The “Five S’s”: the benefits of 24 hour physical behaviour activities for people living with Type 2 diabetes

Dr Sarah Davies, GP Cardiff

IMPORTANCE OF 24-HOUR PHYSICAL BEHAVIORS FOR TYPE 2 DIABETES

SITTING/BREAKING UP PROLONGED SITTING

Limit sitting. Breaking up prolonged sitting (every 30 min) with short regular bouts of slow walking/simple resistance exercises can improve glucose metabolism.

STEPPING

- An increase of only 500 steps/day is associated with 2–9% decreased risk of cardiovascular morbidity and all-cause mortality.
- A 5-to 6-min brisk-intensity walk per day equates to ~4 years' greater life expectancy.

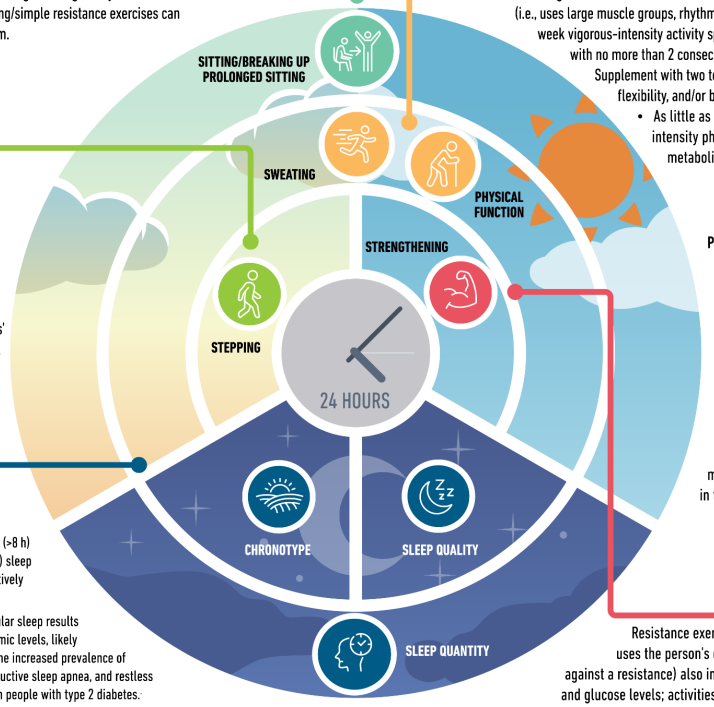
SLEEP

Aim for consistent, uninterrupted sleep, even on weekends.

Quantity – Long (>8 h) and short (<6 h) sleep durations negatively impact HbA_{1c}.

Quality – Irregular sleep results in poorer glycemic levels, likely influenced by the increased prevalence of insomnia, obstructive sleep apnea, and restless leg syndrome in people with type 2 diabetes.

Chronotype – Evening chronotypes (i.e., night owl: go to bed late and get up late) may be more susceptible to inactivity and poorer glycemic levels vs, morning chronotypes (i.e., early bird: go to bed early and get up early).



SWEATING (MODERATE-TO-VIGOROUS ACTIVITY)

- Encourage ≥150 min/week of moderate-intensity physical activity (i.e., uses large muscle groups, rhythmic in nature) OR ≥75 min/week vigorous-intensity activity spread over ≥3 days/week, with no more than 2 consecutive days of inactivity. Supplement with two to three resistance, flexibility, and/or balance sessions.
  - As little as 30 min/week of moderate-intensity physical activity improves metabolic profiles.

Physical function/frailty/ sarcopenia

- The frailty phenotype in type 2 diabetes is unique, often encompassing obesity alongside physical frailty, at an earlier age. The ability of people with type 2 diabetes to undertake simple functional exercises in middle- age is similar to that in those over a decade older.

STRENGTHENING

Resistance exercise (i.e., any activity that uses the person's own body weight or works against a resistance) also improves insulin sensitivity and glucose levels; activities like tai chi and yoga also encompass elements of flexibility and balance.

	Glucose/insulin	Blood pressure	HbA_{1c}	Lipids	Physical function	Depression	Quality of life
SITTING/BREAKING UP PROLONGED SITTING	↓	↓	↓	↓	↑	↓	↑
STEPPING	↓	↓	↓	↓	↑	↓	↑
SWEATING (MODERATE-TO-VIGOROUS ACTIVITY)	↓	↓	↓	↓	↑	↓	↑
STRENGTHENING	↓	↓	↓	↓	↑	↓	↑
ADEQUATE SLEEP DURATION	↓	↓	↓	↓	?	↓	↑
GOOD SLEEP QUALITY	↓	↓	↓	↓	?	↓	↑
CHRONOTYPE/CONSISTENT TIMING	↓	?	↓	?	?	↓	?

IMPACT OF PHYSICAL BEHAVIORS ON CARDIOMETABOLIC HEALTH IN PEOPLE WITH TYPE 2 DIABETES

↑ **Higher levels/improvement** (physical function, quality of life); ↓ **Lower levels/improvement** (glucose/insulin, blood pressure, HbA_{1c}, lipids, depression); ? no data available;
↑ **Green arrows = strong evidence;** ↑ **Yellow arrows = medium strength evidence;** ↑ **Red arrows = limited evidence.**

Disclosures

- I have received honorarium for speaking or support for attending meetings from:
  - Abbott
  - Amarin
  - Astra Zeneca
  - Bayer
  - Boehringer Ingelheim
  - Daiichi Sankyo
  - Dexcom
  - Lilly
  - Menarini
  - Novo Nordisk
  - Roche

Challenges of effecting lifestyle change

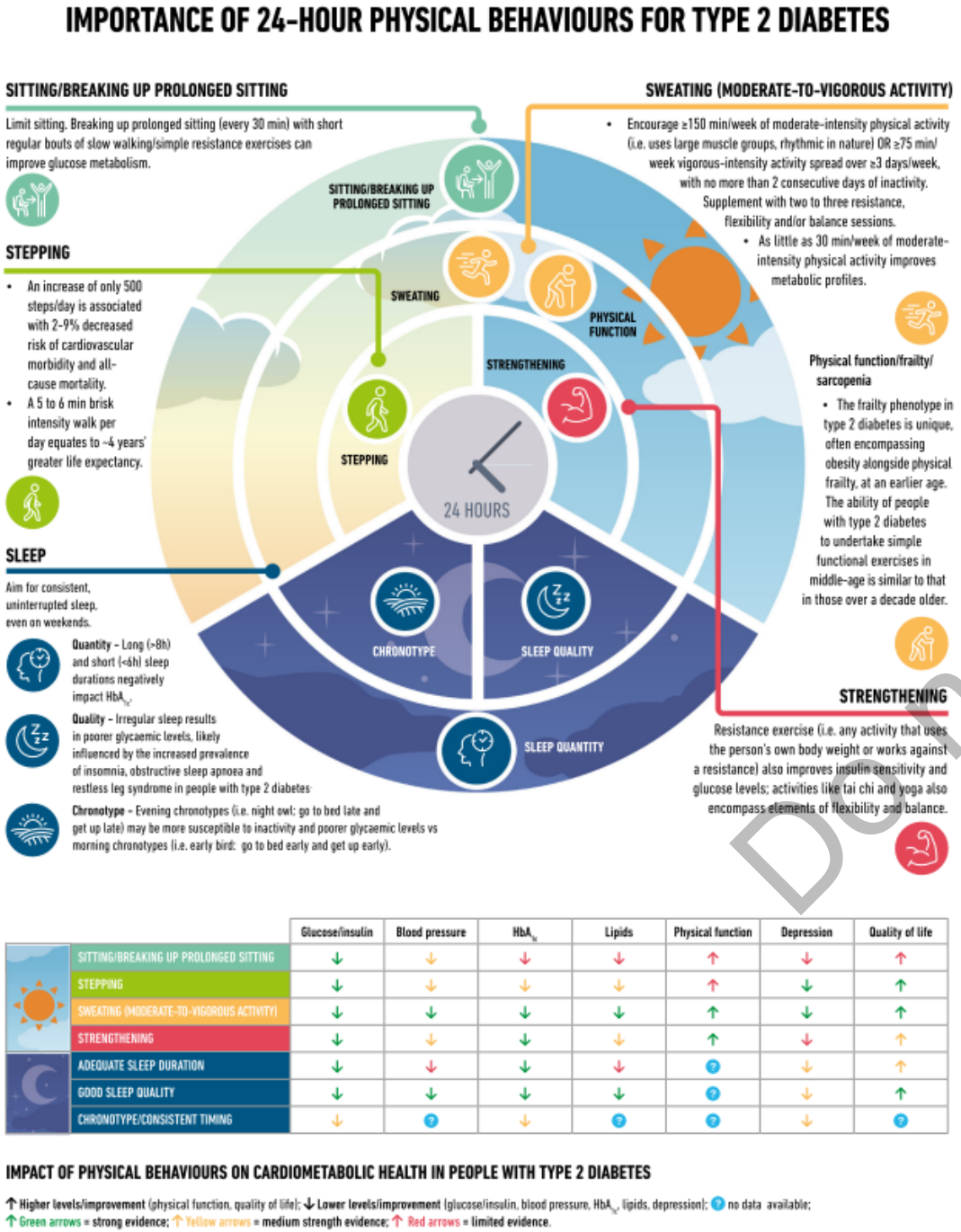
WHAT MESSAGE TO GIVE?

TIME LIMITATIONS

REALISM

SUSTAINABILITY

SOCIAL DETERMINANTS



The five S's

- **S**itting / breaking up prolonged sitting
- **S**weating
- **S**tepping
- **S**trengthening
- **S**leep

Management of hyperglycaemia in type 2 diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD) (diabetologia-journal.org)

“Beneficial effects are evident across the continuum of human movement”

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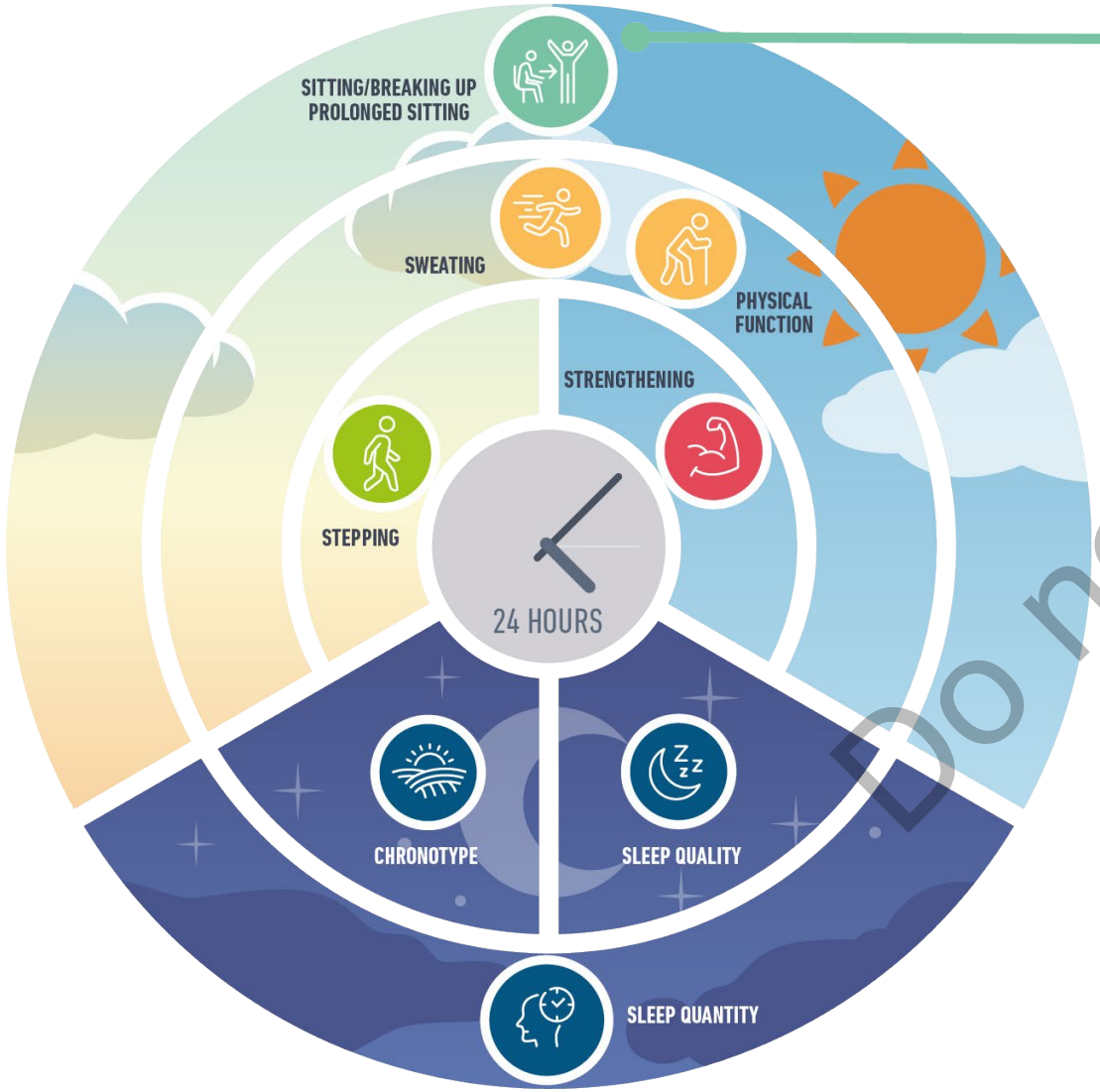
FIGURE 2: IMPORTANCE OF 24-HOUR PHYSICAL BEHAVIOURS FOR TYPE 2 DIABETES



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Diabetes Care 2022; https://doi.org/10.2337/dci22-0034. *Diabetologia* 2022; https://doi.org/10.1007/s00125-022-05787-2.

- High volumes of time spent in sedentary behaviours (sitting) are associated with poorer cardiometabolic risk profiles and a higher incidence of type 2 diabetes

- Observational studies have reported that in the general population, those who regularly interrupt their sitting time have more favourable cardiometabolic risk profiles

- In studies of those with T2D, **interruptions of 3 min every 30 min with either light walking or simple resistance activities** (SRAs) significantly reduced postprandial glucose and insulin responses in comparison with prolonged sitting.

Frequency of Interruptions to Sitting Time: Benefits for Postprandial Metabolism in Type 2 Diabetes

Diabetes Care 2021;44:1254–1263 | https://doi.org/10.2337/dc20-1410

WebDonuts.com

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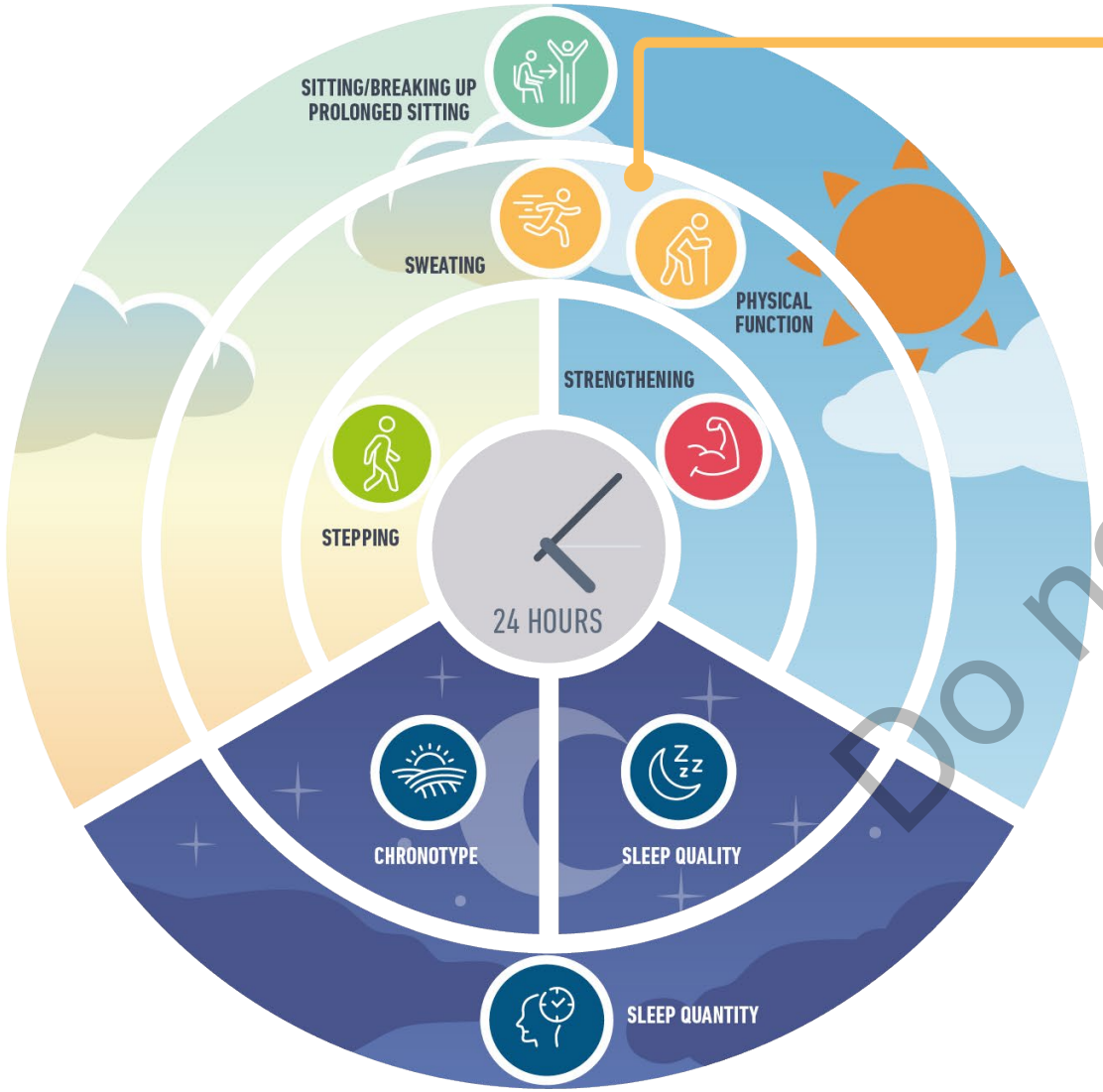

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Diabetes Care 2022; https://doi.org/10.2337/dci22-0034. *Diabetologia* 2022; https://doi.org/10.1007/s00125-022-05787-2.

How does exercise treatment compare with antihypertensive medications?

- Network Meta–analysis 2019 Br J Sports Med
  - 391 RCTs (no head to head trials of exercise vs medications)
  - Multiple meds – ACE, ARB, B-blockers, CCBs, diuretics
  - Multiple exercise approaches – endurance, resistance and combination

British Journal of Sports Medicine

- The systolic BP lowering effects of regular aerobic exercise is similar to commonly used anti-hypertensives
  - Reduction of SBP by 8.96mmHg for exercise in hypertensive population, no signif difference in the lowering seen in medication groups

- “Regular exercise is as effective as a blood pressure tablet”

Naci H, Salcher-Konrad M, Dias S, Blum MR, Sahoo SA, Nunan D, Ioannidis JPA. How does exercise treatment compare with antihypertensive medications? A network meta-analysis of 391 randomised controlled trials assessing exercise and medication effects on systolic blood pressure. Br J Sports Med. 2019 Jul;53(14):859-869. doi: 10.1136/bjsports-2018-099921. Epub 2018 Dec 18. PMID: 30563873.

Wall squats and planks best at lowering blood pressure

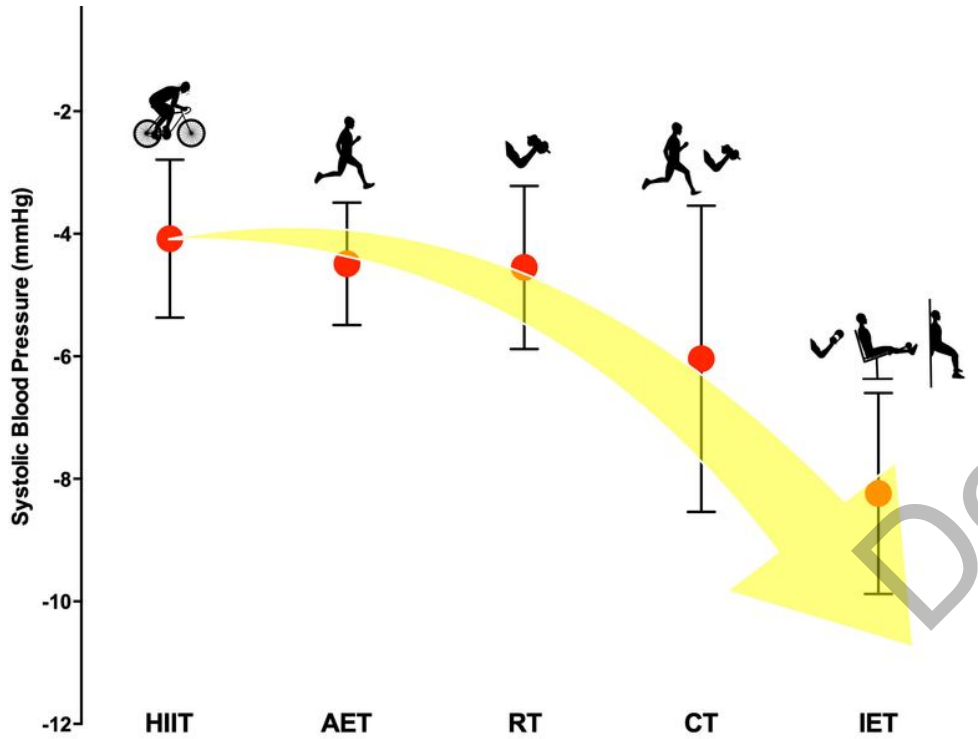
26 July

GETTY IMAGES

Wall squats are particularly good at lowering high resting blood pressure, a study of previous trials suggests

Which type of exercise has the biggest impact on lowering BP?

British Journal of Sports Medicine



- Large-scale systematic review and network meta-analysis of 270 trials
- Aerobic exercise training, dynamic resistance training, combined training, high-intensity interval training and isometric exercise training are all significantly effective in reducing resting systolic and diastolic blood pressure
- **Overall, isometric exercise training is the most effective mode**

Edwards JJ, Deenmamode AHP, Griffiths M, *et al*
Exercise training and resting blood pressure: a large-scale pairwise and network meta-analysis of randomised controlled trials
British Journal of Sports Medicine Published Online First: 25 July 2023. doi: 10.1136/bjsports-2022-106503

Impact of aerobic activity in Type 2 Diabetes

Exercise/Physical Activity in Individuals with Type 2 Diabetes: A Consensus Statement from the American College of Sports Medicine

Exercise training modalities in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis

- Regular aerobic exercise training improves glycaemic management in adults with Type 2 diabetes, with less daily time in hyperglycaemia and 6-8mmol/mol reductions in HBA1c
- And clinically significant benefits in cardiorespiratory fitness

Kanaley, J. A., Colberg, S. R., Corcoran, M. H., Malin, S. K., Rodriguez, N. R., Crespo, C. J., ... & Zierath, J. R. (2022). Exercise/Physical Activity in Individuals with Type 2 Diabetes: A Consensus Statement from the American College of Sports Medicine. Medicine and science in sports and exercise, 54(2), 353-368.

Pan, B., Ge, L., Xun, Yq. *et al.* Exercise training modalities in patients with type 2 diabetes mellitus: a systematic review and network meta-analysis. *Int J Behav Nutr Phys Act* **15**, 72 (2018). https://doi.org/10.1186/s12966-018-0703-3

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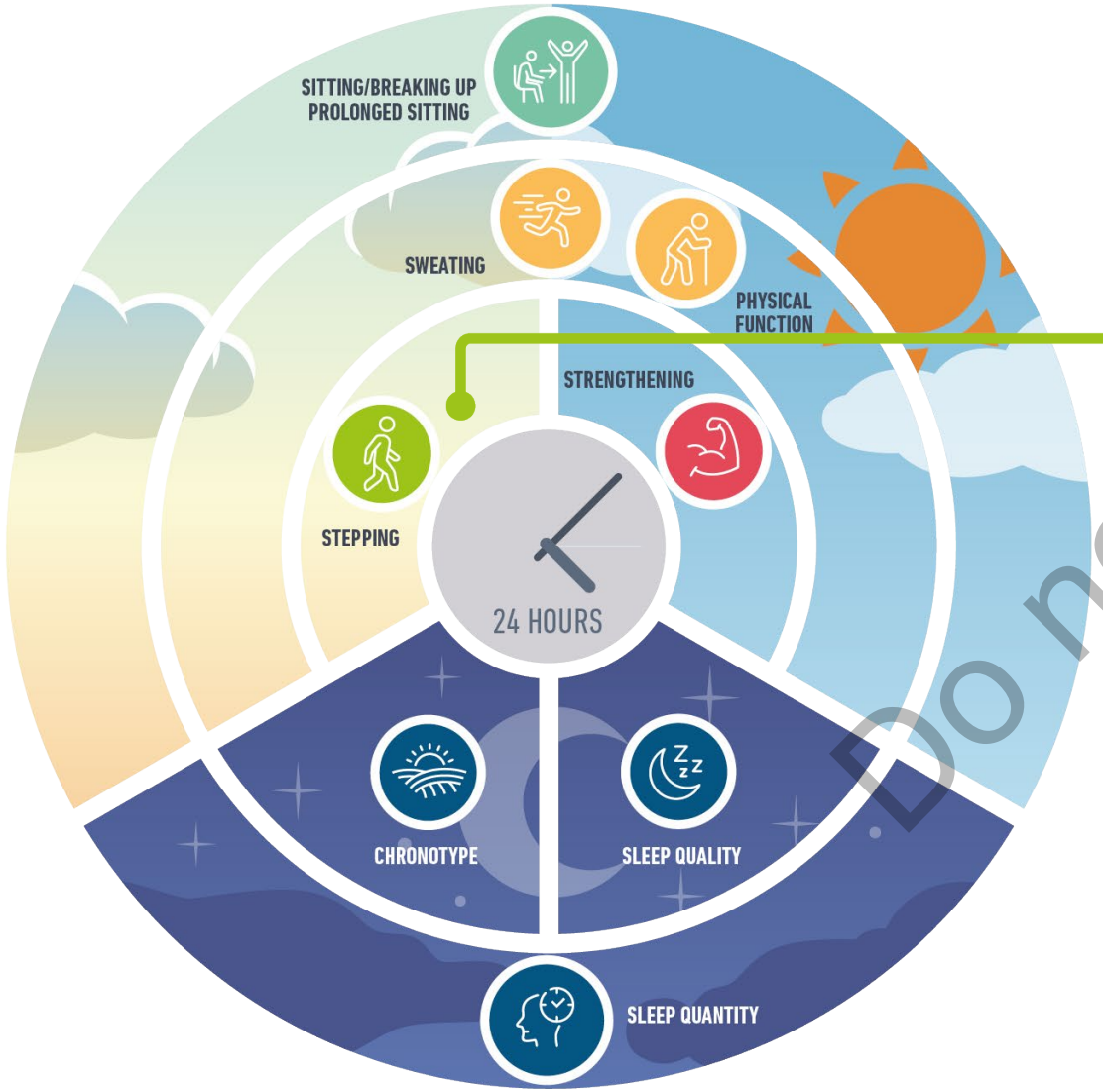

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10,000 steps?

一万

- UK Biobank prospective cohort study aged 40-79 years
- N= 78,500; median follow up 7 years

- Outcomes - association between steps and:
  - All cause / CV / cancer mortality
  - Incidence of cancer and CVD events

I would walk 10 000 steps but should I walk 10 000 more?

- Clear dose-response type relationship up to 10,000 steps
- Increasing beyond 10,000 further reduced risk, esp CV and cancer incidence

- No minimum daily step count associated with these morbidity and mortality benefits

- Daily step count goals should be individualised to ensure they remain realistic and achievable, yet still provide improvements in morbidity and mortality.

- Now have an evidence base for 10,000 steps!

del Pozo Cruz B, Ahmadi MN, Lee I, Stamatakis E. Prospective Associations of Daily Step Counts and Intensity With Cancer and Cardiovascular Disease Incidence and Mortality and All-Cause Mortality. *JAMA Intern Med.* 2022;182(11):1139–1148. doi:10.1001/jamainternmed.2022.4000
Fernando, K I would walk 10 000 steps but should I walk 10 000 more? Diabetes & Primary Care Vol 25 No 2 2023 https://bit.ly/43PH3VM

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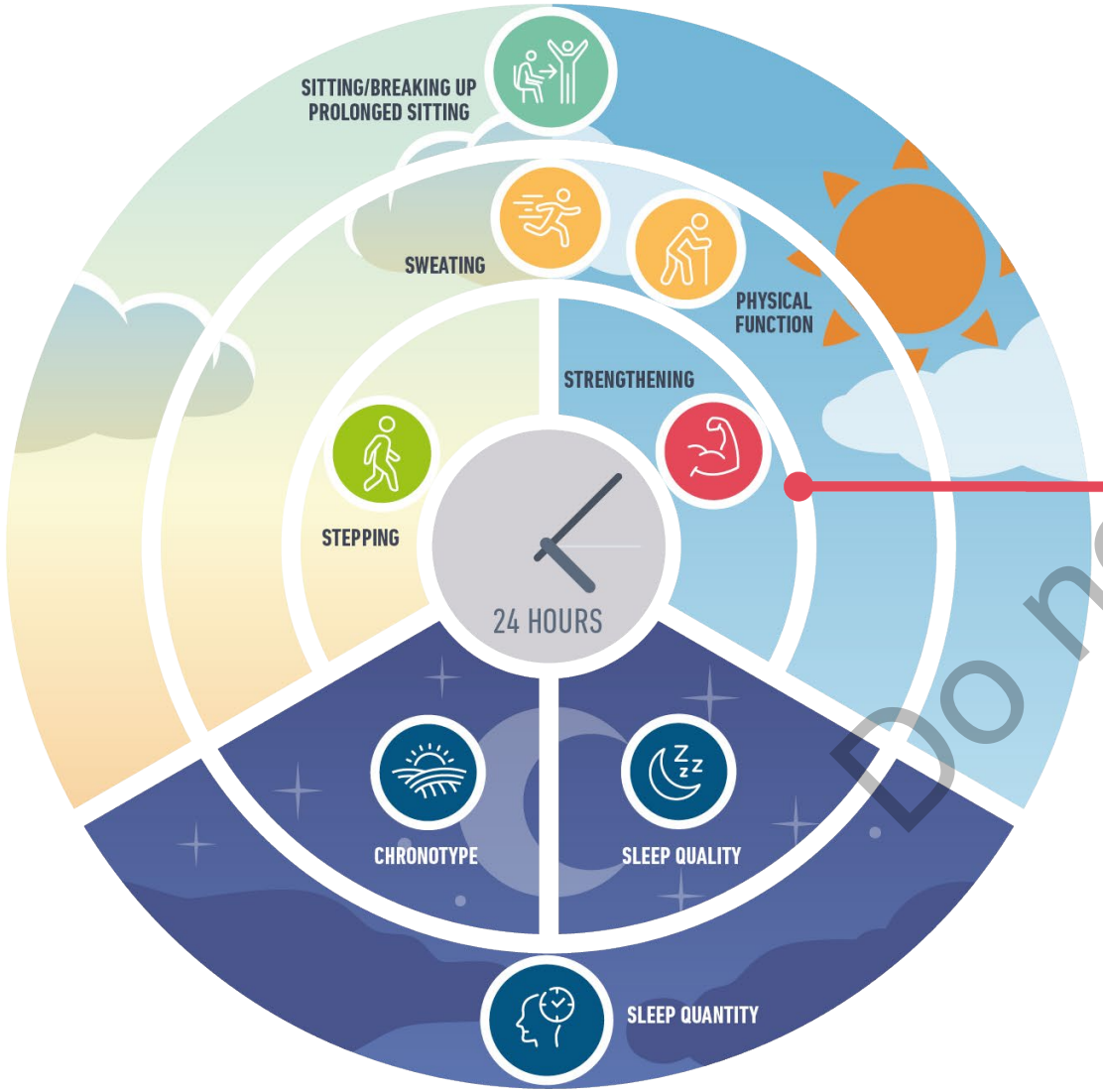

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Resistance exercise, frailty and sarcopenia

- Increasing recognition of early onset frailty in type 2 diabetes
  - Not just in older people
  - T2D as a chronic condition is associated with a state of accelerated metabolic ageing.

- Why?
  - Multimorbidity
  - Sarcopenic obesity

- Frailty and physical function are dynamic and potentially reversible processes
  - Exercise counteracts many of the factors responsible for impaired physical function and improves blood supply and nutrient delivery to working tissues

Ahmad, E.; Sargeant, J.A.; Yates, T.; Webb, D.R.; Davies, M.J. Type 2 Diabetes and Impaired Physical Function: A Growing Problem. *Diabetology* **2022**, *3*, 30-45. https://doi.org/10.3390/diabetology3010003

CODEC study Leicester

DIABETIC Medicine

Device-measured physical activity and its association with physical function in adults with type 2 diabetes mellitus

- >600 adults with T2D
  - Mean age 66yrs, A1c < 86mmol/mol, T2D > 6 mths, BMI 31

- Assessed functional capacity
  - 60s Sit to Stand test
    - Mean repetitions was 21, consistent with values for those **75–79 years** – a decade older than the average age of the group
  - Average hand-grip strength equated to **75–85 year old** adults

Mickute, M, Henson, J, Rowlands, AV, et al. Device-measured physical activity and its association with physical function in adults with type 2 diabetes mellitus. *Diabetic Medicine*. 2021; 38:e14393. https://doi.org/10.1111/dme.14393

Weight loss and sarcopenia

- Many interventions in T2D focus on weight loss
  - Remission of T2D
  - Pharmacological and surgical intervention
- Weight loss without addressing physical function or preserving lean muscle mass may limit the longer-term benefits of losing the weight
  - Combining aerobic with strengthening exercises has the best evidence

Villareal et al N Engl J Med 2017; 376:1943-1955 DOI: 10.1056/NEJMoa1616338

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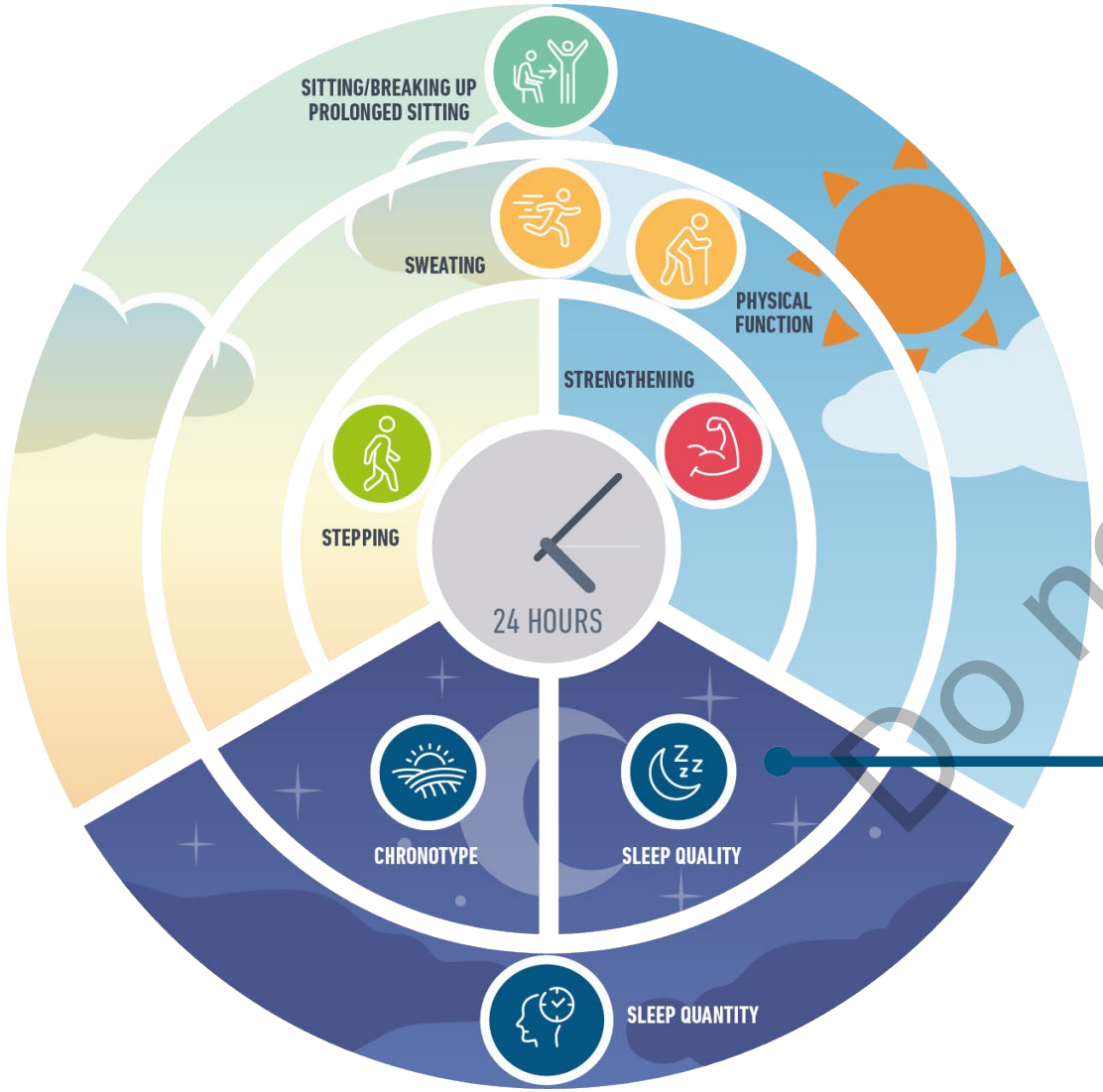

SLEEP

Aim for consistent, uninterrupted sleep, even on weekends.

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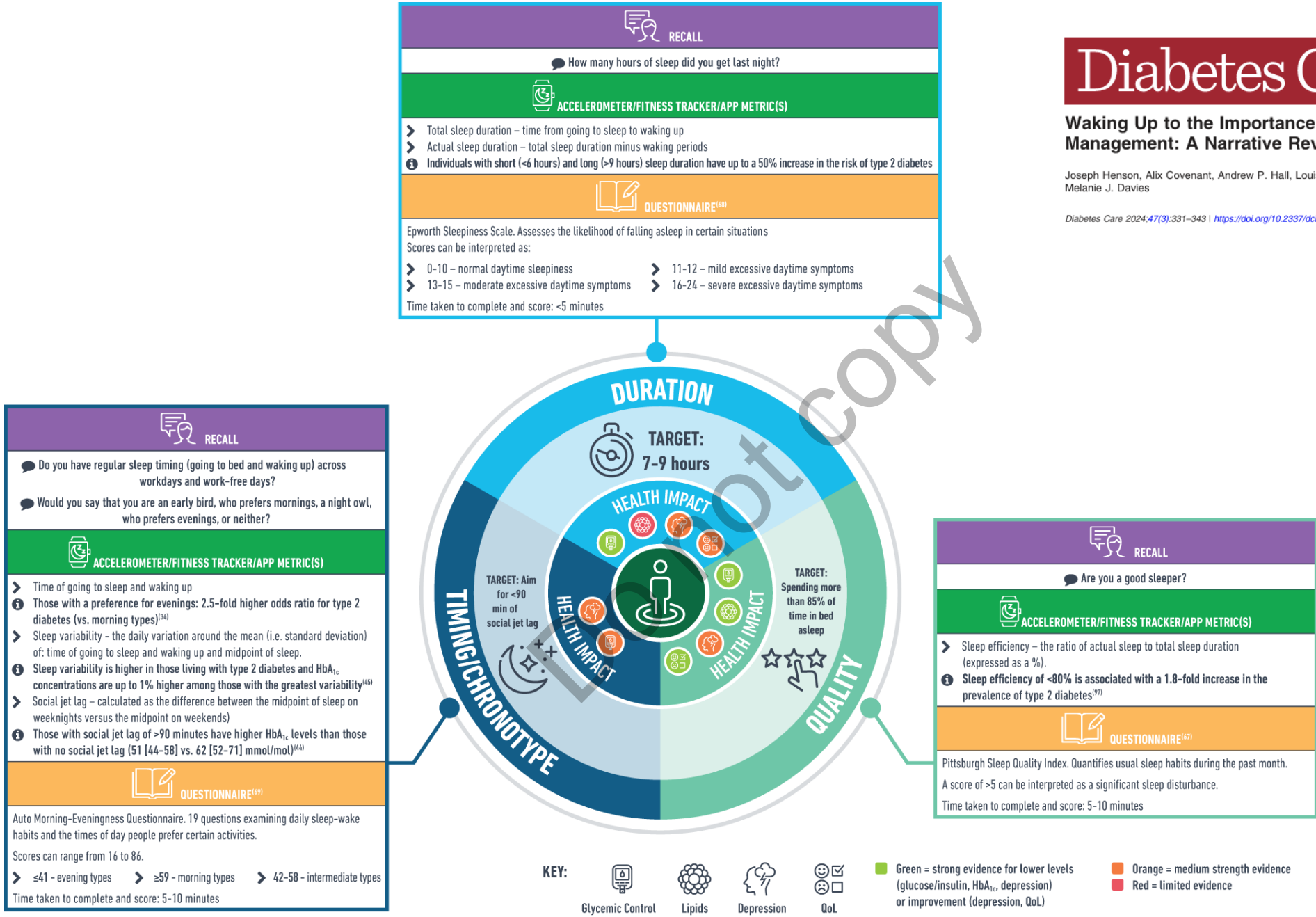
Diabetes Care
American Diabetes Association.

Waking Up to the Importance of Sleep in Type 2 Diabetes Management: A Narrative Review

Joseph Henson, Alix Covenant, Andrew P. Hall, Louisa Herring, Alex V. Rowlands, Thomas Yates, and Melanie J. Davies

Diabetes Care 2024;47(3):331–343 | https://doi.org/10.2337/dci23-0037



Quantity of sleep

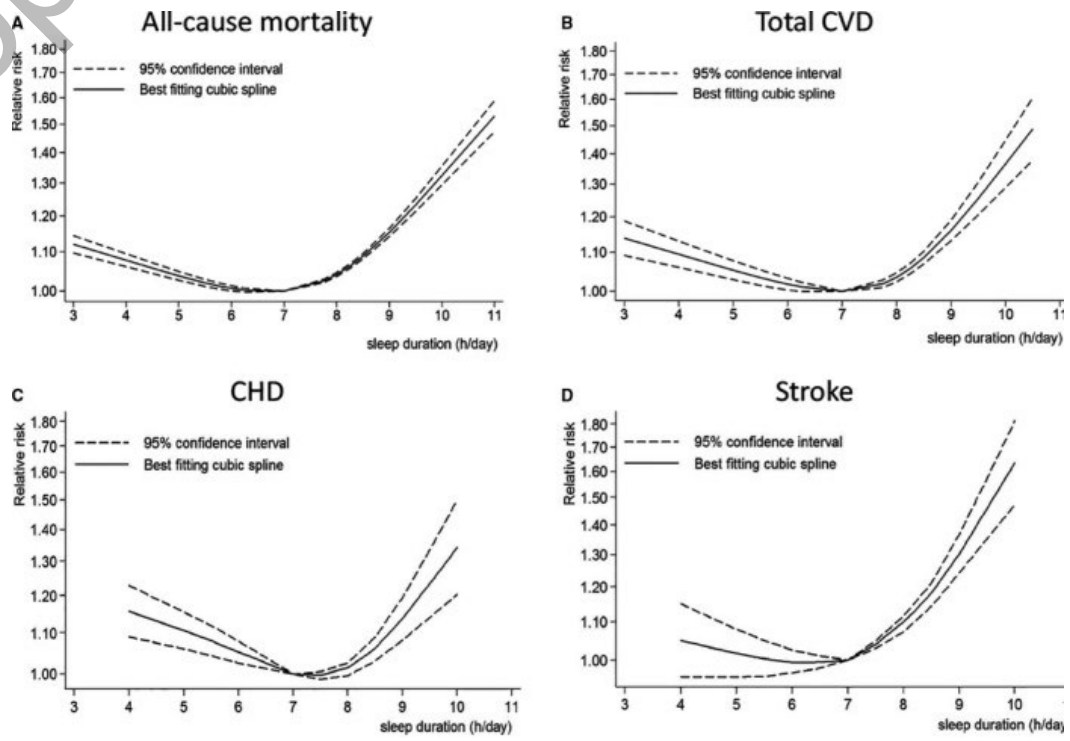
The impact of sleep amount and sleep quality on glycemic control in type 2 diabetes: A systematic review and meta-analysis

Sleep Medicine Reviews
Volume 31, February 2017, Pages 91-101

- Evidence shows that sleeping too long (> 8 hrs) or too short (< 6 hours) negatively impacts on risk of developing type 2 diabetes, glycaemic control as well as all-cause mortality and CV events
  - U shaped relationship
  - The lowest risk observed for ≈7-hours

- By extending the sleep duration of short sleepers, it is possible to improve insulin sensitivity.

- However, "catch-up" weekend sleep alone is not enough to reverse the impact of insufficient sleep.



Shaun Wen Huey Lee, Khuen Yen Ng, Weng Khong Chin, The impact of sleep amount and sleep quality on glycemic control in type 2 diabetes: A systematic review and metaanalysis,Sleep Medicine Reviews,Volume 31,2017,Pages 91-101,ISSN 1087-0792,https://doi.org/10.1016/j.smrv.2016.02.001.
Yin J, Jin X, Shan Z, Li S, Huang H, Li P, Peng X, Peng Z, Yu K, Bao W, Yang W, Chen X, Liu L. Relationship of Sleep Duration With All-Cause Mortality and Cardiovascular Events: A Systematic Review and Dose-Response Meta-Analysis of Prospective Cohort Studies. J Am Heart Assoc. 2017 Sep 9;6(9):e005947. doi: 10.1161/JAHA.117.005947. PMID: 28889101; PMCID: PMC5634263.
Sondrup N, Termannsen AD, Eriksen JN, et al. Effects of sleep manipulation on markers of insulin sensitivity: a systematic review and meta-analysis of randomized controlled trials. *SleepMed Rev* 2022;62:101594
Depner CM, Melanson EL, Eckel RH, et al. Ad libitum weekend recovery sleep fails to prevent metabolic dysregulation during a repeating pattern of insufficient sleep and weekend recovery sleep. *Curr Biol* 2019;29:957–967.e4

Quality of sleep

Sleep Regularity and Cardiometabolic Heath: Is Variability in Sleep Patterns a Risk Factor for Excess Adiposity and Glycemic Dysregulation?

Systematic review of clinical practice guidelines to identify recommendations for sleep in type 2 diabetes mellitus management

- Sleep disorders are common in people with Type 2 diabetes and contribute to poor quality of sleep
  - Obstructive sleep apnoea
  - Restless leg syndrome
  - Depression

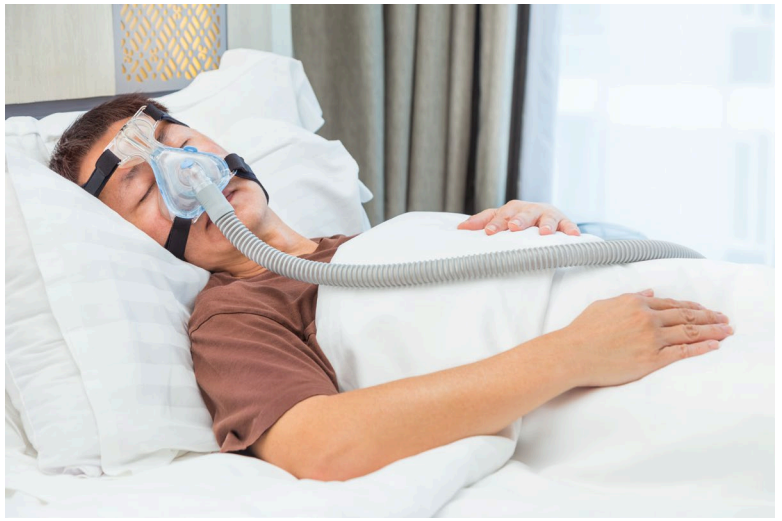
- There is consistent evidence of associations between sleep quality and an increased risk of adiposity, glucose dysregulation, T2D, and metabolic syndrome

- Optimising sleep quality has been associated with a 3% reduction in deaths, 2% reduction in MI and 5% in microvascular complications.

Smyth A, Jenkins M, Dunham M, Kutzer Y, Taheri S, Whitehead L. Systematic review of clinical practice guidelines to identify recommendations for sleep in type 2 diabetes mellitus management. *Diabetes Res Clin Pract* 2020;170:108532
Zuraikat, F.M., Makarem, N., Redline, S. *et al.* Sleep Regularity and Cardiometabolic Heath: Is Variability in Sleep Patterns a Risk Factor for Excess Adiposity and Glycemic Dysregulation?. *Curr Diab Rep* **20**, 38 (2020). https://doi.org/10.1007/s11892-020-01324-w

Obstructive Sleep Apnoea / Hypopnea syndrome

- Leads to fragmented sleep and is associated with significantly increased CV risk premature mortality
- OSA affects over 50% of people with Type 2 diabetes, and its severity is associated with blood glucose levels
- Treatment (CPAP) significantly reduces risk



Fallahi A, Jamil DI, Karimi EB, Baghi V, Gheshlagh RG. Prevalence of obstructive sleep apnea in patients with type 2 diabetes: a systematic review and meta-analysis. *Diabetes Metab Syndr* 2019;13:2463–2468

Obstructive sleep apnoea/hypopnoea syndrome and obesity hypoventilation syndrome in over 16s

NICE guideline [NG202] Published: 20 August 2021

NICE National Institute for Health and Care Excellence

Take a sleep history and assess people for OSAHS if they have 2 or more of the following features:

- snoring
- witnessed apnoeas
- unrefreshing sleep
- waking headaches
- unexplained excessive sleepiness, tiredness or fatigue
- nocturia (waking from sleep to urinate)
- choking during sleep
- sleep fragmentation or insomnia
- cognitive dysfunction or memory impairment.

Overview | Obstructive sleep apnoea/hypopnoea syndrome and obesity hypoventilation syndrome in over 16s | Guidance | NICE

Epworth Sleepiness Scale

Name: _____ Today's date: _____

Your age (Yrs): _____ Your sex (Male = M, Female = F): _____

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?

This refers to your usual way of life in recent times.

Even if you haven't done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the **most appropriate number** for each situation:

0 = would **never** doze
1 = **slight chance** of dozing
2 = **moderate chance** of dozing
3 = **high chance** of dozing

It is important that you answer each question as best you can.

Situation	Chance of Dozing (0-3)
Sitting and reading	
Watching TV	
Sitting, inactive in a public place (e.g. a theatre or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in the traffic	

Obstructive sleep apnoea/hypopnoea hypoventilation syndrome in over 16s

NICE guideline [NG202] Published: 20 August 2021

STOP-Bang Questionnaire

Is it possible that you have ...
Obstructive Sleep Apnea (OSA)?

Please answer the following questions below to determine if you might be at risk.

Yes ○ No ○

Snoring ?

Do you **Snore Loudly** (loud enough to be heard through closed doors or your bed-partner elbows you for snoring at night)?

Yes ○ No ○

Tired ?

Do you often feel **Tired, Fatigued, or Sleepy** during the daytime (such as falling asleep during driving or talking to someone)?

Yes ○ No ○

Observed ?

Has anyone **Observed** you **Stop Breathing** or **Choking/Gasping** during your sleep ?

Yes ○ No ○

Pressure ?

Do you have or are being treated for **High Blood Pressure** ?

Yes ○ No ○

Body Mass Index more than 35 kg/m^2?

Body Mass Index Calculator

○ cm / kg ○ inches / lb

Height: Weight:

Chronotype

- Nurses' Health Study 2
  - 64,615 women from 2005 to 2011
  - Evening preference was associated with a higher risk of developing Type 2 diabetes and increased risk of obesity

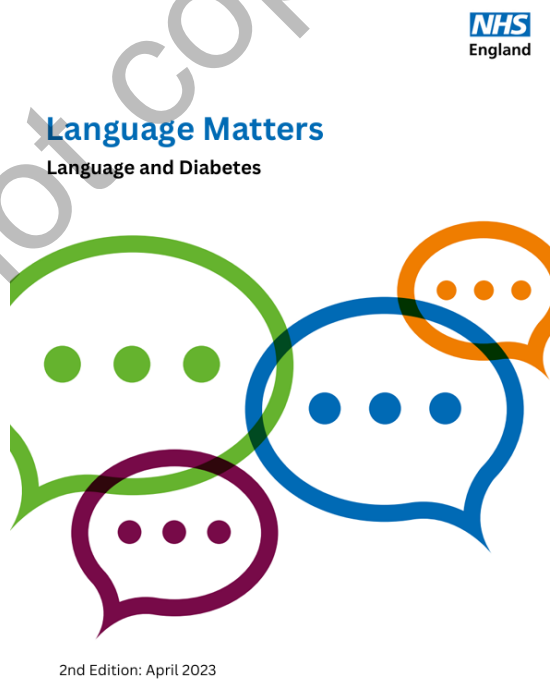
- Impact on glycaemic control in people with T2D
  - Studies suggest that evening chronotype is associated with higher prevalence of:
    - Raised HBA1c
    - CV complications

Vetter C, et al.. Mismatch of sleep and work timing and risk of type 2 diabetes. *Diabetes Care.* 2015;38(9):1707–1713.
Docimo A, Verde L, Barrea L, Vetrani C, Memoli P, Accardo G, Colella C, Nosso G, Orio M, Renzullo A, Savastano S, Colao A, Muscogiuri G. Type 2 Diabetes: Also a "Clock Matter"? Nutrients. 2023 Mar 16;15(6):1427. doi: 10.33
PMC10059837.

Motivating lifestyle change

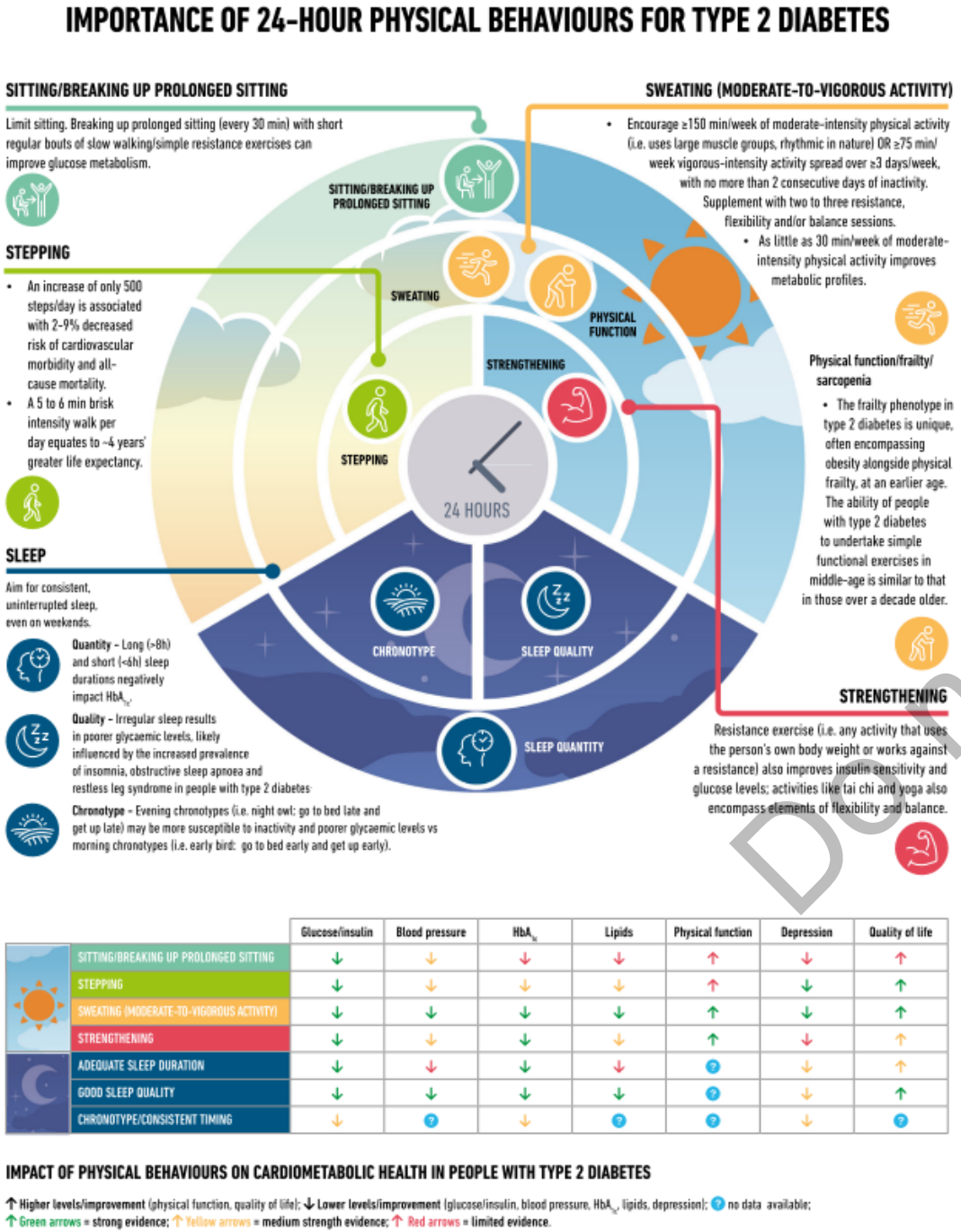
- In primary care we see the people who have the most to gain
  - Small changes still significant e.g. completely sedentary to slightly active
  - Power of **brief intervention**
  - **Language Matters**
  - Keep in mind ***social determinants***

parkrun



www.movingmedicine.ac.uk

language-matters-language-and-diabetes-v2.pdf (england.nhs.uk)



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Any questions?

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- Stepping
- Strengthening
- Sleep

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