

Leveraging Phone Sensors for Early Detection of Symptom Changes in Cancer Patients

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Cancer patients often experience fluctuations in their health, which can be challenging to monitor continuously through traditional methods, such as patient self-reporting during clinic visits. With the growing prevalence of smartphones and their built-in sensors, new opportunities have emerged for real-time, passive monitoring of patient behavior and health. These phone sensors—tracking factors like physical activity, location, and phone usage—can provide continuous data that may signal subtle changes in a patient’s condition even before they become consciously aware of worsening symptoms.

THE AIM:

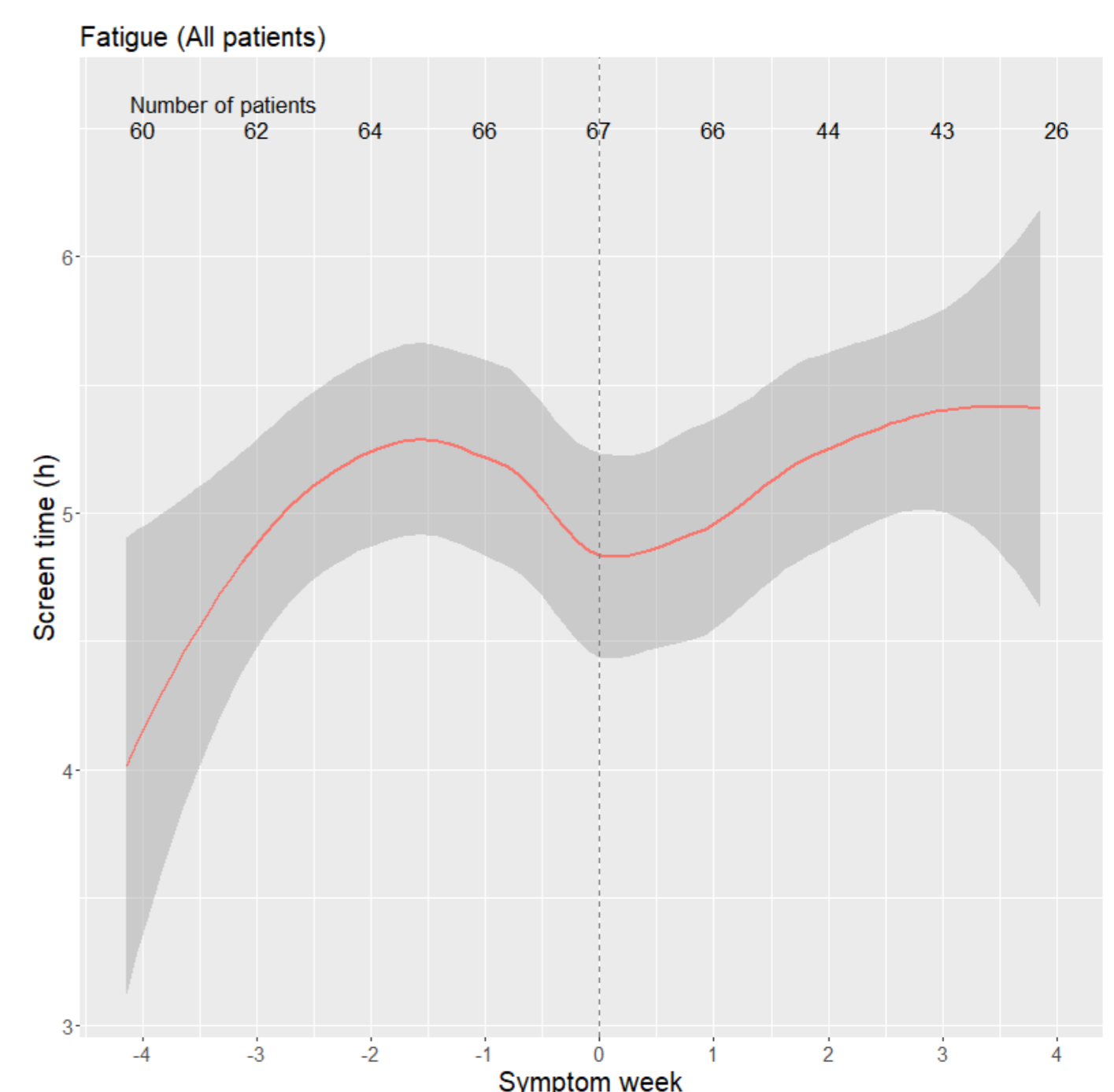
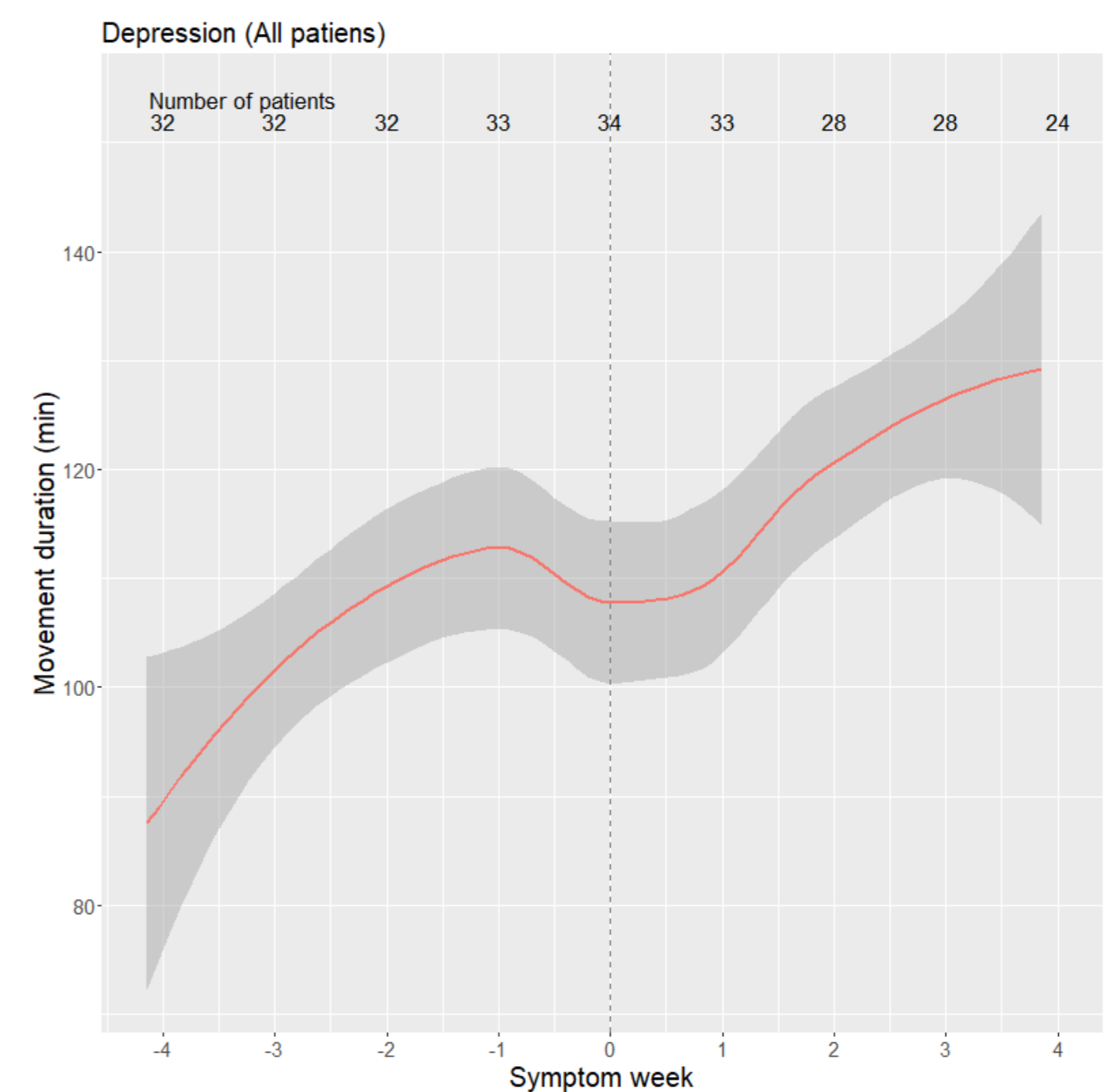
Explore how smartphone sensor data can help identify worsening symptoms in cancer patients, allowing for timely intervention and improved patient care.

DATA FOR ANALYSIS:

- 108 patients with different types of cancer.
- Data streams from smartphone sensors to describe the activity and sociability: GPS and power state.
- European Organization for Research and Treatment of Cancer Core Quality of Life questionnaire.

ANALYSIS PROCESS:

- GPS data:
Distance from home, Average speed of movement, Movement duration, Time spent at home
 - Power state data:
Screen time
1. Data from phone sensors is examined to understand how real-time behavioral changes may be related to the onset of symptoms in cancer patients.
 2. It investigates how daily activity patterns, such as movement and phone use, can signal an impending change in symptoms.
 3. The study included patients grouped by cancer type, sex, functional status (ECOG scale), and age.
 4. Loess regression and statistical analysis (Wilcoxon signed-rank test), were applied to examine the dynamics of sensor data before and after symptom onset.



RESULTS:

- Patients' activity levels and time spent at home start to decline even before they report symptoms such as fatigue.
- Monitoring sensor data helps predict symptom worsening, allowing for early intervention.
- Early intervention is crucial for enhancing the quality of patient care and managing symptoms effectively.
- Sensor data enables personalized care tailored to each patient’s condition, which is particularly beneficial for cancer patients.

DEPRESSION		A month before the symptom (median)	A month after the symptom (median, p-value)	Two month after the symptom (median, p-value)
Distance from home (km)	All patients	0.241	0.463 [p=7.759e-6]	0.615 [p=0.000]
	Men	0.053	0.891 [p=5.105e-10]	0.783 [p=3.858e-6]
	Younger than 60	0.209	0.776 [p=4.394e-5]	
	Older than 60	0.264	0.276 [p=0.022]	0.951 [p=2.166e-5]
	EGOC 0	0.278	0.334 [p=0.002]	
Movement duration (min)	All patients	120.00	130.00 [p=2.465e-5]	
	Men	76.00	116.50 [p=9.621e-8]	
	Younger than 60	122.00		96.00 [p=0.001]
	Older than 60	117.00	132.00 [p=6.289e-9]	122.00 [p=9.354e-5]
	EGOC 0	120.00	130.00 [p=0.000]	

		A month before the symptom (median)	A month after the symptom (median, p-value)	Two month after the symptom (median, p-value)	Three month after the symptom (median, p-value)
Fatigue	Screen time (h)	3.232	3.174 [p=0.883]	3.382 [p=0.175]	3.136 [p=0.312]
	Distance from home (km)	0.379	0.478 [p=0.134]	0.210 [p=0.035]	0.648 [p=0.005]
	Time spent at home (h)	18.950	19.025 [p=0.239]	20.517 [p=0.034]	18.150 [p=0.000]
	Average speed of movement (km/h)	0.001	0.000 [p=0.021]	0.000 [p=0.007]	0.002 [p=0.841]
Vomiting	Screen time (h)	3.053	3.854 [p=0.025]	4.083 [p=4.094e-5]	3.685 [p=0.006]
	Time spent at home (h)	18.992	20.542 [p=0.272]	9.092 [p=0.005]	2.750 [p=7.133e-5]

