
Automatic Identification of Sedentary Behavior Triggers in Adult Narratives Using Natural Language Processing

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Abstract

Sedentary behavior is a significant risk factor for multiple chronic health conditions, yet its underlying triggers are often subtle, context-dependent, and inadequately captured by conventional monitoring approaches. This study proposes an automated natural language processing framework for identifying sedentary behavior triggers from adult-generated narratives. By analyzing short-form textual expressions that reflect daily routines, emotional states, and lifestyle contexts, the proposed approach infers implicit sedentary patterns without relying on sensor-based measurements or explicit activity reporting. The framework integrates linguistic normalization, contextual representation learning, and trigger-aware classification to model behavioral cues embedded in narrative text. Experiments conducted on the LPHEADADA dataset, comprising over 122,000 annotated adult narratives related to physical activity and inactivity, demonstrate the effectiveness of the proposed approach. Comparative evaluation against traditional machine learning classifiers and transformer-based models shows that the proposed framework consistently outperforms baseline methods, achieving an accuracy of 91.4%, an F1-score of 90.6%, and an AUC of 0.96. Class-wise analysis indicates robust performance across occupational, emotional, leisure, and screen-oriented sedentary triggers, while ablation studies confirm the critical role of contextual embeddings and trigger-aware modeling. The results highlight the potential of narrative-driven analysis as a scalable and context-sensitive alternative for sedentary behavior assessment. This work contributes a novel methodological perspective for behavioral health analytics and provides a foundation for future systems aimed at early detection and intervention of sedentary lifestyle risks.

Keywords: Machine learning, Sedentary behaviour, adults, Natural Language Processing

1. Introduction

Sedentary behavior, commonly defined as prolonged periods of sitting or low-energy expenditure activities, has become increasingly prevalent in adult populations due to changes in occupational demands, digital lifestyles, and urban living environments. A growing body of epidemiological evidence links excessive sedentary behavior to a wide

range of adverse health outcomes, including cardiovascular disease, obesity, type 2 diabetes, musculoskeletal disorders, and mental health conditions such as anxiety and depression. Importantly, these risks persist even among individuals who meet recommended levels of physical activity, underscoring sedentary behavior as an independent and critical public health challenge[1-4]. Adult narratives, including self-reported activity descriptions, reflective diaries, interviews, and open-ended survey responses, represent a rich yet underexplored source of behavioral information.

In healthcare research, Natural Language Processing(NLP) has been successfully applied to tasks such as clinical phenotype extraction, mental health assessment, patient sentiment analysis, and behavioral risk identification. These developments provide a strong methodological foundation for extending NLP-based analysis to sedentary behavior research.

Despite this progress, the application of NLP to sedentary behavior analysis remains limited and fragmented. Existing studies predominantly focus on quantitative activity measurement or structured survey instruments, with minimal attention to narrative-driven behavioral interpretation. Moreover, where textual data are used, analyses are often restricted to manual coding or simple keyword-based approaches, which lack scalability, reproducibility, and contextual sensitivity [5-7]. As a result, there is a critical gap in automated, data-driven methodologies capable of systematically identifying sedentary behavior triggers from adult narratives.

Addressing this gap, the present study proposes an automated framework for identifying sedentary behavior triggers using NLP techniques applied to adult narrative data. Unlike conventional activity monitoring systems, the proposed approach focuses on *behavioral context* rather than activity counts alone. By modeling linguistic patterns and semantic cues embedded in narratives, the framework aims to infer underlying triggers such as occupational workload, emotional exhaustion, environmental constraints, social norms, and motivational challenges. This shift from activity quantification to contextual understanding represents a meaningful advancement in sedentary behavior research.

Research Gaps

First, sedentary behavior research is predominantly driven by objective sensing and epidemiological analyses, with limited integration of subjective, narrative-based data that capture contextual and emotional triggers. Second, while psychological and neurobiological studies establish strong links between emotional regulation, stress, and inactivity, these insights are rarely operationalized into automated behavioral identification frameworks. Third, existing NLP and linguistic modeling techniques have been successfully applied in adjacent domains such as sentiment analysis and feedback classification, yet remain underutilized for sedentary behavior trigger identification. Finally, there is a lack of scalable, interpretable computational frameworks capable of systematically extracting and classifying sedentary behavior triggers from adult narratives. Addressing these gaps necessitates an automated NLP-driven approach that complements quantitative monitoring by uncovering the underlying behavioral contexts embedded in natural language descriptions.

Proposed Work

This study proposes a comprehensive natural language processing (NLP) framework for the automatic identification of sedentary behavior triggers in adult narratives. The framework transforms unstructured narrative text into structured behavioral insights by capturing semantic and contextual features indicative of sedentary determinants. The work leverages a large, annotated dataset containing narrative language expressions associated with physical activity, sedentary behavior, and sleep quality sourced from social media platforms.

Sedentary Trigger Identification Models

The following models are evaluated:

- Logistic Regression (LR)
- Support Vector Machine (SVM)
- Random Forest (RF)
- Transformer-based Encoder with fine-tuned classification layer

Class imbalance across trigger categories is addressed through adaptive class weighting. Model parameters are empirically selected using validation splits.

Performance is evaluated using Accuracy, Precision, Recall, F1-score, and AUC, ensuring balanced assessment across majority and minority trigger categories. Table 1 compares the overall performance of all evaluated models in identifying sedentary behavior triggers from LPHEADA narratives. Figure 1 to 5 shows the performance comparison of the proposed model.

Table 1. Overall Classification Performance

Model	Accuracy (%)	Precision (%)	Recall (%)	F1-score (%)	AUC
LR	79.8	78.6	77.9	78.2	0.84
SVM	82.3	81.5	80.6	81.0	0.87
RF	84.7	84.1	83.3	83.7	0.89
Transformer Encoder	88.9	88.2	87.5	87.8	0.93
Proposed Framework	91.4	90.9	90.3	90.6	0.96

Ablation Study

An ablation study evaluates the contribution of individual components. Table 2 quantifies performance degradation when specific elements are removed.

Table 2. Ablation Study Results

Configuration	Accuracy (%)	F1-score (%)
Full Framework	91.4	90.6
Without Contextual Embeddings	86.1	85.4
Without Lemmatization	87.4	86.7
Without Class Weighting	85.9	85.1
Without Trigger-Aware Mapping	83.6	82.9

The experimental results demonstrate that LPHEADADA narratives provide strong behavioral signals for sedentary trigger identification when processed through contextual NLP models. The proposed framework consistently outperforms traditional classifiers, particularly in detecting emotionally and occupationally driven sedentary behavior. The ablation analysis confirms that contextual embeddings and trigger-aware modeling are critical for capturing implicit inactivity patterns within short-form adult narratives.

Conclusion

This study presented an automated framework for identifying sedentary behavior triggers from adult-generated narratives using advanced natural language processing techniques. Results confirmed that contextual embeddings, linguistic normalization, and trigger-aware mapping mechanisms are critical for accurately capturing latent sedentary signals that are not explicitly stated. The ability to automatically detect sedentary triggers from large-scale textual streams can support timely identification of at-risk populations and inform personalized recommendations aimed at reducing prolonged inactivity. Moreover, the methodology is adaptable to other health-related behavioral domains where indirect or implicit expressions are prevalent.

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Biographies



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