Temporal relationship between objectively measured physical activity and pain occurrence in patients with sickle cell anemia: a pilot study

Naka Rio[1], Coly Mame Saloum[2], Diaw Mor[2], Gadji Macoura[3], Samb Abdoulaye[2], Diop Saliou[3], Faye Felix Blaise[3], Nader Elie[4], Ranque Brigitte[5], Charlot Keyne[6], Connes Philippe[4], Yoshida Tsukasa[7], Miyachi Motohiko[7], Tripette Julien[1]

[1]Ochanomizu University, Japan; [2]Université Cheikh Anta Diop, Senegal; [3]Centre National de Transfusion Sanguine, Senegal; [4]Université Claude Bernard Lyon, France; [5]Assistance Publique-Hôpitaux de Paris, France; [6]Institut de Recherche Biomédicale des Armées, France; [7]National Institutes of Biomedical Innovation, Health and Nutrition, Japan

tripette.julien@ocha.ac.jp

19KK0248

お茶の水女子大学
Ochanomizu University

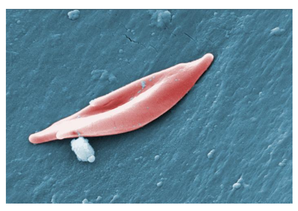
SPORT & SCIENCE ECSS ● PARIS 2023

ABSTRACT

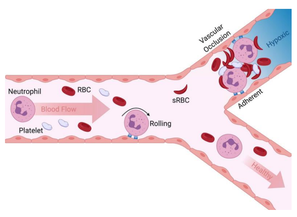
INTRODUCTION:
Sickle cell anemia is caused by a mutation on the beta-globin gene, which leads to the production of abnormal hemoglobin. Under deoxygenated conditions, this hemoglobin may polymerize, causing red blood cells to adopt a sickle-like shape. Acute painful vaso-occlusive crises observed in sickle cell anemia patients result from the obstruction of vessels by sickled red blood cells. Since hypoxemia is one of the main triggers of red blood cell sickling, patients are usually recommended to avoid vigorous exercise. However, the adoption of sedentary lifestyles may prevent the development of physical activity-mediated adaptations that could have improved the clinical outcome of the disease. The present study aims at exploring the temporal relationship between objectively assessed physical activity and pain occurrence in sickle cell disease patients.
METHODS:
Eighty sickle cell disease patients were recruited through the National Center for Blood Transfusion of Dakar, Senegal for the “drePAnon” study (UMIN000042826, UMIN-CTR Clinical Trial). The participants were given a wrist-worn activity tracker equipped with an accelerometer and providing access to minute-by-minute physical activity data. The monitoring period lasted for 5 to 15 weeks. The participants also complete a pain diary. The data of 6 patients (male only, 30 ± 5 years old) with the highest quality of pain and physical activity data were used to perform the temporal statistical analysis. For each day of the monitoring period, 24 data features informing on the timing, duration, and volume of 3 and 6 METs or more physical activity over periods of 24, 48, and 72 hours were extracted from the minute-by-minute activity tracker time series. The temporal relationship between the principal components of the 24 physical activity parameters and pain was tested using cross-correlation tests for each patient and for time lags of 0 to -5 days.
RESULTS:
Significant positive correlations between the principal component parameter of 3 and 6 METs or more physical activity and pain intensity were found in 3 of the 6 patients (correlation coefficients between 0.23 and 0.72). Interestingly, the strongest correlations (i.e., correlation coefficient above 0.70) occur for a time lag of -3 days.
CONCLUSION:
The present study tends to confirm the potential temporal relationship between relatively high intensities of physical activity completed during daily life and later painful vaso-occlusive events in some subjects. The risk of experiencing acute painful episodes on one given day may be related to physical behaviors that were performed 3 days before. Further studies are necessary to confirm these preliminary observations and to develop activity tracker-based preventive strategies against vaso-occlusive events.

INTRODUCTION

The beta-globin gene causes
- Sickle-like shape
- Acute painful vaso-occlusive crises



Sickle cell blood cell[1)]



Overview of acute painful vaso-occlusive crises[2)]

Sickle cell anemia patients are recommended to avoid vigorous exercise.[3)]

⇅

WHO[4)] Everyone can benefit from increasing physical activity and reducing sedentary behavior.[5)]

Research objective

Exploring the temporal relationship between objectively assessed physical activity and pain occurrence in sickle cell disease patients.

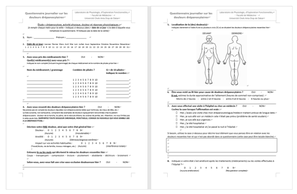
METHODS

National Center for Blood Transfusion of Dakar[6)]

Characteristics of the subject
- 68 sickle cell disease patients
- No confirmed VOC in the preceding 3 months
- No acute chest syndrome in the preceding 3 months
- No transfusion in the preceding 2 months

Collected data
- Minute-by-minute activity tracker time
- Pain intensity
- Monitoring period: 5~15 weeks

Wrist-worn activity tracker[7)]



Pain diary

Subject characteristics in this study

- 6 sickle cell disease patients
- Man patients only
- 30 ± 5 years old
- **High data quality standard: min-per-min data only**

Subject	Pain days	Observation days
1	4	34
2	3	31
3	4	38
4	10	31
5	9	102
6	9	27

Data feature extraction

Intensity	Time [hours]	Parameters	Intensity	Time [hours]	Parameters
VPA	24	Total physical activity minutes	MVPA	24	Total physical activity minutes
		Bout 1 minute or more			Bout 1 minute or more
		Bout 10 minutes or more			Bout 10 minutes or more
		Bout 20 minutes or more			Bout 20 minutes or more
	48	Total physical activity minutes		48	Total physical activity minutes
		Bout 1 minute or more			Bout 1 minute or more
		Bout 10 minutes or more			Bout 10 minutes or more
		Bout 20 minutes or more			Bout 20 minutes or more
	72	Total physical activity minutes		72	Total physical activity minutes
		Bout 1 minute or more			Bout 1 minute or more
		Bout 10 minutes or more			Bout 10 minutes or more
		Bout 20 minutes or more			Bout 20 minutes or more

Time-lagged cross-correlation tests

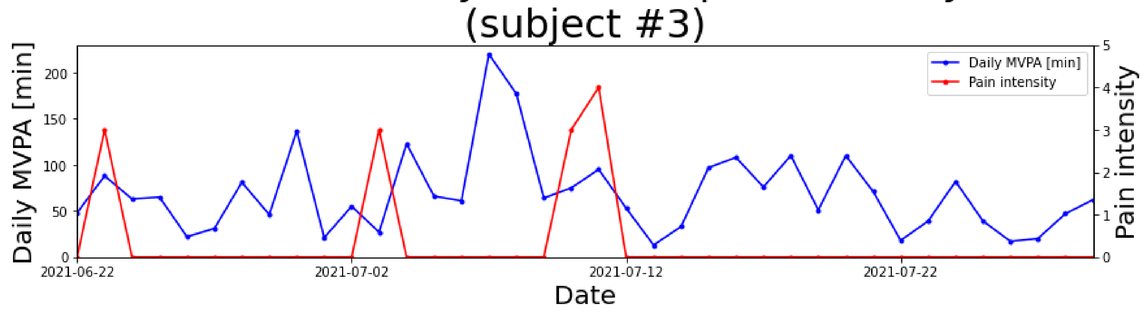
- Principal component of the 24 physical activity parameters vs. pain
- Explored time lags: 0 to -5 days.

RESULTS

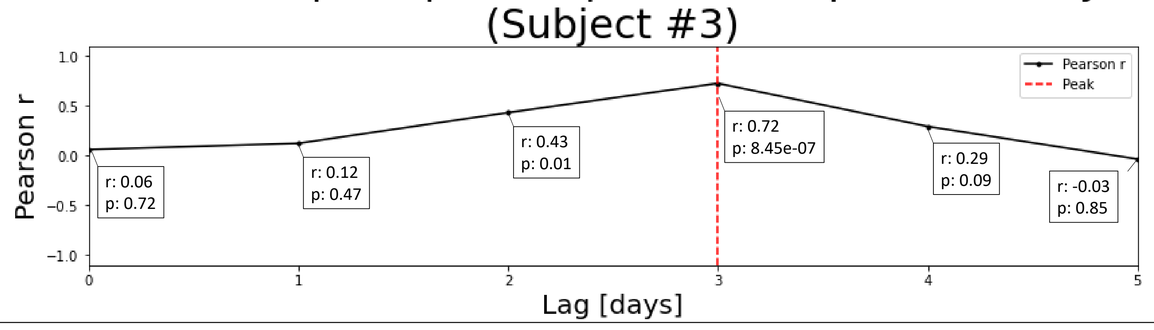
Time-lagged cross-correlations between principal component and pain intensity

Subject	Lag[days]	r	p
1	-	-	>0.05
2	-	-	>0.05
3	3	0.72	8.40E-07
4	0	0.38	0.04
5	5	0.23	0.03
6	-	-	>0.05

Temporal relationship between daily MVPA and pain intensity (subject #3)



Time-lagged cross-correlations between principal component and pain intensity (Subject #3)



CONCLUSION

- The present study tends to confirm the potential temporal relationship between relatively high intensities of physical activity completed during daily life and later painful vaso-occlusive events in some subjects.
- The risk of experiencing acute painful episodes may be related to physical behaviors that were performed between 0 to 5 days before.

REFERENCE

1) CDC: Details - Public Health Image Library(PHIL), <https://phil.cdc.gov/details.aspx?pid=11688>
2) Frontiers: Targeting Neutrophil Adhesive Events to Address Vaso-Occlusive Crisis in Sickle Cell Patients, < https://www.frontiersin.org/articles/10.3389/fimmu.2021.663886/full>
3) CDC: What is Sickle Cell Disease?, < https://www.cdc.gov/ncbddd/sicklecell/facts.html >
4) World Health Organization: Logo, <https://www.who.int/about/policies/publishing/logo>
5) World Health Organization: WHO guidelines on physical activity and sedentary behaviour: at a glance, <https://www.who.int/europe/publications/i/item/9789240014886>
6) MINISTRY OF HEALTH AND SOCIAL ACTION: Coronavirus: The Minister of Health and Social Action at the National Blood Transfusion Center <https://www.sante.gouv.sn/mediatheque/phototheques/coronavirus-le-ministre-de-la-sant%C3%A9-et-de-laction-sociale-au-centre>
7) Fitbit：心拍数機能を備えたフィットネストラッカー, <https://www.fitbit.com/global/jp/products/trackers/inspire2?sku=418BKBK>