Development of a health and well-being scorecard: The Five S's

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Abstract

Objectives: Health instruments are important for people to understand their physical and mental health parameters. The aim of this study was to create an algorithm and a balanced scorecard based on the five S's (Sleep, Sedentary behaviour, Stress, Sugar consumption, and Smoking/alcohol).

Methods: A multitude of sources concerning each of the five S's were reviewed and integrated to develop an algorithm that sufficiently gathers inputs and outputs a score. There were inputs identified to sufficiently encapsulate all the separate factors for each of the five S's; 1) sleep quality (sleep time, sleep schedule and nap time), 2) sedentary behaviour (physical activity and constant time sitting/standing), 3) stress (a combination of different mental health/stress validated questionnaires), 4) sugar consumption (blood sugar through Hemoglobin A1C levels and glucose levels) and 5) smoking/alcohol (packs per week and drinks per week).

Results: The findings and development of the scorecard were taken from a variety of validated sources with each source providing insight into the various methods that were used in developing the total scorecard/algorithm (Score = S_L (Sleep Score) + S_B (Sedentary behaviour score) + S_T (Stress Score) + S_C (Sugar Consumption Score) + S_A (Smoking/Alcohol Score)).

Practical Implications: Mental and physical health are among the most important aspects of one's lifestyle as it determines several indicators including quality of life. Making a relatively simple way to measure and monitor one's health and well-being is fundamental. A health score that can be calculated in limited time is extremely valuable as it can provide insight when access to healthcare is limited. Inadvertently, this scorecard would also optimise the awareness and education of key health parameters, serving as a cornerstone of health education.

Keywords: Five S's, sleep, stress, smoking, sedentary behaviour, sugar, health, wellness

Introduction

Health is one of the most fundamental aspects of human life (Lloyd-Jones et al., 2022). Healthcare monitoring (Betto et al., 2022), ease of access to healthcare (Lovejoy et al., 2023) and health equity (Hale et al., 2022; Mitra et al., 2022) have become key elements in promoting health and well-being and quality of life, in several settings globally, despite varied contextual determinants (Das et al., 2020). Health is also dependent on several factors such as lifestyle, genetics, nutrition, etc (Balwan & Kour, 2021). Optimal health doesn't always just depend on lifestyle factors such as eating habits or physical activity, but also heavily dependent on mental health (Briguglio et al., 2020).

Both the scholarly and clinical literature showcases several scorecards that can be used to measure one's health and well-being metrics (Miron-Shatz & Ratzan, 2011; Cleland et al., 2014; Meena & Thakkar, 2014; Lang et al., 2020; Cignitas et al., 2021; Singh et al., 2023). When trying to determine which aspects of one's lifestyle need to change and which don't, it's critical to assess overall health and well-being as well as identify the lifestyle factors that contribute to beneficial or detrimental health (using a variety of subjective and/or self-reported instruments – despite it's limitations).

Based on the above, the aim of this paper is to illustrate and demonstrate a health and well-being scorecard that is dependent on five distinct factors; Sleep, Sedentary behaviour, Stress, Sugar consumption and Smoking/alcohol. Except for sugar, smoking/alcohol and sedentary behaviour; stress and sleep were also included because these two factors contribute significantly to a person's mental health, and ultimately, contributes to total health.

Simplified inputs for a user-friendly scorecard

When looking for inputs to the scorecard, simpler inputs were identified that would not take a lot of effort for the user to think about. This was extremely important as we wanted this scorecard to be relatively simple and a time-efficient method for people to identify how healthy they are. Eventually, the goal of the scorecard would be to have it developed via an application or a website, to enhance ease of usage. All the factors that are inputs into the scorecard can take less than 10 minutes in total to calculate/measure, which will allow for the scores to be calculated with limited time. Although the scorecard formulates simple inputs, these inputs encapsulate everything needed to accurately determine a score for each of the five S's. Through consultation with various academic sources, these inputs were determined as vital parts of each of the five S's, and therefore, were sufficient in being the only inputs for the calculation of the total score. In the next section, each of the five S's along with its input calculations will be described (Table 1).

Methodology

1) Sleep: We measure sleep quality using three separate inputs: sleep time, sleep schedule and nap time. Through various studies, it was discovered that the optimal sleep time was averaged around 8.3±0.9 hours (Watson et al., 2015; Chaput, 2018). While several studies mentioned a vaguer optimal sleep time, 7-9 hours was the majority (Kahn, 2024), and 8.3 was an average that was centralised among studies. It was also discovered that consistency of sleep schedule was extremely important for total sleep quality, rather than the exact time one sleeps (Cherney, 2019). Making sure that sleep schedule is not differing by more than one hour as a measure of when one sleeps and wakes up, is a vital measure of sleep quality (Pesonen et al., 2022; Scott et al., 2023; McMahon et al., 2020). It was subsequently investigated whether sleeping at 1am is significantly worse than sleeping at 9pm. However, evidence suggests that it doesn't matter when one sleeps, as long as it is consistent (Barber & Munz, 2011). Finally, nap time is something that is incorporated into many people's lives, but many don't understand that too much nap time can exacerbate the REM (rapid eye movement) for one's sleep schedule, which could interfere with one's ability to fall asleep at night and obtain adequate sleep quality. The studies that were looked at mentioned that nap time should be capped at 45 minutes, to guarantee that the nap does not extend into REM and interfere with sleep quality at night (Li et al., 2023), which is also important to consider for sleep health among athletes (Sargent et al., 2021). It was also investigated whether screen time in close proximity to the time one sleeps would affect sleep quality (Khare et al., 2021). However, the majority of studies actually showed that blue light exposure (light emitted from phones, tablets, etc) is not much worse, if at all, than any other forms of lights (Blume et al., 2024).

2) Sedentary Behaviour: Sedentary behaviour is defined as any waking behaviour with low energy expenditure while in a sitting, reclining or lying postures (Bonnet & Cheval, 2023). It was discovered that sedentary behaviour for a long time continuously is associated with a higher risk of dementia, decreased cognitive function, higher risk of depression and worse effects on cardiometabolic risk (Saunders et al., 2020). Breaking up sedentary time rather than constant sedentary time was extremely beneficial in reducing risk to these potential health challenges. Further, high levels of MVPA (moderate to vigorous physical activity), greater than 300 minutes per week (about 45 minutes per day), could offset the harmful effects of sedentary behaviour (Dempsey, 2020).

3) Stress: Various studies were also gathered to consider objective information to output a quantitative stress meter. However, there are no studies that concretely pinpoint measures other than stress questionnaires (Crosswell & Lockwood, 2020; Lupien et al., 2022). Therefore, the DASS-21 questionnaire (Zanon et al., 2021) and the General Health Questionnaire (Lupien et al., 2022) were utilised, in combination, for the most relevant questions regarding stress to yield a valid measure of stress.

Table 1. Health and well-being scorecard (Five S's)

Scorecard				
Category		**Input or Description**		**Score**
Sleep Quality	Sleep Time	Amount of time slept in the day (x)		10 * 2 * Normpdf(x, 8.3, 0.9)
	Sleep Schedule Consistency	List of last 7 days of sleep schedule (time slept, time woke up)		7 - (amt of days where sleep schedule differs by more than an hour)
	Nap time	Napped for less than 45 minutes total		3
		Napped between 45-75 minutes total		1.5
		Napped for more than 75 minutes total		0
Sedentary Behaviour	MVPA (Moderate to Vigorous Physical Activity	Total time spent in MVPA > 45 minutes		20
		Total time spent in MVPA < 45 minutes		Look at time spent in sedentary behaviour
	Consistent time spent in sedentary behaviour	Input = List of time spent straight in sedentary behaviour (Iterate through list)		Set Score to 20
		Element in list between 60 and 90 minutes		Subtract 4
		Element in list between 90 and 120 minutes		Subtract 8
		Element in list > 120 minutes		Subtract 12
Stress	Stress Questionnaire	Questions rated 1 - 5 (1 = Considerably Frequently, 2 = Very Frequently, 3 = Somewhat Frequently, 4 = Rarely, 5 = Never)		Divide Total Score by 5
		1	Felt constantly under strain?	1 - 5
		2	Lost much sleep over worry?	1 - 5
		3	Felt you couldn't overcome your difficulties?	1 - 5

		4	Been feeling unhappy or depressed?	1 - 5
		5	Found yourself getting agitated?	1 - 5
		6	Found it difficult to relax?	1 - 5
		7	Got upset about little things?	1 - 5
		8	Felt scared for no good reason?	1 - 5
		9	Felt close to panic?	1 - 5
		10	Unable to be enthusiastic about anything?	1 - 5
		11	Felt you had nothing to look forward to?	1 - 5
		12	Breathing difficulty?	1 - 5
		13	Found yourself getting agitated?	1 - 5
		14	Could not stop feeling sad?	1 - 5
		15	Tended to overreact to situations	1 - 5
		16	Felt down-hearted or blue?	1 - 5
		17	Found yourself aware of your heartbeat in non-exertion situations?	1 - 5
		18	Felt that life was meaningless?	1 - 5
		19	Felt incapable of making decisions by yourself?	1 - 5
		20	Found it hard to wind down?	1 - 5
Sugar Consumption	Hemoglobin A1C Levels	Hemoglobin A1C > 6.4%		0
		Hemoglobin A1C between 5.7% and 6.4%		5
		Hemoglobin A1C < 5.7%		10
	Fasting Blood Glucose Levels	Glucose levels > 7.0 mmol/L		0
		Glucose Levels < 3.9 mmol/L		0
		Glucose Levels between 5.6 mmol/L and 6.9 mmol/L		5
		Glucose Levels between 3.9 mmol/L and 5.5 mmol/L		10
Smoking and Alcohol Consumption	Smoking	Current Smoker		0
		Quit less than a year ago		5
		Quit more than a year ago or never smoked		10
	Alcohol	4 or more drinks this week		0
		2-3 drinks this week		5
		1 drink this week		8
		0 drinks this week		10
TOTAL				**/ 100**

4) Sugar Consumption: Pertaining to sugar consumption, a wide variety of studies were investigated to determine what factors that are relatively easier to measure could provide an optimal representation of how sugar consumption could affect one's overall health. Based on these findings, two main factors were identified, a) the level of blood sugar measured through Hemoglobin A1C and 2) fasting blood glucose levels (Diamond, 2003).

5) Smoking/Alcohol: In order to gauge how badly intoxication can affect one's health (Hart et al., 2010; Xu et al., 2007), the brain scare scorecard (BCS) was investigated and it was determined that drinks/packs per week pertaining to alcohol and smoking, respectively, were important when determining a health score. Drinks in a day could be once-off and not a proper representation of one's actual total health (Singh et al., 2023).

Algorithm Description

The Score: The score is out of 100 (Table 1) and essentially assigns a letter grade, similar to a grading scale you would see in an academic setting, in order to quantity one's health score. 85-100 is considered an A (excellent health), 70-85 is considered a B (good health), 60-70 is considered a C (adequate health), 45-60 is considered a D (poor health) and anything below 45 is considered an F (detrimental health). The score is calculated evenly among the 5 S's categories, with 20 points coming from each of the 5 S's. The breakdowns for each of the categories is listed below.

1) Sleep: The inputs for the sleep score are {Amount of time slept, what time they slept, What time they woke up, Amount of time napped} for the given day. The score begins at 0. To calculate the score concerning the amount of time slept affecting health, we will use a normal model with a mean of 8.3 hours and a standard deviation of 0.9 hours. Using the input of the amount of time slept and the normal model specified before, calculate the z-score. Multiply the z-score by 2 and then 10, which is the score for time slept. For example, if you slept exactly 8.3 hours, your score would be 10 because you are 0 standard deviations away from the mean so you would subtract 0 from 10. Add the sleep time score to the total sleep score. Next, we will calculate the score concerning consistency of sleep schedule. Pull the previous 7 days sleep schedule into a list. Iterate backwards through the list and count how many days in a row from yesterday that the sleep schedule hasn't differed by more than an hour. The score for sleep schedule is maxed out and starts at 7. If the sleep schedule has differed by more than an hour, subtract one from the score for each day it has differed. Add the sleep schedule score to the total sleep score. Finally, we will calculate the nap score. Check if the total nap time is less than 45 minutes. If the total nap time is less than 45 minutes, then 3 is the nap score. If the total nap time is between 45-75 minutes, then 1.5 is the nap score. And if the total nap score is greater than 75 minutes, 0 is the nap score. Add the nap score to the total score and return the total sleep score after the calculation of the three categories within the sleep quality category.

2) Sedentary Behaviour: The inputs for the sedentary behaviour score are the amount of time spent straight in sedentary behaviour as a list of integers (ex: [15, 45, 6, 60]). Also have the amount of time spent in MVPA (Moderate to Vigorous Physical Activity). Set the sedentary behaviour score to 20. If your total time spent in MVPA is greater than 45 minutes, score is 20. Otherwise, iterate through the list of sedentary behaviour. If any elements in the list are greater than 60 minutes, subtract 4 from the score, if any are greater than 90, subtract 8 from the score, and if any are greater than 120, subtract 12 from the score. However, the score cannot go below 0, so if it reaches 0 it stays at 0. After iterating through the entire list, return the total sedentary behaviour score out of 20.

3) Stress: The total stress score is based on a questionnaire combining several different mental health and stress-based questionnaires. There are 20 questions where the user will answer on a scale of 1-5: 1 represents Considerably Frequently, 2 represents Very Frequently, 3 represents Somewhat Frequently, 4 represents Rarely, 5 represents Never. The questions are listed in the scorecard.

4) Sugar Consumption: The score for sugar consumption is strictly based off Hemoglobin A1C levels in blood sugar. The score is simple. If hemoglobin levels are greater than 6.4, then the sugar consumption score is simply 0. If the hemoglobin levels are between 5.7 and 6.4, then the score is 10. If the hemoglobin levels are lower than 5.7, the sugar consumption score is the maximum, 20.

5) Smoking/Alcohol Consumption: The score is based on recent activity of both smoking and alcohol. For the smoking score (out of 10), if the user is a current smoker, the smoking score is 0, if the user quit less than a year ago, the smoking score is 5, and if the user was never a smoker or quit more than a year ago, the smoking score is 10. For the alcohol score (out of 10), if the user had 4 or more drinks over the course of the week, the alcohol score is 0, if the user had 2-3 drinks over the course of the week, the alcohol score is 5, if the user had 1 drink over the course of the week, the alcohol score is 8, and if the user had 0 drinks over the course of the week, the alcohol score is 10. The total intoxication score is the smoking score plus the alcohol score, which would be out of 20.

Algorithm Calculation

1. **Sleep Score (S_L) =** $S_t + S_h + S_n$

   Sleep Time Score(S_t):

   $S_t = 10 \times 2 \times$ Normpdf (X, 8.3, 0.9); Where X is the number of hours slept

   Sleep Schedule Score (S_h):

S_h = 7 – (number of days in the week where sleep schedule differed by more than one hour)

Nap Score (S_n):

S_n = 3 if nap time ≤ 45

S_n = 1.5 if nap time between 45 and 75

S_n = 0 if nap time > 75

2. **Sedentary Behaviour Score (S_B) =** S_m

   MVPA Score (S_m):

   S_m = 20 if MVPA > 45

   S_m = S_c if MVPA ≤ 45

   Consistency Sedentary Behaviour Score (S_c):

   S_c = 20 – ((4 if sedentary behaviour time in list > 60 but < 90) (8 if sedentary behaviour time in list > 90 but < 120) (12 if sedentary behaviour time in list > 120))

3. **Stress Score (S_T) = (**Score from stress questionnaire) / 5

4. **Sugar Consumption Score (S_C) =** S_h + S_g

   Hemoglobin A1C Score (S_h):

   S_h = 0 if Hemoglobin A1C > 6.4%

   S_h = 5 if Hemoglobin A1C is between 5.7% and 6.4%

   S_h = 10 if Hemoglobin A1C < 5.7%

   Glucose Level Score (S_g):

   S_g = 0 if fasting blood glucose < 3.9 mmol/L or if fasting blood glucose > 7.0 mmol/L

   S_g = 5 if fasting blood glucose is between 5.6 mmol/L and 6.9 mmol/L

   S_g = 10 if fasting blood glucose is between 3.9 mmol/L and 5.5 mmol/L

5. Smoking/Alcohol Score (S_A) = $S_m + S_a$

Smoking Score (S_m):

$S_m = 0$ if current smoker

$S_m = 5$ if person quit smoking < 1 year ago

$S_m = 10$ if person quit smoking > 1 year ago OR person never smoked

Alcohol Score (S_A):

$S_a = 0$ if ≥ 4 drinks this week

$S_a = 5$ if person drank 2-3 drinks this week

$S_a = 8$ if person drank 1 drink this week

$S_a = 10$ if person drank 0 drinks this week

Total Score (S_S) (out of 100) = $S_L + S_B + S_T + S_C + S_A$

Hypothetical Examples

Example 1 (male): Dan sleeps five hours day consistently from 1:00 AM to 6:00 AM. He also naps once a day from 4:00 PM to 6:00 PM. He goes to the gym and exercises for an hour and a half everyday but sits from 9:00 AM to 12:00 PM and 1:00 PM to 3:00 PM straight. Dan scored a 70 on the stress questionnaire. Every Saturday, Dan has about 2-3 drinks and he does not smoke. His glucose levels are at 5.8 and his hemoglobin levels are at 5.5. Based on the total algorithm we can calculate his health score. His sleep score is based on his total sleep time (5 hours), consistency of sleep schedule, and nap time (2 hours). In total, $S_L = 10.01$. His sedentary behaviour score is based om MVPA (90 minutes) and time spent in sedentary behaviour (3 hours then 2 hours). In total, $S_B = 20$. His stress score is based on his score in the questionnaire (70). In total, $S_T = 14$. His smoking/alcohol score is based on the amount of drinks in the past week (2-3 drinks) and how long ago they stopped smoking (never smoked). In total, $S_A = 15$. His sugar consumption score is based on his hemoglobin (5.5) and glucose (5.8) levels. In total, $S_C = 15$. As a result, Dan's total score is 74.01. On the grading scale, he has a B grade health score, which means he is in good health.

Example 2 (female): Emily sleeps eight hours per day consistently from 11:00 PM to 7:00 AM. She does not nap at all. She works out every day for 60 minutes but sits at work every day from 8:00 AM to 1:00 PM. Emily scored a 50 on the stress questionnaire and doesn't drink at all but smokes a pack

a week. Her glucose and hemoglobin levels are both at 6.0. Based on the total algorithm, we can calculate her health score. Her sleep score is based on her total sleep time (8 hours), consistency of sleep schedule and nap time (0 hours). In total, $S_L = 18.4$. Her sedentary behaviour score is based on MVPA (60 minutes) and time spent in sedentary behaviour (5 hours). In total $S_B = 20$. Her stress score is based on her score in the questionnaire (50). In total, $S_T = 10$. Her smoking/alcohol score is based on the amount of drinks in the past week (0 drinks) and how long ago they stopped smoking (current smoker). In total $S_A = 10$. Her sugar consumption is based on her hemoglobin (6.0) and glucose (6.0) levels. In total, $S_C = 10$. As a result, Emily's total health score is 68.4. On the grading scale, she has a C grade health score, which means she is in adequate health.

Limitations

There are several drawbacks to the current five S's scorecard, despite its advantages and usefulness. First, bias may be introduced, and the accuracy of the ratings may be impacted by the use of self-reported data for inputs such as stress levels, physical activity and quality of sleep. Secondly, the scorecard oversimplifies intricate health variables into a single score, potentially ignoring subtle variations in each patient's condition. Third, even though the algorithm is based on reliable sources, it does not fully account for the variation in how different people react to health habits, such as variations in their stress tolerance or sleep needs. Furthermore, the scorecard is yet to be validated and piloted among population groups and leaves out important health-related variables that could have a substantial impact on general health (i.e. genetic predispositions, chronic medical disorders and a diversity of dietary practices). Lastly, the implementation and usability of the scorecard through an application or website are contingent on the availability of technology and user engagement, which may not be uniformly accessible to all populations and settings.

Conclusion

The development of a comprehensive health scorecard based on the five S's – Sleep, Sedentary behaviour, Stress, Sugar consumption and Smoking/alcohol – offers a practical and efficient tool for assessing individual health. This scorecard offers a comprehensive picture of both physical and mental health because it is supported by a strong algorithm that incorporates reliable sources. Its simplicity of use as well as the limited time and effort of gathering inputs; improves its usability and accessibility, especially in situations when access to healthcare is restricted. People can discover areas that require development and obtain important insights into how their lifestyle choices affect their overall well-being by using a balanced score to assess their health. This application promotes awareness and proactive management of important health parameters by acting as a vital educational resource in addition to making personal health monitoring easier.

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