出國報告（出國類別：開會）

2024 美國胸腔醫學會年會(ATS)及美國智慧醫療與睡眠醫學交流

服務機關：衛生福利部臺中醫院

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派赴國家/地區：美國/加州

出國期間：113 年 5 月 3 日至 5 月 10 日&113 年 5 月 17 日至 5 月 22 日

報告日期：113 年 7 月 5 日

摘要

參訪以 AHMC Healthcare Inc.為主是美國加州的醫療集團之一，旗下附屬 10 家醫院，超過萬名員工並與 6000 多名醫師合作的醫療集團包括 Doctors Hospital Of Riverside、Seton Medical Center 及 Seton Coastside、Garfield Medical Center 等，每年至少服務 20 萬人次。邱前部長為集團的共同執行長指出成功的醫院管理應具備基礎管理完備、注重品質與病人安全、優化急診流程、聚焦門診及日間手術、有效率的醫保給付流程，以及與醫師緊密合作等特點。該集團自 2016 年起發展「語音智慧照護」（Voice Smart Care）系統，並有發展穿戴型裝置、達文西手術、語音病歷紀錄、預測分析、遠距照護系統、影像診斷及最新的 GPT-4 於醫師及醫療顧問系統。我有興趣的睡眠醫學檢查已從醫院檢查 level 1 轉至居家檢查 level 3，並使用遠距照護提升照護品質。

這次參加美國胸腔醫學年會，分享了 3 篇研究: 1）Predicting the effect of mandibular advancement device by neck computed tomography; 2）Evaluating the cost effectiveness of different approaches for patients with moderate to severe obstructive sleep apnea; 3）Comparison of telomere length between patients with and without obstructive sleep apnea，受到廣泛討論及重視。

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113 年 5 月 3 日至 5 月 10 日(美國加州交流觀摩智慧醫療及睡眠醫學)以及 113 年 5 月 17 日至 5 月 22 日(參加美國胸腔醫學年會學術研究分享)

過程

感謝邱前部長安排參訪 AHMC Healthcare Inc.的醫療集團，旗下附屬 10 家醫院包含醫學中心及社區醫院包括 Doctors Hospital Of Riverside、Seton Medical Center 及 Seton Coastside、Garfield Medical Center、Anaheim Regional Medical Center、Greater El Monte Community Hospital、Monterey Park Hospital、San Gabriel Valley Medical Center、Whittier Hospital Medical Center 等，擁有超過萬名員工並與 6000 多名醫師合作的醫療集團，每年至少服務 20 萬人次。該集團自 2016 年起發展「語音智慧照護」（Voice Smart Care）系統，並有發展穿戴型裝置、達文西手術、語音病歷紀錄、預測分析、遠距照護系統、影像診斷及最新的 GPT-4 於醫師及醫療顧問系統。參訪中曾問 AI 人工智能未來可能取代醫師嗎? 與會人員回答「人工智能只是輔助，準確率雖高，但還是會有誤差，最後的決定還是需要醫師判斷。」在應用上，當獲取訊息摘要後，一定要再確認，不能完全相信與依賴人工智能。雖然人工智能目前在放射影像學及病理學診斷有幫忙，但是最後還是需要醫師確認蓋章，保險才能給付。

我也撥冗訪視了一個 75 歲女士居家病人為 bronchiectasis with respiratory failure，自臺灣旅居美國已 40 年，因為支氣管擴張症肺部感染 2022 年住院達 2 個月因慢性呼吸衰竭轉到照護機構，今年再轉為居家自我照護，有居家長照，因長期使用氧氣已達 8L/min 及 BiPAP，大都躺在床上，除了喘，還有便秘、夜間失眠問題，雖然個案已經簽了 DNR，意識清楚改善生活品質還是需要的。現場我教導病患帶著 BiPAP 及氧氣執行上肢擴胸運動，接著抬腿運動及踢腳運動，雖然運動中血氧濃度曾掉到 87%，但已有明顯腸胃蠕動放屁；透過復健運動促進腸胃蠕動，增加食慾，蛋白質、脂肪攝取，可改善肌少症；鼓勵白天走出戶外曬

太陽至少 30 分鐘減緩骨質疏鬆，並教導夜間冥想，提升副交感神經改善睡眠品質，宗教信仰的介入。

參加了 American Thoracic Society 2024 在 San Diego 舉辦的 International Conference May 17-May 22, 2024，提供了胸腔肺部各種不同領域的教育及討論，包含了

1> Three keynote speech: K1 Artificial Intelligence in Medicine

K2 From Polio to COVID-19: Lessons in Ventilation From Our Past

K3 Immigrant Health

2> Four Clinical Year in Review Sessions

3> Six Adult Core Sessions: CC1 Adult Pulmonary Clinical Core Curriculum, CC2 Adult Sleep Clinical Core Curriculum, CC3 Adult Pulmonary Clinical Core Curriculum, CC4 Adult Sleep Clinical Core Curriculum, CC5 Adult Critical Care Clinical Core Curriculum, CC6 Adult Critical Care Clinical Core Curriculum

4> Pediatric Clinical Core Curriculum: PCC1 Pediatric Clinical Core Curriculum 1, PCC2 Pediatric Clinical Core Curriculum 2, PCC3 Pediatric Clinical Core Curriculum 3

我比較有興趣的是 Adult Sleep Clinical solution, 期間詢問了美國 in-lab polysomnography 費用要約 623 USD, 中國大陸要 1000 RMB，台灣則是健保 4500 點（健保點值若為 0.9 元則約 4100 NTD)，阻塞性睡眠呼吸中止症（OSA)還是如 2021 年 circulation 發表所提的數字，臨床症狀像 OSA，卻還有 86-95%沒有被診斷出；由於排檢時間冗長，各國都在嘗試 level 3 居家得睡眠檢測，我則是提出 level 4 nocturnal pulse oximetry monitor，因為 2015 年我們曾發表 Validation of overnight oximetry to diagnose patients with moderate to severe obstructive sleep apnea 在 BMC pulmonary medicine，我們試著用成本效果決策樹分析診治中重度阻塞性睡眠呼吸中止症，研究顯示以 nocturnal pulse oximetry monitor 最具成本效果；我也發表了從 neck CT 預測 mandibular advancement device 治療 OSA 的效果，發現 mandibular advancement device 適合用在輕度的 OSA 患者效果較好。

這次去 American Thoracic Society 2024 分享了 3 篇研究

1）Predicting the effect of mandibular advancement device by neck computed tomography

2）Evaluating the cost effectiveness of different approaches for patients with moderate to severe obstructive sleep apnea

3）Comparison of telomere length between patients with and without obstructive sleep apnea

在 e-poster presentation 題目” Comparison of telomere length between patients with and without obstructive sleep apnea”，受到廣泛討論，主持人 professor Johnathan 建議加上 body mass index 及 SpO2 列入討論更具可看性。

心得及建議

人工智能雖然如火如荼的進展，惟目前人工智能只是輔助醫師，最後的決定還是需要醫生判斷。COVID-19 疫情流行期間遠距照護發揮出效果，台灣疫情降階後，礙於法令遠距照護尚難於日常醫療發展，而在地廣的美國遠距照護則是持續發揮出效果。台灣雖然地狹人稠，醫療機構林立民眾就醫方便；但對於行動不便甚至臥床的病人要移動就醫非常困難，就可能形成「鬧區中的離島」，本人就曾與居家護理師走路 300 公尺前往醫院後面的菜市場 2 樓公寓去訪視一位脊椎受傷自頸部下癱瘓的病人，要病人下樓就醫就極為困難，像這種移動就醫極具困難的病人，像是「鬧區中的離島」政府應該適度開放遠距照護，解決民眾就醫問題。

睡眠醫學裡罹患阻塞性睡眠呼吸中止症的病人依然有多數沒有被診斷出，由於阻塞性睡眠呼吸中止症併夜間低血氧會造成高血壓、高血脂、高血糖，甚至引發心律不整、缺氧性心臟病及腦血管疾病。依照個人的研究成本效果決策樹分析診治中重度阻塞性睡眠呼吸中止症，研究顯示以 nocturnal pulse oximetry monitor 最具成本效果，值得居家推廣。現在的健保規定不給付居家檢測睡眠檢查，因為健保給付的測睡眠檢查必須包含 electroencephalogram (EEG)，現在歐洲冰島新研發一種居家型的睡眠檢查 nox A1s，就含有 EEG，electrooculogram (EOG)，electrocardiogram (ECG)，及 electromyogram (EMG)，研究顯示此居家型的睡眠檢查 nox A1s 診斷時的計分結果與醫院的多項式睡眠檢查儀做出來的計分結果一致性高，如果健保署同意給付；不僅可以減少病人在醫院睡覺檢測的不適還可以縮短排檢時間(目前醫院多項式睡眠檢查排檢時間需要一個月至六個月)，更可以真實反映病人居家真實的睡眠狀況。

國外已經針對大眾運輸工具的駕駛必須進行睡眠檢測如果發現中重度阻塞性睡眠呼吸中止症的駕駛必須接受治療，不只照護大眾運輸工具駕駛的健康也保護用路人的交通安全。

罹患中重度阻塞性睡眠呼吸中止症的人常不自知，病人的醫師也常忽略，因為攸關許多內科共病特別是心血管疾病及腦血管疾病，不只影響個人健康也會造成家庭及社會的損失，政府值得多加推廣認知「睡眠呼吸中止症」。


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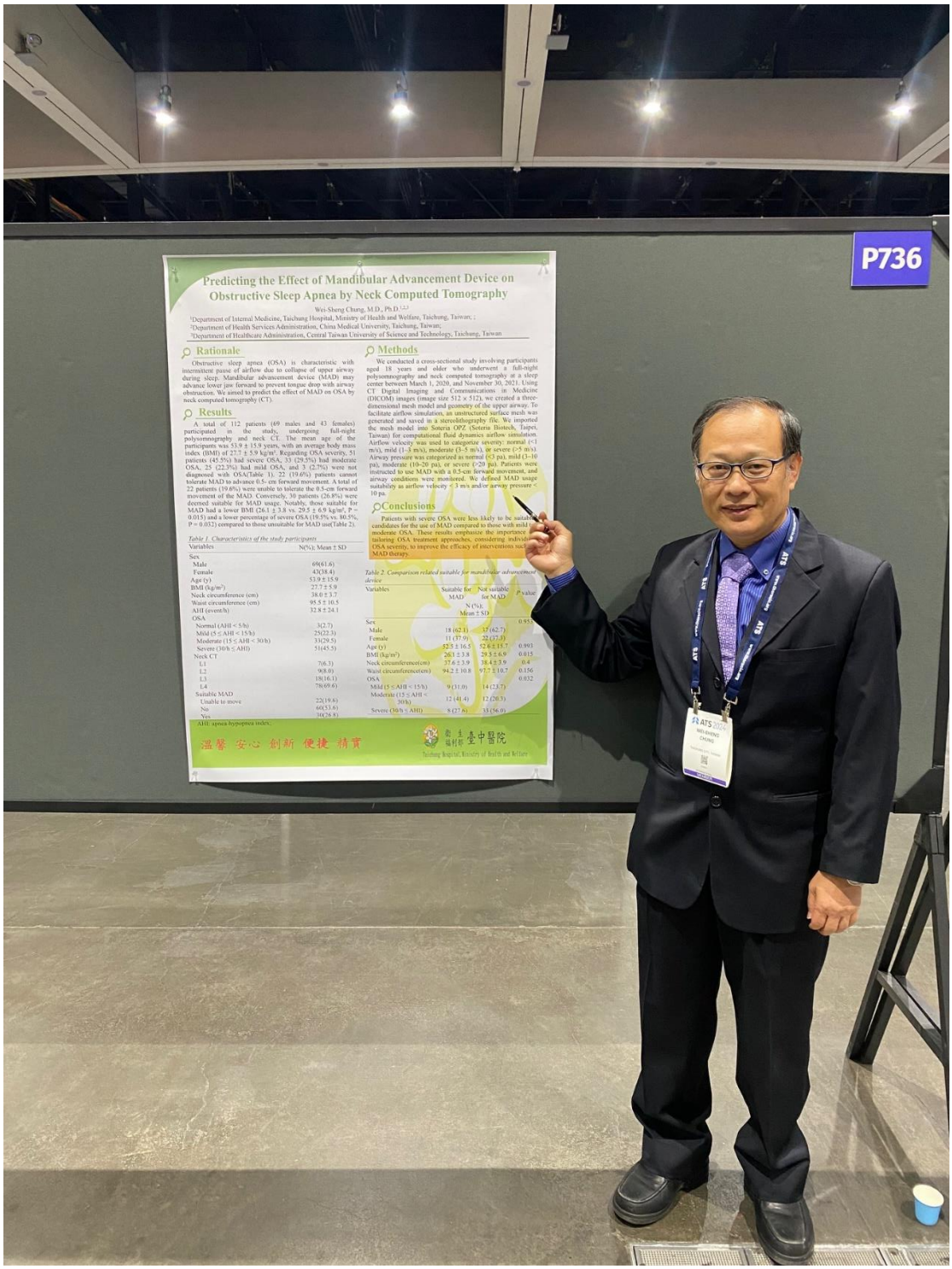
P736
Predicting the Effect of Mandibular Advancement Device on Obstructive Sleep Apnea by Neck Computed Tomography
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Rationale
Obstructive sleep apnea (OSA) is characteristic with intermittent pause of airflow due to collapse of upper airway during sleep. Mandibular advancement device (MAD) may advance lower jaw forward to prevent tongue drop with airway obstruction. We aimed to predict the effect of MAD on OSA by neck computed tomography (CT).
Results
A total of 112 patients (69 males and 43 females) participated in the study, undergoing full-night polysomnography and neck CT. The mean age of the participants was 53.9 ± 15.9 years, with an average body mass index (BMI) of 27.7 ± 5.9 kg/m². Regarding OSA severity, 51 patients (45.5%) had severe OSA; 33 (29.5%) had moderate OSA; 25 (22.3%) had mild OSA; and 3 (2.7%) were not diagnosed with OSA(Table 1). 22 (19.6%) patients cannot tolerate MAD to advance 0.5- cm forward movement. A total of 22 patients (19.6%) were unable to tolerate the 0.5-cm forward movement of the MAD. Conversely, 30 patients (26.8%) were deemed suitable for MAD usage. Notably, those suitable for MAD had a lower BMI (26.1 ± 3.8 vs. 29.5 ± 6.9 kg/m², P = 0.015) and a lower percentage of severe OSA (15.5% vs. 80.5%, P = 0.032) compared to those unsuitable for MAD use(Table 2).
Table 1. Characteristics of the study participants
Variables N(%); Mean ± SD
Sex
Male 69(61.6)
Female 43(38.4)
Age (y) 53.9 ± 15.9
BMI (kg/m²) 27.7 ± 5.9
Neck circumference (cm) 38.0 ± 3.7
Waist circumference (cm) 95.5 ± 10.5
AHI (event/h) 32.8 ± 24.1
OSA
Normal (AHI < 5/h) 3(2.7)
Mild (5 ≤ AHI < 15/h) 25(22.3)
Moderate (15 ≤ AHI < 30/h) 33(29.5)
Severe (30/h ≤ AHI) 51(45.5)
Neck CT
L1 7(6.3)
L2 9(8.0)
L3 18(16.1)
L4 78(69.6)
Suitable MAD
Unable to move 22(19.6)
No 60(53.6)
Yes 30(26.8)
AHI: apnea-hypopnea index.
Methods
We conducted a cross-sectional study involving participants aged 18 years and older who underwent a full-night polysomnography and neck computed tomography at a sleep center between March 1, 2020, and November 30, 2021. Using CT Digital Imaging and Communications in Medicine (DICOM) images (image size 512 × 512), we created a three-dimensional mesh model and geometry of the upper airway. To facilitate airflow simulation, an unstructured surface mesh was generated and saved in a stereolithography file. We imported the mesh model into Soteria OPZ (Soteria Biotech, Taipei, Taiwan) for computational fluid dynamics airflow simulation. Airflow velocity was used to categorize severity: normal (<1 m/s), mild (1–3 m/s), moderate (3–5 m/s), or severe (>5 m/s). Airway pressure was categorized as normal (<5 pa), mild (5–10 pa), moderate (10–20 pa), or severe (>20 pa). Patients were instructed to use MAD with a 0.5-cm forward movement, and airway conditions were monitored. We defined MAD usage suitability as airflow velocity < 3 m/s and/or airway pressure < 10 pa.
Conclusions
Patients with severe OSA were less likely to be suitable candidates for the use of MAD compared to those with mild to moderate OSA. These results emphasize the importance of tailoring OSA treatment approaches, considering individual OSA severity, to improve the efficacy of interventions such as MAD therapy.
Table 2. Comparison related suitable for mandibular advancement device
Variables Suitable for MAD Not suitable for MAD P value
N (%); Mean ± SD
Sex 0.93
Male 18 (62.1) 37 (62.7)
Female 11 (37.9) 22 (37.3)
Age (y) 52.5 ± 16.5 52.4 ± 15.7 0.993
BMI (kg/m²) 26.1 ± 3.8 29.5 ± 6.9 0.015
Neck circumference(cm) 37.6 ± 3.9 38.4 ± 3.9 0.4
Waist circumference(cm) 94.2 ± 10.8 97.7 ± 10.7 0.156
OSA 0.032
Mild (5 ≤ AHI < 15/h) 9 (31.0) 14 (23.7)
Moderate (15 ≤ AHI < 30/h) 12 (41.4) 12 (20.3)
Severe (30/h ≤ AHI) 8 (27.6) 33 (56.0)
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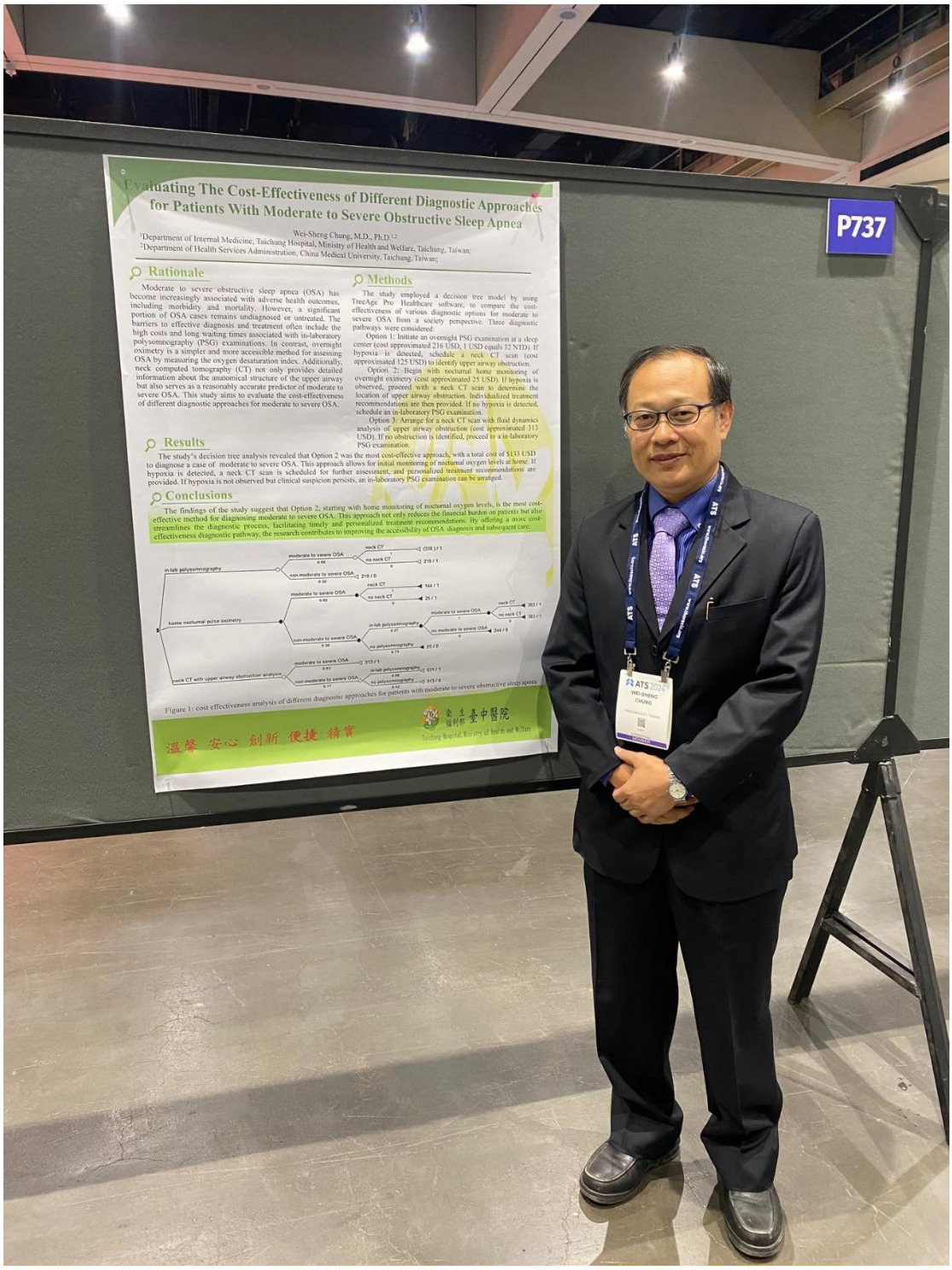
P737
Evaluating The Cost-Effectiveness of Different Diagnostic Approaches for Patients With Moderate to Severe Obstructive Sleep Apnea
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Rationale
Moderate to severe obstructive sleep apnea (OSA) has become increasingly associated with adverse health outcomes, including morbidity and mortality. However, a significant portion of OSA cases remains undiagnosed or untreated. The barriers to effective diagnosis and treatment often include the high costs and long waiting times associated with in-laboratory polysomnography (PSG) examinations. In contrast, overnight oximetry is a simpler and more accessible method for assessing OSA by measuring the oxygen desaturation index. Additionally, neck computed tomography (CT) not only provides detailed information about the anatomical structure of the upper airway but also serves as a reasonably accurate predictor of moderate to severe OSA. This study aims to evaluate the cost-effectiveness of different diagnostic approaches for moderate to severe OSA.
Methods
The study employed a decision tree model by using TreeAge Pro Healthcare software, to compare the cost-effectiveness of various diagnostic options for moderate to severe OSA from a society perspective. Three diagnostic pathways were considered:
Option 1: Initiate an overnight PSG examination at a sleep center (cost approximated 216 USD, 1 USD equals 32 NTD). If hypoxia is detected, schedule a neck CT scan (cost approximated 125 USD) to identify upper airway obstruction.
Option 2: Begin with nocturnal home monitoring of overnight oximetry (cost approximated 25 USD). If hypoxia is observed, proceed with a neck CT scan to determine the location of upper airway obstruction. Individualized treatment recommendations are then provided. If no hypoxia is detected, schedule an in-laboratory PSG examination.
Option 3: Arrange for a neck CT scan with fluid dynamics analysis of upper airway obstruction (cost approximated 313 USD). If no obstruction is identified, proceed to a in-laboratory PSG examination.
Results
The study's decision tree analysis revealed that Option 2 was the most cost-effective approach, with a total cost of $133 USD to diagnose a case of moderate to severe OSA. This approach allows for initial monitoring of nocturnal oxygen levels at home. If hypoxia is detected, a neck CT scan is scheduled for further assessment, and personalized treatment recommendations are provided. If hypoxia is not observed but clinical suspicion persists, an in-laboratory PSG examination can be arranged.
Conclusions
The findings of the study suggest that Option 2, starting with home monitoring of nocturnal oxygen levels, is the most cost-effective method for diagnosing moderate to severe OSA. This approach not only reduces the financial burden on patients but also streamlines the diagnostic process, facilitating timely and personalized treatment recommendations. By offering a more cost-effectiveness diagnostic pathway, the research contributes to improving the accessibility of OSA diagnosis and subsequent care.
in-lab polysomnography
home nocturnal pulse oximetry
neck CT with upper airway obstruction analysis
moderate to severe OSA
non-moderate to severe OSA
neck CT
no neck CT
no polysomnography
in-lab polysomnography
Figure 1: cost effectiveness analysis of different diagnostic approaches for patients with moderate to severe obstructive sleep apnea
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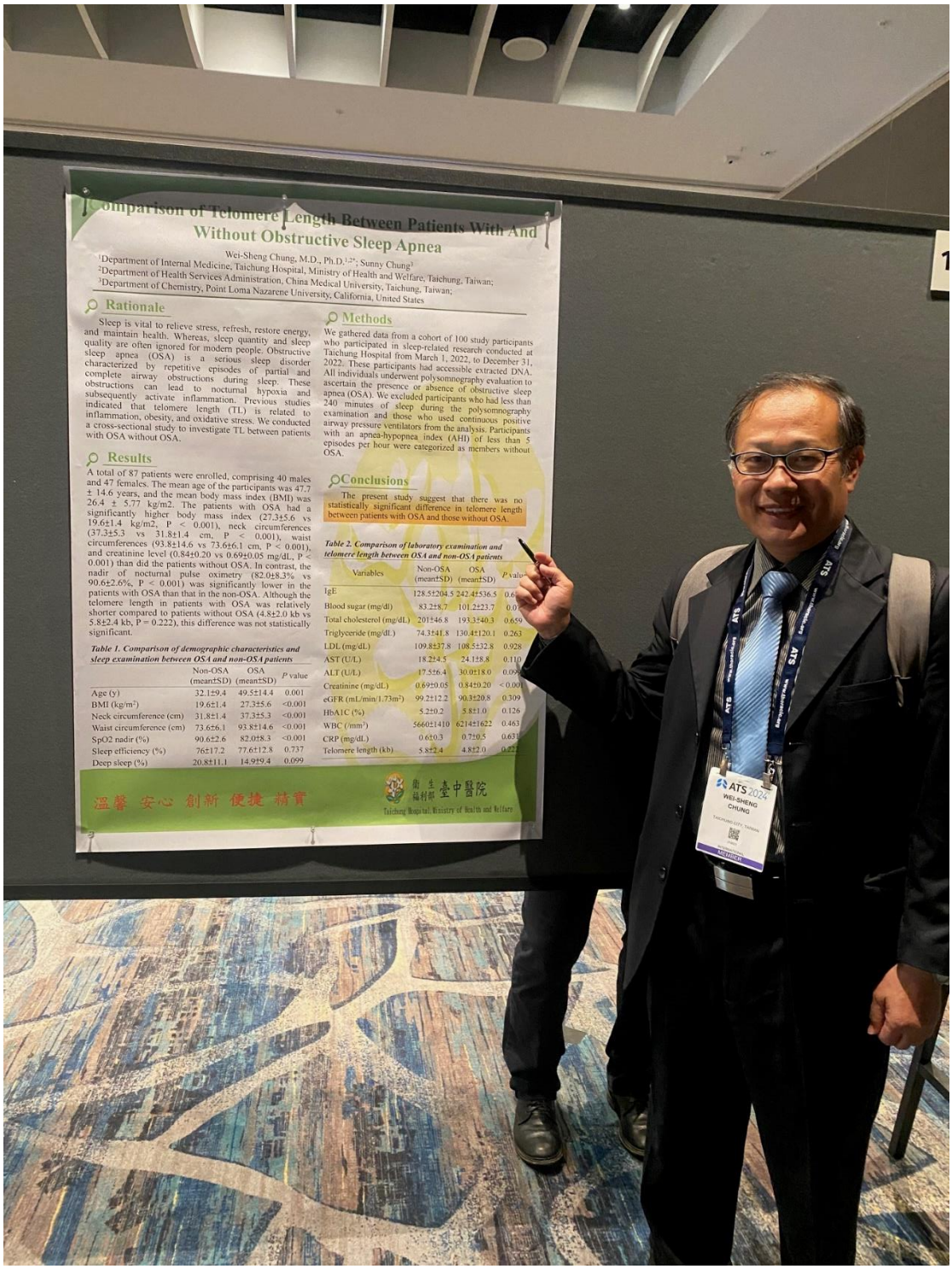
Comparison of Telomere Length Between Patients With And Without Obstructive Sleep Apnea
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Rationale
Sleep is vital to relieve stress, refresh, restore energy, and maintain health. Whereas, sleep quantity and sleep quality are often ignored for modern people. Obstructive sleep apnea (OSA) is a serious sleep disorder characterized by repetitive episodes of partial and complete airway obstructions during sleep. These obstructions can lead to nocturnal hypoxia and subsequently activate inflammation. Previous studies indicated that telomere length (TL) is related to inflammation, obesity, and oxidative stress. We conducted a cross-sectional study to investigate TL between patients with OSA without OSA.
Methods
We gathered data from a cohort of 100 study participants who participated in sleep-related research conducted at Taichung Hospital from March 1, 2022, to December 31, 2022. These participants had accessible extracted DNA. All individuals underwent polysomnography evaluation to ascertain the presence or absence of obstructive sleep apnea (OSA). We excluded participants who had less than 240 minutes of sleep during the polysomnography examination and those who used continuous positive airway pressure ventilators from the analysis. Participants with an apnea-hypopnea index (AHI) of less than 5 episodes per hour were categorized as members without OSA.
Results
A total of 87 patients were enrolled, comprising 40 males and 47 females. The mean age of the participants was 47.7 ± 14.6 years, and the mean body mass index (BMI) was 26.4 ± 5.77 kg/m2. The patients with OSA had a significantly higher body mass index (27.3±5.6 vs 19.6±1.4 kg/m2, P < 0.001), neck circumferences (37.3±5.3 vs 31.8±1.4 cm, P < 0.001), waist circumferences (93.8±14.6 vs 73.6±6.1 cm, P < 0.001), and creatinine level (0.84±0.20 vs 0.69±0.05 mg/dL, P < 0.001) than did the patients without OSA. In contrast, the nadir of nocturnal pulse oximetry (82.0±8.3% vs 90.6±2.6%, P < 0.001) was significantly lower in the patients with OSA than that in the non-OSA. Although the telomere length in patients with OSA was relatively shorter compared to patients without OSA (4.8±2.0 kb vs 5.8±2.4 kb, P = 0.222), this difference was not statistically significant.
Table 1. Comparison of demographic characteristics and sleep examination between OSA and non-OSA patients
Non-OSA (mean±SD) OSA (mean±SD) P value
Age (y) 32.1±9.4 49.5±14.4 0.001
BMI (kg/m²) 19.6±1.4 27.3±5.6 <0.001
Neck circumference (cm) 31.8±1.4 37.3±5.3 <0.001
Waist circumference (cm) 73.6±6.1 93.8±14.6 <0.001
SpO2 nadir (%) 90.6±2.6 82.0±8.3 <0.001
Sleep efficiency (%) 76±17.2 77.6±12.8 0.737
Deep sleep (%) 20.8±11.1 14.9±9.4 0.099
Conclusions
The present study suggest that there was no statistically significant difference in telomere length between patients with OSA and those without OSA.
Table 2. Comparison of laboratory examination and telomere length between OSA and non-OSA patients
Variables Non-OSA (mean±SD) OSA (mean±SD) P valu
IgE 128.5±204.5 242.4±536.5 0.6
Blood sugar (mg/dl) 83.2±8.7 101.2±23.7 0.0
Total cholesterol (mg/dL) 201±46.8 193.3±40.3 0.659
Triglyceride (mg/dL) 74.3±41.8 130.4±120.1 0.263
LDL (mg/dL) 109.8±37.8 108.5±32.8 0.928
AST (U/L) 18.2±4.5 24.1±8.8 0.110
ALT (U/L) 17.5±6.4 30.0±18.0 0.00
Creatinine (mg/dL) 0.69±0.05 0.84±0.20 < 0.00
eGFR (mL/min/1.73m²) 99.2±12.2 90.3±20.8 0.309
HbA1C (%) 5.2±0.2 5.8±1.0 0.126
WBC (/mm³) 5660±1410 6214±1622 0.463
CRP (mg/dL) 0.6±0.3 0.7±0.5 0.63
Telomere length (kb) 5.8±2.4 4.8±2.0 0.22
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