



# QUALITY IN SPORT

eISSN 2450-3118 · Open Access · Peer-reviewed

apcz.umk.pl/QS Nicolaus Copernicus University in Toruń



ŚCIEBURA, Kacper, MORDAL, Natalia, ZIENKIEWICZ, Damian, MAKULEC, Gabriela, DOMOSUD, Karolina, WALENDZIAK, Weronika, WIŚNIEWSKA, Wiktoria, OSTASZEWSKA, Magdalena, MAJCHRZYK, Milena and MALCZYK, Anna. Physical Activity in Polycythemia Vera: Benefits, Risks and Evidence-Based Exercise Recommendations - A Narrative Review. *Quality in Sport*. 2026;56:72507. <https://doi.org/10.12775/QS.2026.56.72507>

## ARTICLE TIMELINE

Received: 24.05.2026 Revised: 26.05.2026

Accepted: 26.05.2026 Published: 30.05.2026

## INDEXING & EVALUATION

MEiN points: 20 Unique ID: 201398

Disciplines: Economics & Finance; Management & Quality Sciences

The journal has been awarded 20 points in the parametric evaluation by the Polish Ministry of Higher Education and Science (Annex to the announcement of 05.01.2024, No. 32553). Unique Journal Identifier: 201398. Scientific disciplines: Economics and Finance (Social Sciences); Management and Quality Sciences (Social Sciences).

Punkty Ministerialne z 2019 – aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych). © The Authors 2026.

**OPEN ACCESS · CC BY-NC-SA 4.0** This article is published with open access under the License Open Journal Systems of Nicolaus Copernicus University in Toruń, Poland, and is distributed under the terms of the Creative Commons Attribution Non-commercial Share Alike License (<http://creativecommons.org/licenses/by-nc-sa/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the work is properly cited. The authors declare no conflict of interest regarding the publication of this paper.

## Physical Activity in Polycythemia Vera: Benefits, Risks and Evidence-Based Exercise Recommendations - A Narrative Review

Kacper Ściebura, ORCID <https://orcid.org/0009-0004-8279-8008>

E-mail [kacpersciebura99@gmail.com](mailto:kacpersciebura99@gmail.com)

Military Institute of Medicine - National Research Institute, Szaserów 128, 04-141 Warsaw, Poland

Natalia Mordal, ORCID <https://orcid.org/0009-0000-7494-8070>

E-mail [nataliamordal21@gmail.com](mailto:nataliamordal21@gmail.com)

Mazowiecki Szpital Bródnowski, Kondratowicza 8, 03-242 Warsaw, Poland

Damian Zienkiewicz, ORCID <https://orcid.org/0009-0008-7263-1545>

E-mail [zienkiewicz.damian@gmail.com](mailto:zienkiewicz.damian@gmail.com)

Praga Hospital of the Transfiguration, Solidarności 67, 03-401 Warsaw, Poland

Gabriela Makulec, ORCID <https://orcid.org/0009-0009-1357-1340>

E-mail [gabriela.makulec@gmail.com](mailto:gabriela.makulec@gmail.com)

Military Institute of Medicine - National Research Institute, Szaserów 128, 04-141 Warsaw, Poland

Karolina Domosud, ORCID <https://orcid.org/0009-0007-4345-2188>

E-mail [karolinadomosud@gmail.com](mailto:karolinadomosud@gmail.com)

Military Institute of Medicine - National Research Institute, Szaserów 128, 04-141 Warsaw, Poland

Weronika Walendziak, ORCID <https://orcid.org/0009-0008-9764-7324>

E-mail [wwalendziak00@gmail.com](mailto:wwalendziak00@gmail.com)

The National Medical Institute of the Ministry of the Interior and Administration, 02-507 Warsaw, Poland

Wiktoria Wiśniewska, ORCID <https://orcid.org/0009-0003-7401-419X>

E-mail [wisniewskaw2077@gmail.com](mailto:wisniewskaw2077@gmail.com)

Mazowiecki Szpital Bródnowski, Kondratowicza 8, 03-242 Warsaw, Poland

Magdalena Ostaszewska, ORCID <https://orcid.org/0009-0007-6519-0449>

E-mail [magdalen.ostaszewska@gmail.com](mailto:magdalen.ostaszewska@gmail.com)

The National Medical Institute of the Ministry of the Interior and Administration, 02-507 Warsaw, Poland

Milena Majchrzyk, ORCID <https://orcid.org/0009-0003-1054-9953>

E-mail [majchrzykmilena@gmail.com](mailto:majchrzykmilena@gmail.com)

The National Medical Institute of the Ministry of the Interior and Administration, 02-507 Warsaw, Poland

Anna Malczyk, ORCID <https://orcid.org/0009-0009-0206-2348>

E-mail [anna.malczyk2409@gmail.com](mailto:anna.malczyk2409@gmail.com)

Międzyleski Szpital Specjalistyczny w Warszawie ul. Bursztynowa 2, 04-749 Warsaw, Poland

### **Corresponding Author**

Kacper Ściebura, E-mail [kacpersciebura99@gmail.com](mailto:kacpersciebura99@gmail.com)

### **Abstract**

**Background.** Polycythemia vera (PV) is a type of Philadelphia-negative myeloproliferative neoplasm (MPN) associated with a good prognosis but possible serious complications. Although medications lower hematocrit and reduce thrombosis risk, patients and clinicians underuse non-drug approaches such as physical activity (PA), despite growing evidence for their help while dealing with the disease's symptoms and complications.

**Aim:** This study aims to identify and evaluate the safest and most effective types of physical activity specifically recommended for patients diagnosed with PV.

**Methods:** A brief review of studies examining physical activity in patients with PV or other MPNs was conducted using PubMed, ScienceDirect, American Society of Hematology publications and Google Scholar.

**Results:** Regular PA of moderate intensity, such as walking, swimming, or cycling, for 150–300 minutes per week is safe in well-controlled PV (hematocrit < 45%). This level of activity reduces the most common PV complication - fatigue - by 30–50%, but also soothes aquagenic pruritus, especially during water-based exercise, helps with concentration problems, and decreases bone or muscle pain.

**Discussion and conclusions:** Tailored physical activity for patients with polycythemia vera shows promising results in reducing common symptoms. However, further research is needed to develop optimal activity recommendations for all patient groups.

**Keywords:** polycythemia vera, physical activity, myeloproliferative neoplasms, quality of life

## 1. Introduction

Polycythemia vera (PV) is a chronic Philadelphia-negative myeloproliferative neoplasm characterised by clonal proliferation of hematopoietic stem cells, leading predominantly to erythrocytosis and increased blood viscosity [1,6,15]. The disease is strongly associated with activating mutations in the JAK2 gene [15], resulting in constitutive activation of the JAK–STAT signalling pathway and dysregulated hematopoiesis [2-5]. Patients with PV are characterised by a decent long-term survival rate, but it comes with significantly increased risk of thrombotic events, which remain the leading causes of morbidity and mortality in this patient population [15,25,31]. Additionally, vascular and microcirculation complications can be induced by increased hematocrit, endothelial dysfunction, leukocytosis and platelet activation. [7,8].

A wide spectrum of symptoms not associated with thromboembolic events is also present in patients suffering from PV. The most frequently reported symptoms were fatigue, aquagenic pruritus, microvascular disturbances, cognitive impairment, and musculoskeletal pain [1,2,6,15-17,19-20]. Fatigue is among the most prevalent and noticeable symptoms, significantly affecting daily functioning and quality of life [8,10,31,32]. Importantly, patient-reported outcome studies have demonstrated that symptom severity does not always correlate with hematological parameters, suggesting that disease control does not fully translate into improved well-being [32]. This divergence highlights the role of systemic

inflammation and cytokine dysregulation in the pathogenesis of PV-related symptoms [5,6,9]. Elevated levels of pro-inflammatory mediators may contribute to fatigue and reduced functional capacity.

Current therapeutic strategies for polycythemia vera (PV) primarily aim to reduce hematocrit levels and minimise thrombotic risk. Standard management includes phlebotomy, low-dose aspirin, and cytoreductive therapy with agents such as hydroxyurea or interferon [9]. While these interventions effectively lower the incidence of major vascular events, they have limited impact on relentless symptoms and overall functional capacity [25,28]. Consequently, there is growing interest in complementary, non-pharmacological approaches to address these unmet clinical needs. Interventions targeting cardiovascular fitness, inflammation, and endothelial function may offer additional benefits beyond standard treatment.

Physical activity (PA) is a well-documented non-pharmacological intervention that reduces the risk of many chronic illnesses, such as cardiovascular incidents, metabolic disorders, and cancers. In oncology and hematology, substantial evidence indicates that regular physical activity improves quality of life, reduces cancer-related fatigue, and enhances both physical and psychological functioning [18,21,26,27]. For patients with myeloproliferative neoplasms (MPNs), including polycythemia vera, observational and interventional studies have shown that physical activity reduces symptom burden and improves overall well-being [1]. These benefits are attributed to improvements in cardiovascular efficiency, reductions in systemic inflammation, and modulation of neuroendocrine responses [1-6].

Despite these potential benefits, the importance of physical activity amongst patients and doctors remains disregarded. This often stems from general concerns, mostly about bleeding, the risk of arterial thrombosis, or symptom exacerbation during exercise [15]. Furthermore, the lack of disease-specific, evidence-based exercise guidelines contributes to uncertainty among both patients and healthcare professionals[1]. Consequently, recommendations regarding physical activity in PV are often inconsistent and are not routinely integrated into clinical practice.

Given the chronic nature of PV, its significant symptom burden, and the importance of cardiovascular risk, physical activity may be a valuable adjunctive intervention. Exercise could address key mechanisms in PV, such as endothelial dysfunction, impaired microcirculation, and chronic low-grade inflammation [2-5, 13]. However, current evidence is limited and mainly derived from studies of broader MPN populations.

Therefore, a comprehensive review of available data is needed to clarify the role of physical activity in this patient group.

## **2. Aim**

The aim of this study is to evaluate the current evidence on the safety and effectiveness of physical activity in patients with polycythemia vera. It focuses on the impact of exercise on fatigue, quality of life, and long-term survivability. The study also seeks to identify potential risks arising from incorrect exercise and activity recommendations for individual patients and to propose evidence-based exercise recommendations tailored to this specific patient group.

## **3. Methods**

### **3.1 Search Strategy**

A narrative literature review was conducted to evaluate the role of physical activity in patients with polycythemia vera. A wide search of electronic databases, including PubMed, Google Scholar, ScienceDirect and publications from the American Society of Haematology, has been conducted. The search did not have strict time constraints. This approach allowed us to include both foundational and recent studies relevant to the topic.

The search strategy began with the keywords: “polycythemia vera”, “myeloproliferative neoplasms”, “physical activity”, “exercise”, “fatigue”, “thrombosis”, and “quality of life”. Reference lists of relevant articles were also manually screened to identify additional studies that may not have been captured during the initial database search.

### **3.2 Eligibility Criteria**

Studies were included after meeting previously chosen criteria:

- patients diagnosed with polycythemia vera or other myeloproliferative neoplasms,
- physical activity, exercise, or lifestyle interventions monitored in patients with polycythemia vera or other MPNs
- included clinical outcomes such as fatigue, symptom burden, quality of life, or thrombotic risk,
- publications published in English.

Both observational and interventional studies were considered. Due to the limited number of studies specifically focused on polycythemia vera, studies involving broader myeloproliferative neoplasm populations were also included. This approach enabled a more

comprehensive evaluation of evidence relevant to polycythemia vera. Findings from related myeloproliferative neoplasm research may offer pertinent insights because of shared disease mechanisms and clinical features.

### **3.3 Study Selection and Data Analysis**

Relevant studies were screened by titles and abstracts, followed by full-text evaluation. Data from selected articles were collected, analysed, and used as a source to create results and discussion.

Given the heterogeneity of available studies and the limited number of controlled trials, a narrative approach was preferred over a meta-analysis. The analysis focused on identifying consistent findings regarding the safety, benefits, and potential risks of physical activity in patients with PV, as well as gaps in the current evidence base.

## **4. Results**

### **4.1 Symptom Burden and Quality of Life in Polycythemia Vera**

Patients with polycythemia vera experience a substantial symptom burden that significantly affects quality of life. The most frequently reported symptoms include fatigue, pruritus, cognitive impairment, and musculoskeletal discomfort [1-8,10,15,20,22]. Fatigue stands out as one of the most debilitating symptoms. It often persists even with adequate hematological control [4]. Patient-reported outcome studies show that symptom severity does not always match laboratory parameters, suggesting that disease burden extends beyond measurable hematologic indices [9,17]. Several studies have demonstrated that patients with myeloproliferative neoplasms (MPNs), including PV, report reduced physical functioning and lower overall quality of life compared to the general population [1,4]. Importantly, fatigue has been shown to affect a majority of patients with MPNs and is frequently described as a chronic, multidimensional symptom influenced by inflammatory processes, altered cytokine profiles, and impaired energy metabolism [1,8,24,32]. These findings highlight the need for supportive interventions to improve daily functioning and patients' well-being.

**Table 1.** Symptoms of Polycythemia Vera, Their Prevalence and Clinical Impact

Symptom	Prevalence in patients suffering from PV	Clinical Impact/ Effect on patients' health
Fatigue	Very common	Reduced physical activity; decreased quality of life
Aquagenic pruritus	Common	Significant discomfort; Trouble while doing daily activities (shower, taking a bath etc.)
Headache	Common	Trouble with concentration; Reduced productivity
Vertigo	Moderately common	Increased risk of falls/injuries; reduced daily activity
„Brain fog”	Moderately common	Memory lapses; Trouble with focusing; Mental fatigue
Night sweats	Moderately common	Overreactive inflammatory response; severe sleep disruption
Microvascular symptoms	Moderately common	ringing in the ears; erythromelalgia; headaches
Bone and muscle pain	Moderately common	Localized pain
Depression/anxiety	Moderately common	Reduced motivation; Emotional burden of the disease
Splenomegaly	Less common	Abdominal pain; Increased risk of internal bleeding
Thrombotic risk	Less common	Increased risk of arterial and venous blood clots
Hemorrhagic events	Less common	Increased risk of internal/external strong bleeding

## 4.2 Effects of Physical Activity on Fatigue and Functional Capacity

Available evidence suggests physical activity may help reduce fatigue and improve functional capacity in patients with MPNs [1]. Observational and intervention-based studies indicate regular moderate-intensity exercise is linked to reduced level of fatigue, better physical performance and overall well-being [1,12,14,31]. Structured exercise interventions can reduce cancer-related fatigue by improving mitochondrial function, increasing cardiovascular efficiency, and modulating inflammatory pathways. Interventions such as aerobic training, resistance exercise, and mind–body practices like yoga have been reported to decrease fatigue and enhance quality of life in patients with hematological malignancies [18,21,26]. In MPN populations, higher physical activity levels are associated with better functional outcomes and reduced symptom burden [1]. Although data specific to PV are limited, broader MPN studies consistently support the positive impact of physical activity on symptom management, suggesting potential applicability in this patient group.

**Table 2.** Effects of physical activity in patients with polycythemia vera and myeloproliferative neoplasms

Domain	Observed effects of physical activity	Mechanism	Clinical relevance
Quality of life (QoL)	Improvement in overall quality of life	Enhanced physical fitness	Better well-being and life satisfaction
Fatigue	Reduction of tiredness and fatigue	Reduced systemic inflammation	Improved daily functioning
Psychological health	Reduced anxiety and symptoms of depression	Improved neuroendocrine regulation	Improved mental health
Physical capacity	Increased endurance	Improved cardiovascular endurance	Less trouble with daily activities
Cognitive function	Better concentration	Enhanced cerebral blood flow	Improvement in daily functioning
Muscle strength	Increased endurance, daily activities requiring less energy	Muscle adaptation	Reduced physical limitations

Microvascular circulation	Improved blood flow	Improved vasular reactivity	Reduced microvascular symptoms
---------------------------	---------------------	-----------------------------	--------------------------------

### 4.3 Physical Activity and Quality of Life Outcomes

Physical activity has been linked to improvements in many quality of life areas, including physical, psychological, and social functioning. Patients who exercise regularly report better mood, improved cognitive function, and lower levels of anxiety and depression [2,6,25-32]. Studies also suggest that structured physical activity may improve self-efficacy and coping with disease [16,29]. This is especially relevant in PV, where ongoing symptoms and long-term management can harm mental health and everyday life. Improved physical conditioning may also help patients perform daily tasks, lessen perceived disability, and boost independence.

### 4.4 Safety of Physical Activity in Patients with Polycythemia Vera

One of the main concerns regarding physical activity in PV is safety, particularly regarding thrombotic risk. PV is characterised by increased blood viscosity and a prothrombotic state [15,16,24,25], which raises theoretical concerns about exercise-induced complications. Elevated hematocrit, platelet activation, leukocytosis, and endothelial dysfunction contribute to vascular risk [3,4,6]. Evidence suggests that moderate-intensity physical activity is generally safe in patients with well-controlled disease, especially when hematocrit levels are below 45% [1]. Regular exercise may also benefit cardiovascular health and circulation, potentially reducing risk [29].

Exercise-induced improvements in shear stress and nitric oxide bioavailability can enhance vascular function and may counteract endothelial dysfunction in PV. Nevertheless, caution is advised with high-intensity exercise, dehydration, and prolonged immobilisation, as these may raise the risk of adverse events. Tailored exercise prescriptions and proper medical supervision are recommended, especially for patients with additional risk factors or comorbidities [1,2,4,11].

### 4.5 Barriers to Physical Activity and Patient Perspectives

Regular physical activity is helpful, but many people with polycythemia vera (PV) and other myeloproliferative neoplasms (MPNs) do not exercise as much as they could [1]. Most

common reasons of that state are fatigue, fear of complications, unclear advice from doctors, low motivation, pain and dizziness. Research shows that many people with MPNs are unsure if exercise is safe and want clear, evidence-based advice. Patients often say their healthcare providers do not give enough information about what kinds and how much physical activity are right for them [1,29]. Anxiety, low confidence, and fear of making symptoms worse can also hold people back. Giving clear, personalised recommendations may help patients stay active and feel more confident about exercising.

#### **4.6 Exercise Recommendations and Practical Considerations**

Moderate-intensity aerobic activity, such as walking, cycling, or swimming for 150–300 minutes per week, is safe and beneficial for most patients with PV, if the disease is well controlled [1]. This level matches public health guidance and improves cardiovascular fitness and symptom control. Adding resistance and flexibility exercises further improves outcomes by enhancing muscle strength, joint mobility, and physical resilience. Mind–body interventions such as yoga may help reduce fatigue, stress, and psychological symptoms [26,27].

Exercise programs should be individualised, taking into account disease severity, symptom burden, comorbidities, and patient preferences [12,13,15,18]. Special attention should be given to the optimal level of hydration, awareness of patients' personal/physical limits during activity, and monitoring of symptoms during activity. Close collaboration between healthcare providers and patients is essential to ensure safe and effective implementation.

### **5. Discussion and conclusions**

It is clear and well-documented that physical activity represents a promising yet underutilised supportive strategy in managing patients with polycythemia vera. Standard treatments effectively reduce hematocrit levels and thrombotic risk, but they do not sufficiently address the persistent symptom burden or improve quality of life in most patients [1,2,6,15,22]. It can be suggested that physical activity may serve as an important complementary intervention to improve both physical and psychological outcomes in this population [10,14,19,21,29].

Fatigue is repeatedly identified as a primary determinant of reduced quality of life, often persisting despite adequate disease control [3,17,19,31]. Evidence from broader

oncology and myeloproliferative neoplasm populations indicates that regular physical activity can significantly alleviate cancer-related fatigue and improve functional capacity. While direct evidence in polycythemia vera remains limited, findings from related populations support the potential applicability of these interventions [1,26,29,32]. These benefits are likely mediated by improvements in energy metabolism and mitochondrial function, as well as reductions in systemic inflammation, which are central to symptom development in MPNs [4,8].

The relationship between physical activity and thrombotic risk in PV is complex and warrants careful consideration. On one hand, PV is characterised by increased blood viscosity, endothelial dysfunction, and a prothrombotic state, which may raise concerns regarding the safety of exercise. On the other hand, regular moderate-intensity physical activity is known to improve endothelial function, improve circulation, and reduce cardiovascular risk in the general population. These effects may be particularly relevant in PV, where vascular complications play a central role in disease outcomes [4-7,21]. The available evidence suggests that appropriately prescribed physical activity is safe in patients with well-controlled disease, but individualised assessment remains essential [1,29].

Pharmacological treatment mainly focuses on measurable hematological parameters, which creates a situation, where patients' symptom burden remains insufficiently addressed. Physical activity may help bridge this gap by reducing symptoms' intensification without contradiction to pharmacotherapy.

Furthermore, engagement in regular exercise may improve psychological resilience, self-efficacy, and disease coping strategies, which are particularly relevant in chronic conditions such as PV [16]. Patient surveys show that people with MPNs are very interested in getting clear advice and instructions about suitable physical activity [1]. Even though there are clear benefits, people still face several barriers to being physically active. These barriers include symptoms from illnesses like fatigue, worries about possible side effects, not enough medical advice, and a lack of patient education. The lack of disease-specific exercise recommendations further contributes to uncertainty among patients and healthcare providers [1-3,21]. Addressing these barriers is critical for the effective implementation of physical activity interventions in clinical practice. Importantly, the current body of evidence has several limitations. Most available studies are observational or involve heterogeneous patient populations with different myeloproliferative neoplasms. There is a lack of randomised controlled trials specifically investigating physical activity interventions in PV. Additionally, variability in study design, outcome measures, and intervention protocols limits the ability to

draw definitive conclusions. Therefore, further prospective and interventional studies are needed to establish standardised, evidence-based exercise guidelines for this patient population.

Exercise prescriptions should be individualised, considering disease control, symptom burden, comorbidities, and patient preferences[7,16]. Moderate-intensity aerobic activity, combined with resistance and flexibility training, appears to be a safe and effective approach for most patients [1]. Additionally, prospective studies evaluating changes in attitude towards physical activity are needed to show the long-term health outcomes in patients with PV.

## **Disclosure**

### **Author's contribution statement:**

Conceptualization: Kacper Ściebura

Methodology: Kacper Ściebura, Natalia Mordal

Literature Search: Kacper Ściebura

Data interpretation: Kacper Ściebura

Writing - Original Draft: Kacper Ściebura

Writing - Review and Editing: Kacper Ściebura, Natalia Mordal, Weronika Walendziak, Gabriela Makulec, Karolina Domosud, Wiktoria Wiśniewska, Magdalena Ostaszewska, Milena Majchrzyk, Anna Malczyk, Damian Zienkiewicz

Supervision: Kacper Ściebura

All authors have read and agreed to the published version of the manuscript.

## **Funding**

This research received no external funding.

## **Declaration of the use of generative AI and AI-Assisted Technologies in the Writing Process:**

Authors declare using ChatGPT for linguistic and grammatical support only. All scientific content, data collection, interpretation and results were conducted by the authors.

## **Institutional Review Board Statement**

Not applicable.

## **Informed Consent Statement**

Not applicable.

## Data Availability

Not applicable, as no new data were created or analyzed in this study. All analyzed sources are included in the reference list.

## Conflict of Interest

The authors declare no conflict of interest.

## References

1. Felser, S., Rogahn, J., Hollenbach, L., Gruen, J., le Coutre, P., Al-Ali, H-K., Schulze, S., Muegge, L-O., Kraze-Kliebhorn, V., Junghanss, C. Physical exercise recommendations for patients with polycythemia vera based on preferences identified in a large international patient survey study of the East German Study Group for Hematology and Oncology (OSHO #97). 2023 Sep;12(17):18235-18245. <https://doi.org/10.1002/cam4.6413>
2. Doğan, E., Karadağ, F., Aydin, D., Demirel, N., Sağlam, S., Davulcu, E., Erkek, E., Eren, R., Soyer, N., Sahin, F., Saydam, G. The assessment of health-related quality of life in patients with polycythemia vera. 2024 Jul 26;103(30):e38814. <https://doi.org/10.1097/md.00000000000038814>
3. Eckert, R., Huberty, J., Gowin, K., Mesa, R., Marks, L. Physical Activity as a Nonpharmacological Symptom Management Approach in Myeloproliferative Neoplasms: Recommendations for Future Research. 2017 Dec;16(4):439-450. <https://doi.org/10.1177/1534735416661417>
4. Geyer, H., Scherber, R., Kosiorek, R., Dueck, A., Kiladjian, J-J., Xiao, Z., Slot, S., Zweegman, S., Sackmann, F., Fuentes, A., Hernández-Maraver, D., Döhner, K., Harrison, K., Radia, D., Muxi, P., Besses, C., Cervantes, F., Johansson, P., Andreasson, B., Rambaldi, A., et al. Symptomatic Profiles of Patients With Polycythemia Vera: Implications of Inadequately Controlled Disease 2016 Jan 10;34(2):151-9. <https://doi.org/10.1200/jco.2015.62.9337>
5. Stein, B., Moliterno, A., Tiu, R. Polycythemia vera disease burden: contributing factors, impact on quality of life, and emerging treatment options. 2014 Dec;93(12):1965-76. <https://doi.org/10.1007/s00277-014-2205-y>
6. Spivak, J. Polycythemia vera: myths, mechanisms, and management. (2002) 100 (13): 4272–4290. <https://doi.org/10.1182/blood-2001-12-0349>
7. Finazzi, G., Barbui, T. How I treat patients with polycythemia vera. (2007) 109 (12): 5104–5111. <https://doi.org/10.1182/blood-2006-12-038968>

8. Dagenais-Bellefeuille, S., Bilodeau, K., Pouillet, A., Sirhan, S., Delage, R., Cournoyer, G., Chamakhi, I., Talbot, D., Mollica, L., Marceau, D., Ethier, V., Desjardins, P., Olney, H. J., Harnois, M., Busque, L., Szuber, N. Understanding the Lived Experience of Fatigue in Adolescents and Young Adults with Myeloproliferative Neoplasms: A Mixed Methods Study. (2024) 144 (Supplement 1):408. <https://doi.org/10.1182/blood-2024-206225>
9. Mesa, R. A., Kosiorek, H. E., Mascarenhas, J., Prchal, J. T., Rambaldi, A., Berenzon, D., Yacoub, A., Harrison, C. N., McMullin, M. F., Vannucchi, A. M., Ewing, J., O'Connell, C. L., Kiladjian, J.-J., Mead, A. J., Winton, E. F., Leibowitz, D. S., De Stefano, V., Arcasoy, M. O., Kessler, C. M., Catchatourian, R. Impact on MPN Symptoms and Quality of Life of Front Line Pegylated Interferon Alpha-2a Vs. Hydroxyurea in High Risk Polycythemia Vera and Essential Thrombocythemia: Results of Myeloproliferative Disorders Research Consortium (MPD-RC) 112 Global Phase III Trial. (2018) 132 (Supplement 1): 3032. <https://doi.org/10.1182/blood-2018-99-111929>
10. Tolstrup Larsen, R., Tang, L. H., Brochmann, N., Flachs, E. M., Christensen, A. I., Hasselbalch, H. C., Zwisler, A.-D. Associations between fatigue, physical activity, and QoL in patients with myeloproliferative neoplasms. 2018 Jun;100(6):550-559. <https://doi.org/10.1111/ejh.13048>
11. McTiernan, A., Friedenreich, C. M., Katzmarzyk, P. T., Powell, K. E., Macko, R., Buchner, D., Pescatello, L. S., Bloodgood, B., Tennant, B., Vaux-Bjerke, A., George, S. M., Troiano, R. P., Piercy, K. L. Physical Activity in Cancer Prevention and Survival: A Systematic Review. 2019 Jun;51(6):1252-1261. <https://doi.org/10.1249/mss.0000000000001937>
12. Sweegers, M. G., Altenburg, T. M., Chinapaw, M. J., Kalter, J., Verdonck-de Leeuw, I. M., Courneya, K. S., Newton, R. U., Aaronson, N. K., Jacobsen, P. B., Brug, J., Buffart, L. M. Which exercise prescriptions improve quality of life and physical function in patients with cancer during and following treatment? A systematic review and meta-analysis of randomised controlled trials. 2018 Apr;52(8):505-513. <https://doi.org/10.1136/bjsports-2017-097891>
13. Torregrosa, C., Chorin, F., Molina Beltran, E. E., Neuzillet, C., Cardot-Ruffino, V. Physical Activity as the Best Supportive Care in Cancer: The Clinician's and the Researcher's Perspectives. 2022 Nov 2;14(21):5402. <https://doi.org/10.3390/cancers14215402>
14. Yang, Y.-P., Pan, S.-J., Qiu, S.-L., Tung, T.-H. Effects of physical exercise on the quality-of-life of patients with haematological malignancies and thrombocytopenia: A systematic review and meta-analysis. 2022 Apr 6;10(10):3143-3155. <https://doi.org/10.12998/wjcc.v10.i10.3143>

15. Tefferi, A., Barbui, T. Polycythemia vera: 2024 update on diagnosis, risk-stratification, and management. 2023 Sep;98(9):1465-1487. <https://doi.org/10.1002/ajh.27002>
16. Brochmann, N., Flachs, E. M., Christensen, A. I., Bak, M., Andersen, C. L., Juel, K., Hasselbalch, H. C., Zwisler, A.-D., Rottmann, N. Anxiety and depression in patients with Philadelphia-negative myeloproliferative neoplasms: a nationwide population-based survey in Denmark. 2018 Dec 18;11:23-33. <https://doi.org/10.2147/clep.s162688>
17. Mesa, R. A., Niblack, J., Wadleigh, M., Verstovsek, S., Camoriano, J., Barnes, S., Tan, A. D., Atherton, P. J., Sloan, J. A., Tefferi, A. The burden of fatigue and quality of life in myeloproliferative disorders (MPDs): an international Internet-based survey of 1179 MPD patients. 2007 Jan 1;109(1):68-76. <https://doi.org/10.1002/cncr.22365>
18. Surapaneni, P., Scherber, R. M. Integrative Approaches to Managing Myeloproliferative Neoplasms: the Role of Nutrition, Exercise, and Psychological Interventions. 2019 Jun;14(3):164-170. <https://doi.org/10.1007/s11899-019-00516-w>
19. Harrison, C. N., Koschmieder, S., Foltz, L., Guglielmelli, P., Flindt, T., Koehler, M., Mathias, J., Komatsu, N., Boothroyd, R. N., Spierer, A., Perez Ronco, J., Taylor-Stokes, G., Waller, J., Mesa, R. A. The impact of myeloproliferative neoplasms (MPNs) on patient quality of life and productivity: results from the international MPN Landmark survey. 2017 Oct;96(10):1653-1665. <https://doi.org/10.1007/s00277-017-3082-y>
20. Titmarsh, G. J., Duncombe, A. S., McMullin, M. F., O'Rorke, M., Mesa, R., De Vocht, F., Horan, S., Fritschi, L., Clarke, M., Anderson, L. A. How common are myeloproliferative neoplasms? A systematic review and meta-analysis. 2014 Jun;89(6):581-7. <https://doi.org/10.1002/ajh.23690>
21. Borsati, A., Murri, A., Natalucci, V., Cerulli, C., Barbieri, E., Lucertini, F., Lanza, M., Parisi, A., Galvani, C., Buono, P., Mancini, A., Fischetti, F., Poli, L., Di Blasio, A., Iannaccone, A., Avancini, A., Mauri, C., Ferri Marini, C., Grazioli, E. The Effect of Exercise-Based Interventions on Health-Related Quality of Life of Patients with Hematological Malignancies: A Systematic Review and Meta-Analysis. 2025 Feb 21;13(5):467. <https://doi.org/10.3390/healthcare13050467>
22. Patel, A. B., Masarova, L., Mesa, R. A., Hobbs, G., Pemmaraju, N. Polycythemia vera: past, present and future. 2024 Nov;65(11):1552-1564. <https://doi.org/10.1080/10428194.2024.2361836>
23. Reiter, A., Harrison, C. How We Identify and Manage Patients with Inadequately Controlled Polycythemia Vera. 2016 Oct;11(5):356-67. <https://doi.org/10.1007/s11899-016-0311-8>

24. Tefferi, A., Vannucchi, A. M., Barbui, T. Polycythemia vera: historical oversights, diagnostic details, and therapeutic views. 2021 Dec;35(12):3339-3351.  
<https://doi.org/10.1038/s41375-021-01401-3>
25. Tefferi, A., Barbui, T. Polycythemia vera and essential thrombocythemia: 2021 update on diagnosis, risk-stratification and management. 2020 Dec;95(12):1599-1613.  
<https://doi.org/10.1002/ajh.26008>
26. Mønsted Pedersen, K., Zangger, G., Brochmann, N., Mygind Grønfeldt, B., Zwisler, A.-D., Hasselbalch, H. C., Tang, L. H. The effectiveness of exercise-based rehabilitation to patients with myeloproliferative neoplasms-An explorative study. 2018 Sep;27(5):e12865.  
<https://doi.org/10.1111/ecc.12865>
27. Knips, L., Bergenthal, N., Streckmann, F., Monsef, I., Elter, T., Skoetz, N. Aerobic physical exercise for adult patients with haematological malignancies. 2019 Jan 31;1(1):CD009075. <https://doi.org/10.1002/14651858.cd009075.pub3>
28. Horneber, M., Fischer, I., Dimeo, F., Ruffer, J. U., Weis, J. Cancer-related fatigue: epidemiology, pathogenesis, diagnosis, and treatment. 2012 Mar;109(9):161-71.  
<https://doi.org/10.3238/arztebl.2012.0161>
29. Felser, S., Rogahn, J., le Coutre, P., Al-Ali, H. K., Schulze, S., Muegge, L.-O., Gruen, J., Geissler, J., Kraze-Kliebhorn, V., Junghans, C. Anxieties, age and motivation influence physical activity in patients with myeloproliferative neoplasms - a multicenter survey from the East German study group for hematology and oncology (OSHO #97). 2023 Jan 4;12:1056786. <https://doi.org/10.3389/fonc.2022.1056786>
30. Singh, S., Peshin, S., Larsen, A., Gowin, K. Optimizing Care: Integrative Oncology in Myeloproliferative Neoplasm. 2024 Oct;26(10):1135-1145. <https://doi.org/10.1007/s11912-024-01568-9>
31. Mesa, R., Miller, C. B., Thyne, M., Mangan, J., Goldberger, S., Fazal, S., Ma, X., Wilson, W., Paranagama, D. C., Dubinski, D. G., Boyle, J., Mascarenhas, J. O. Myeloproliferative neoplasms (MPNs) have a significant impact on patients' overall health and productivity: the MPN Landmark survey. 2016 Feb 27;16:167. <https://doi.org/10.1186/s12885-016-2208-2>
32. Mesa, R. A., Wadleigh, M., Niblack, J., Gilliland, D. G., Verstovsek, S., Camoriano, J., Solberg, L., Barnes, S., Sloan, J., Atherton, P., Tan, A., Tefferi, A. Fatigue, the Un-Addressed Curse of Myeloproliferative Diseases (MPD): Results of an International Internet Based QOL Survey of 830 MPD Patients. (2005)106(11):2577.  
<https://doi.org/10.1182/blood.V106.11.2577.2577>