HOW TO OBJECTIVLY ASSES UPPER LIMB FUNCTION IN BREAST CANCER SURVIVORS?

Nieke Vets[1,2], Kaat Verbeelen[2,3] , Dr. Jill Emmerzaal[1], Prof. Dr. Nele Devoogdt[1,2,4], Prof. Dr. Ann Smeets[5,6], Prof. Dr. Dieter Van Assche[1], Prof. Dr. Liesbet De Beats[1,8,†], Prof. Dr. An De Groef[1,2,3,7,†]

[1] KU Leuven, Department of Rehabilitation Sciences; [2] CarEdOn Research Group; [3] University of Antwerp, Department of Rehabilitation Sciences, MOVANT research group; [4] Pain in Motion International Research Group; [5] UZ Leuven - University Hospitals Leuven, Department of Vascular Surgery and Department of Physical Medicine and Rehabilitation, Center for Lymphoedema; [6] KU Leuven, Department of Oncology; [7] UZ Leuven - University Hospitals Leuven, Surgical Oncology; [8]The Leuven Centre for Algology and Pain Management and Division of Physical Medicine and Rehabilitation, UZ Leuven—University Hospitals Leuven, B-3000 Leuven, Belgium ; [†] contributed to this work equally

BACKGROUND:

Decreased upper limb (UL) function is observed in approximately 50% of breast cancer (BC) patients at six months post-radiotherapy. Currently, UL function is predominantly assessed using self-report questionnaires, which are subject to known limitations such as recall bias and subjective interpretation. The **FIRST aim** of this study is to **review the existing literature** to identify potential objective assessment methods of UL function across various populations. The **SECOND aim** is **to evaluate the accuracy** of these selected methods specifically within the BC population.

1 LITERATURE REVIEW

METHODS: A systematic literature search was conducted using the following databases: PubMed, Embase, Scopus, Web of Science, SportDiscus, ClinicalTrials.gov, and the International Clinical Trials Registry Platform.

The search terms applied included upper limb, activity tracking, and functional activity.

Studies were included if they reported on the accuracy and/or validity of accelerometer-based methods for assessing upper limb functional use, regardless of the study population.

RESULTS: Assessed mainly in stroke patients, persons with an UL prosthesis or children and adolescents with UL complaints

The counts threshold method (n=7)

- Count = magnitude of acceleration (g) per time epoch(s) (0.01664g/s)
- Describe a threshold when functional/non-functional
- Most described method Least accurate analysis method

The gross movement method (n=3)

- Functional movement occurs when the forearm is elevated and moved laterally with a 30° angular change
- Good specificity results

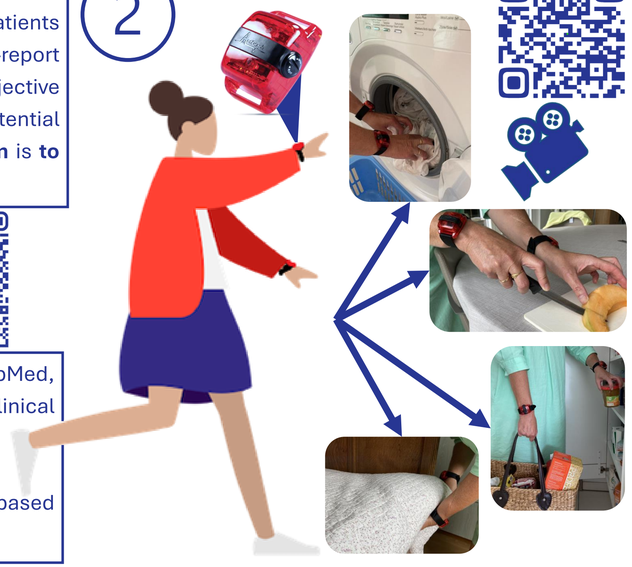
Machine learning methods (n=6)

- Subgroup of artificial intelligence that makes predictions by identifying patterns in a dataset using mathematical algorithms
- Especially Random Forrest classifying model: promising results
- Accuracy results of 90.4-92.6% compared to video-annotated data

Quality assessment:

7 studies scored medium - 6 studies scored low

2 ACCURACY TESTING



METHODS:

10 BCS (median age: 50.5 [IQR: 43.8-56.0]; median QuickDASH score: 11.4 [IQR 3.38-15.9]) performed four daily life activities (laundry, kitchen task, shopping and bed making) while wearing two wrist accelerometers (ActiGraph wGT3X-BT) and being video recorded.

To define upper limb functioning, video data was annotated (ground truth), and accelerometer data was analyzed using a counts threshold method and a pre-trained lab-based machine learning (ML) model (Random Forrest classifying model developed in Matlab).

RESULTS: Nonetheless, a good accuracy of the ML-model (range: 0.76-0.88), it is shown that based on the 'total minutes functional active' and 'percentage in functional active', the pre-trained ML-Model and the counts threshold method overestimate UL functional use.

	Left arm				Right arm			
	accuracy	recall	specificity	f1	accuracy	recall	specificity	f1
Average	0.83	0.96	0.82	0.35	0.85	0.77	0.85	0.47

Mean difference with the ground truth [SD]	Left arm		Right arm	
	ML-Model	Counts	ML-Model	Counts
	0.14 [0.04]	0.27 [0.07]	0.10 [0.04]	0.24 [0.07]

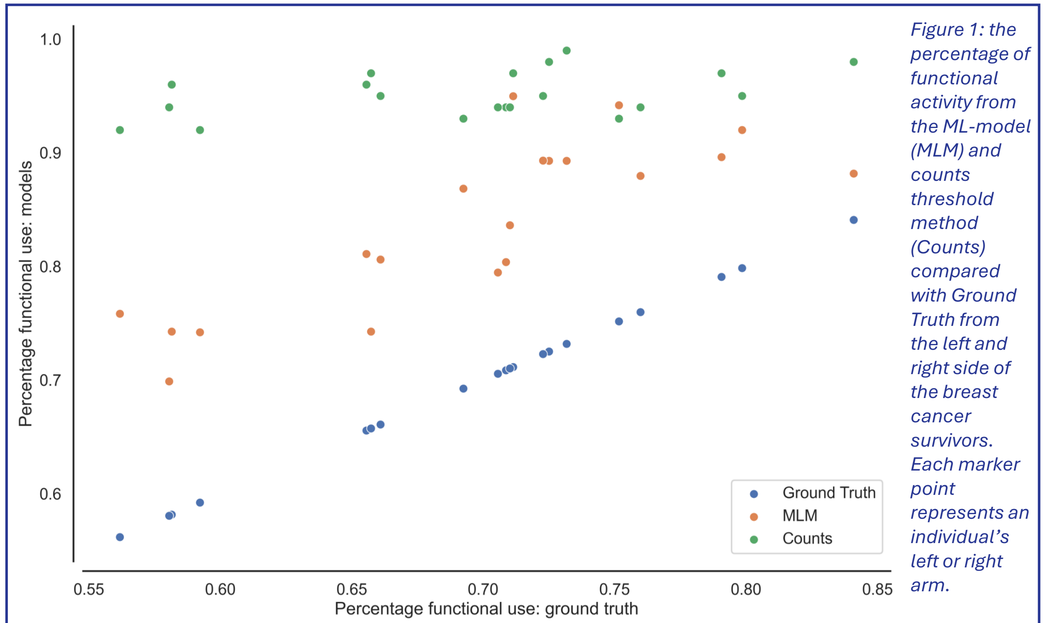


Figure 1: the percentage of functional activity from the ML-model (MLM) and counts threshold method (Counts) compared with Ground Truth from the left and right side of the breast cancer survivors. Each marker point represents an individual's left or right arm.

CONCLUSION:

A good accuracy is present for the ML-model.

The ML-model investigates more accurately UL functioning than the commonly used counts threshold method.

Low f1-score for the ML-model indicates a large number of false positives, whereby non-functional data is categorized as functional upper limb use.

The results of a ML-Model are more in line with the video data, but an overestimation is still present.

Corresponding author:
Vets Nieke,
Research Group for Rehabilitation in Internal Disorders,
ON4 Herestraat 49 box 1510, 3000 Leuven;
nieke.vets@kuleuven.be; tel. +32 16 34 51 97

ClinicalTrials.gov:
NCT05297591;

Ethical committee:
S66248

KU LEUVEN