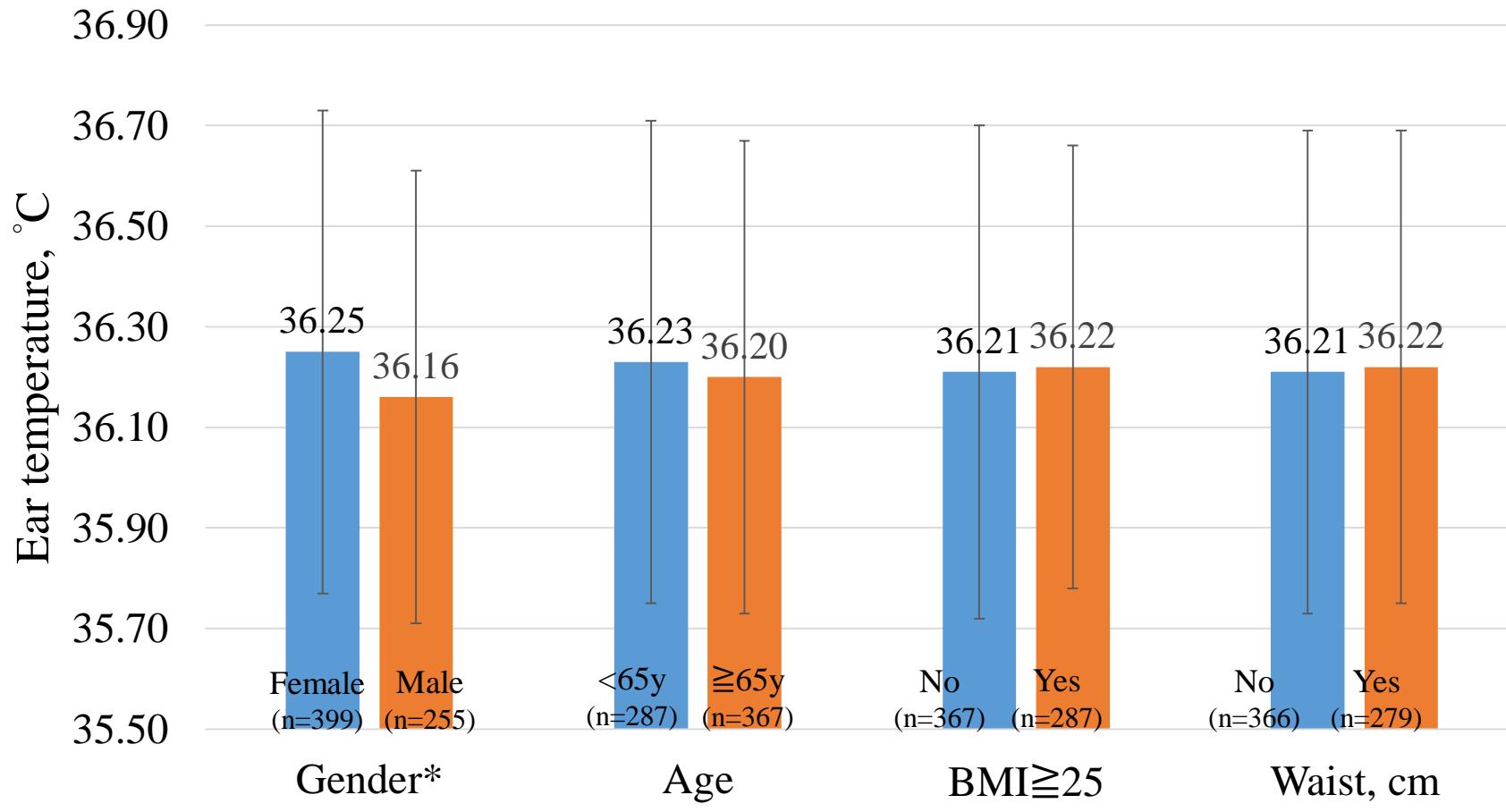
耳溫與年齡之相關性：依性別分組

(Outpatients+YOTA, n=739)



耳溫與門診病人個人特質之比較

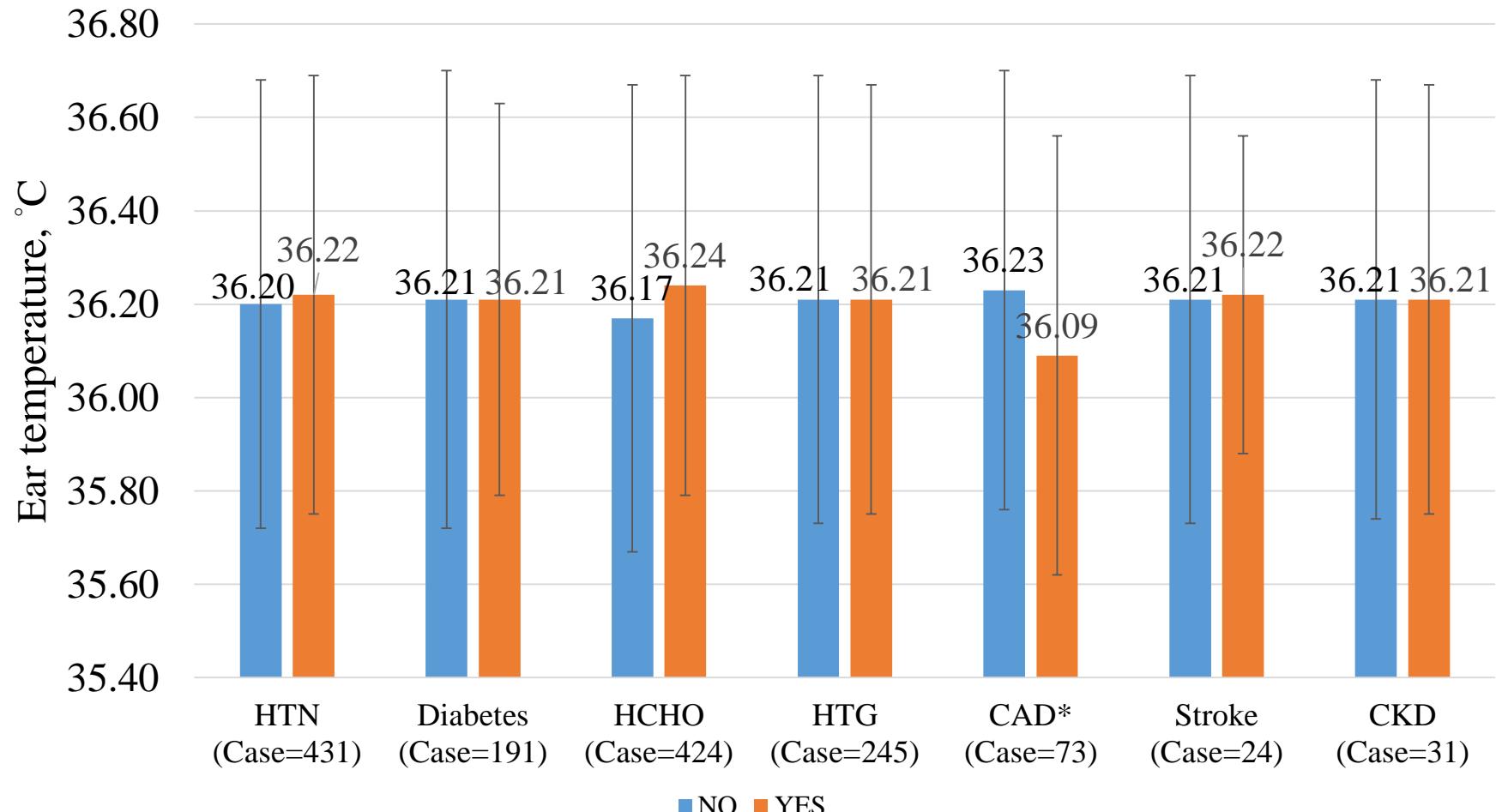
(n=654)



*: p-value between 2 groups < 0.05

耳溫與門診病人三高疾病之比較

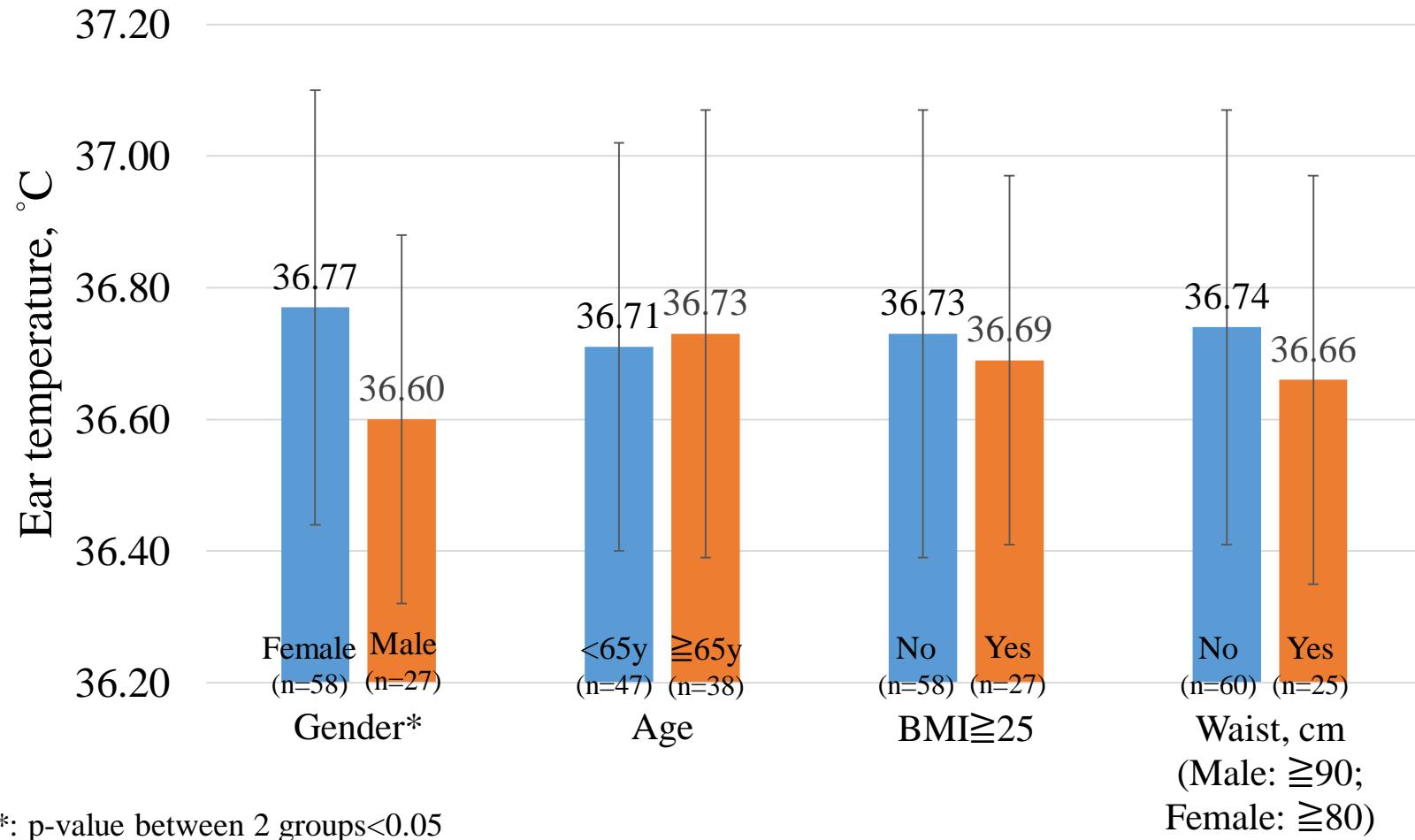
(n=654)



*: p-value between 2 groups<0.05

耳溫與健康成年人個人特質之比較

(YOTA cohort, n=85)



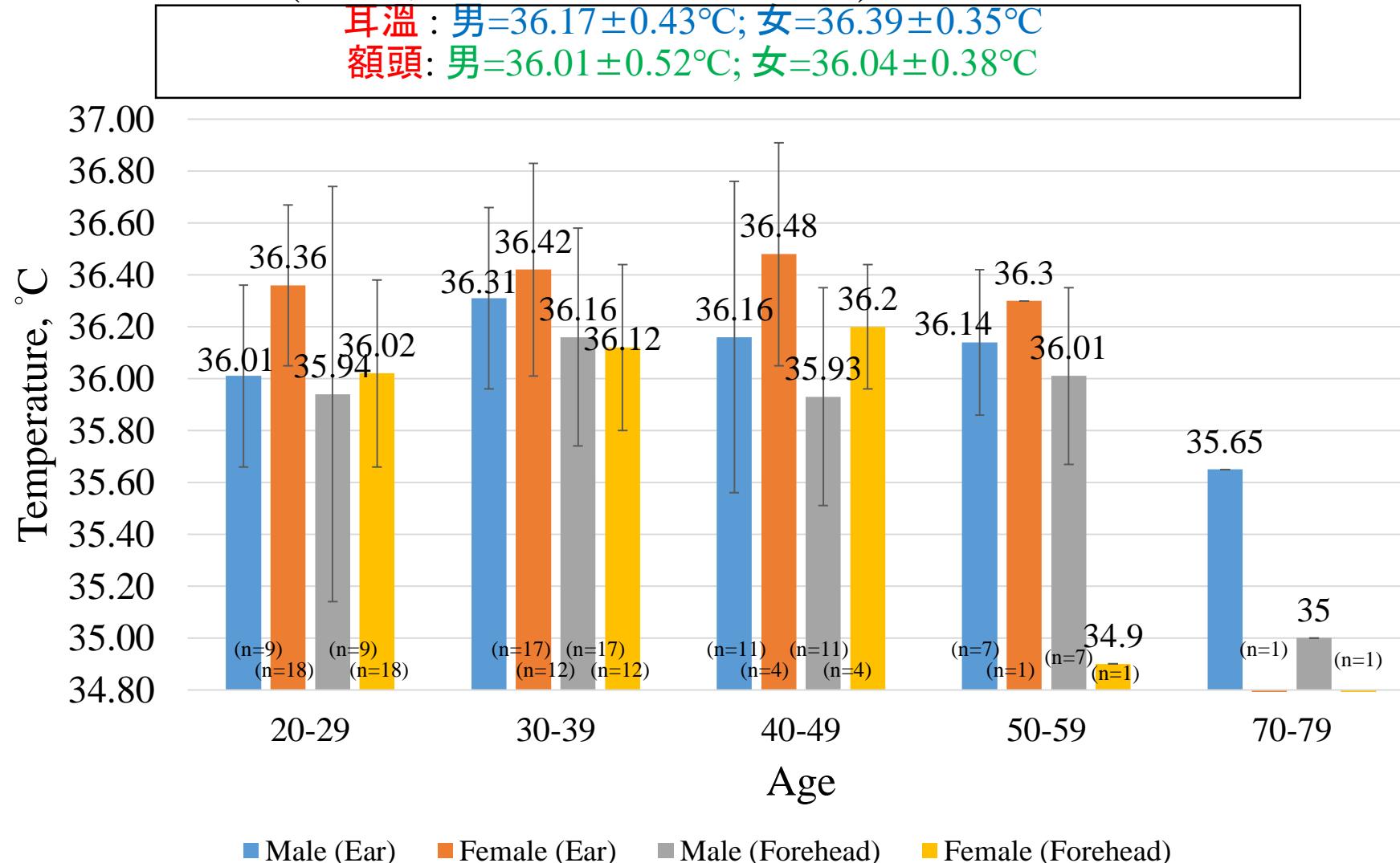
台大公衛學院抗2019-nCoV疫情說明會 與會人員耳溫及額溫之測量 (20200217)



- 百齡耳溫槍型號IRT6030
優盛公司額溫槍型號HA500
- 共八十人 男性44女性36位

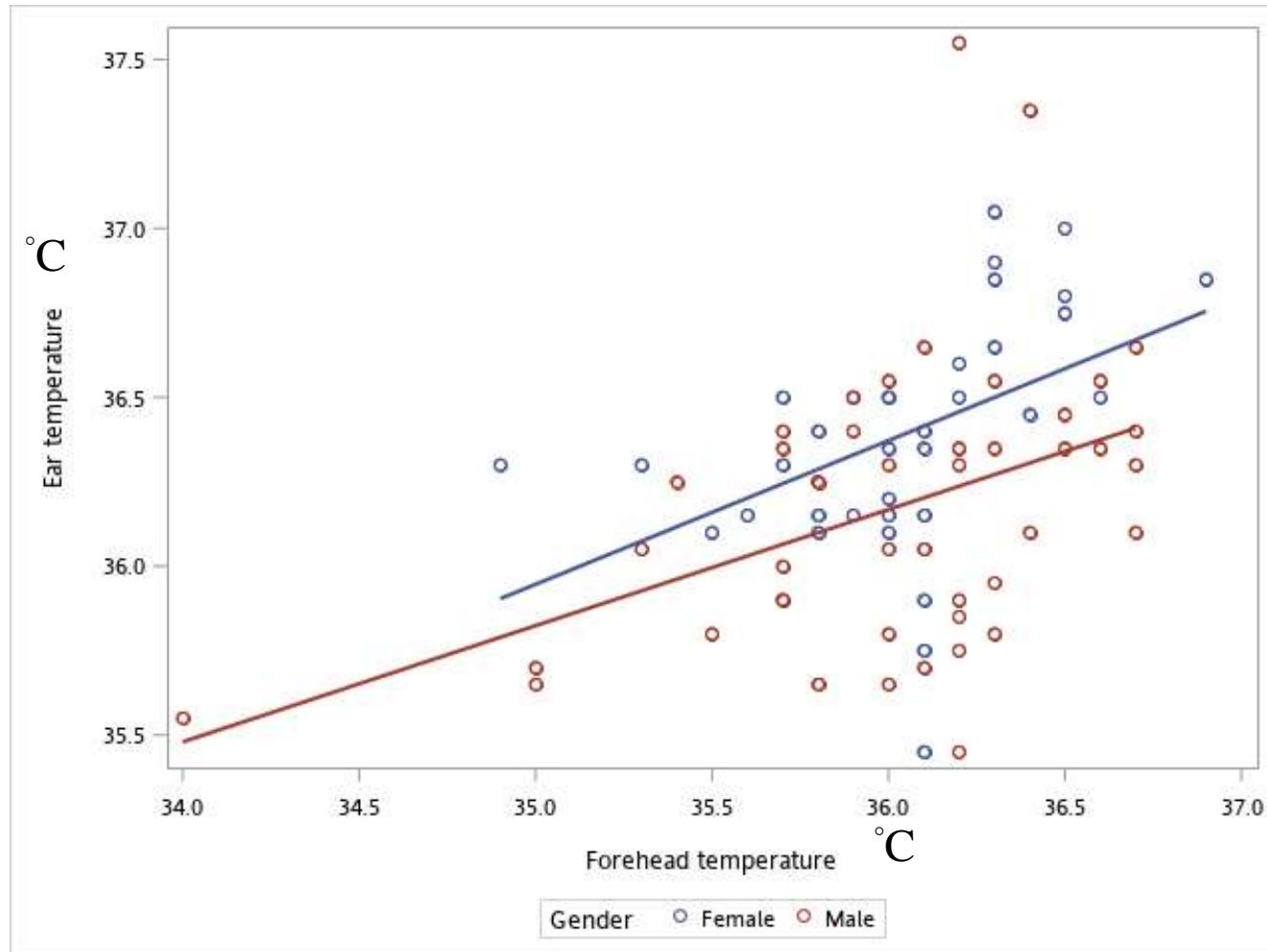
台大公衛學院

抗2019-nCoV疫情說明會與會人員耳溫及額溫之分布 (n=80,男性 44位女性 36位) 20200217



台大公衛學院 抗2019-nCoV疫情說明會 與會人員耳溫與額溫之相關性 (n=80)

20200217



Female:

$$\text{Ear} = 21.05 + 0.43 * \text{Forehead}$$

$$R_{\text{adj}}^2 = 0.1941$$

(p-value=0.0047)

Male:

$$\text{Ear} = 23.78 + 0.34 * \text{Forehead}$$

$$R_{\text{adj}}^2 = 0.1569$$

(p-value=0.0041)

臺大醫院2019年門診病人及參與YOTA研究之健康年輕成年人之體溫(耳溫)

- 去(2019)年九月到十一月，蘇大成醫師在台大醫院內科非傳染疾病的門診，量測病人之體溫平均及分布，總共654位，男性255位女性399位；平均年齡 65.49 ± 12.22 歲。發現男性平均耳溫是 $36.16(0.45)^\circ\text{C}$ 而女性是 $36.25(0.48)^\circ\text{C}$ 。至於年輕成年人其體溫則稍高，在台大醫院參加YOTA研究之健康年輕成年人，女性58位男性27位共85位，平均年齡是 33.76 ± 6.36 歲之體溫測量，發現男性平均耳溫是 $36.6(0.28)^\circ\text{C}$ 而女性是 $36.77(0.33)^\circ\text{C}$ 。739位男性平均耳溫是 $36.2(0.46)^\circ\text{C}$ 而女性是 $36.31(0.5)^\circ\text{C}$ 。
- 而20200217針對80位參加公衛學院記者會之媒體工作者之體溫量測，男性44位女性36位，發現耳溫溫度男性是 $36.17 \pm 0.43^\circ\text{C}$ ；而女性是 $36.39 \pm 0.35^\circ\text{C}$ 。額頭溫度男性是 $36.01 \pm 0.52^\circ\text{C}$ ；女性是 $36.04 \pm 0.38^\circ\text{C}$ 。

發燒定義之建議

- 鑑於上述之調查，在國內目前並無大規模之群體調查資料可參考。基於疫情控制之需要，武漢病毒研究發現許多病人以微燒(37.3°C 以上)來表現。在防疫期間，對目前發燒以 38°C 以上之標準，修訂為衛福部定義的可能輕微發燒，即 37.5°C 以上之病人必須建議進一步評估，先不要上學上班，建議至發燒門診接受評估及治療。這項標準擴及大專院校以上之學生及老師，公務人員以及工廠公司的勞工。
- 至於高中(含)以下之學生也是依循 37.5°C (含)以上之標準，超過者建議先不要上學，建議至發燒門診接受評估及治療。

中小學及大專院校發燒評估及處置建議

- 每位學生進學校必須評估體溫，使用額頭溫度篩檢，若有發燒者 37.5°C (含)以上者，休息五分鐘接受第二次檢查，如若仍然超過 37.5°C (含)者，必須接受耳溫儀器檢查，如仍然超過 37.5°C (含)者，詢問是否有咳嗽及呼吸困難等症狀，必須請假並戴口罩回家，請假不須醫師證明。
- 家長或學生必須聯絡家庭醫師或可以適當就診之醫師，說明其發燒之情形以及旅遊史，是否接觸來自疫區之病人，再安排至適當之發燒檢疫門診，安排進一步之檢查及治療。
- 學校校護及老師必須列冊密切追蹤發燒之學生，以擬定後續可能之隔離或處置。