Oregon Health & Science University
School of Medicine

Scholarly Projects Final Report

Title *(Must match poster title; include key words in the title to improve electronic search capabilities.)*

Relationship Between Mean Platelet Volume and Immature Platelet Fraction in Pediatric Patients with Immune Thrombocytopenia

Student Investigator's Name

Maurisa Rapp

Date of Submission *(mm/dd/yyyy)*

03/12/2026

Graduation Year

2026

Project Course *(Indicate whether the project was conducted in the Scholarly Projects Curriculum; Physician Scientist Experience; Combined Degree Program [MD/MPH, MD/PhD]; or other course.)*

Scholarly Project Curriculum (MD)

Co-Investigators *(Names, departments; institution if not OHSU)*

Marie Martinelli, MD (Department of Pediatric Hematology and Oncology)

Mentor's Name

Marie Martinelli, MD

Mentor's Department

Pediatric Hematology/Oncology

Scholarly Project Final Report

Concentration Lead's Name

Peter Mayinger, PhD

Project/Research Question

Does mean platelet volume (MPV) correlate to immature platelet fraction (IPF)?

Type of Project *(Best description of your project; e.g., research study, quality improvement project, engineering project, etc.)*

Research Study

Key words *(4-10 words describing key aspects of your project)*

Immune Thrombocytopenia, Hematology, Mean Platelet Volume, Immature Platelet Fraction

Meeting Presentations

If your project was presented at a meeting besides the OHSU Capstone, please provide the meeting(s) name, location, date, and presentation format below (poster vs. podium presentation or other).

N/A

Publications *(Abstract, article, other)*

If your project was published, please provide reference(s) below in JAMA style.

First published an ancillary study describing the paradoxical nature of complications observed in patients with immune thrombocytopenia (ITP), illustrated by a pediatric case of multiple cerebral sinovenous thromboses. This paper serves as the basis for the subsequent project that investigates the relationship between immature platelet fraction (IPF) and mean platelet volume (MPV).

- Rapp M, Martinelli M. Pediatric Cerebral Sinovenous Thrombosis Associated With Thrombopoietin Receptor Agonist in the Treatment of Chronic Immune Thrombocytopenia. *Pediatr Blood Cancer.* 2025;72(5):e31635. doi:10.1002/pbc.31635

Submission to Archive

Final reports will be archived in a central library to benefit other students and colleagues. Describe any restrictions below (e.g., hold until publication of article on a specific date).

N/A

Scholarly Project Final Report

Next Steps
What are possible next steps that would build upon the results of this project? Could any data or tools resulting from the project have the potential to be used to answer new research questions by future medical students?

Future directions that would build upon the results of this project include further subanalysis to better understand how various factors influence the relationship between MPV and IPF. Examples of these factors may include but are not limited to preexisting comorbid conditions, severity of bleeding symptoms resulting from ITP, and specific types of treatments received. This project could be further studied by reducing limiting factors such as limited sample size. Furthermore, the results of this scholarly project have the potential to provide practical guidance and utility in underserved and resource-limited communities, where accessibility to technology necessary to run an IPF test may be limited. These outcomes suggest providers may utilize the MPV index, which is a part of the widely available and frequently utilized CBC panel, in place of the IPF variable to diagnose and manage ITP in the pediatric population.

Please follow the link below and complete the archival process for your Project in addition to submitting your final report.

https://ohsu.ca1.qualtrics.com/jfe/form/SV_3ls2z8V0goKiHZP

Student's Signature/Date *(Electronic signatures on this form are acceptable.)*
This report describes work that I conducted in the Scholarly Projects Curriculum or alternative academic program at the OHSU School of Medicine. By typing my signature below, I attest to its authenticity and originality and agree to submit it to the Archive.

Mentor's Approval *(Signature/date)*

Marie Martinelli 3/12/26

Scholarly Project Final Report

Report*: Information in the report should be consistent with the poster, but could include additional material. Insert text in the following sections targeting 1500-3000 words overall; include key figures and tables. Use Calibri 11-point font, single spaced and 1-inch margin; follow JAMA style conventions as detailed in the full instructions.*

Introduction *(≥250 words)*

Immune thrombocytopenia (ITP) is an autoimmune disorder characterized by platelet destruction and impaired platelet production. One of the many hematologic conditions affecting children worldwide, ITP typically presents as severe thrombocytopenia causing bleeding symptoms ranging from mild to life-threatening. Understanding a patient's thrombopoietic activity can be an important step in distinguishing ITP from other hematologic conditions. The laboratory index to assess the activity of megakaryocytes, the platelet precursor cell in the bone marrow, is measured via the immature platelet fraction (IPF), which is akin to "the platelet retic." This variable is useful for distinction between the diagnosis of ITP due to peripheral platelet destruction versus bone marrow failure, a production problem.[1] With proper diagnosis and management, ITP has a good prognosis. However, accessibility to IPF testing may be limited based on available equipment. Conversely, the complete blood count (CBC) is one of the most ordered laboratory studies worldwide and is utilized for both initial steps in ITP diagnosis and in general medical practice.[2,3] Understanding how to appropriately utilize widely accessible laboratory testing for diagnostic and therapeutic purposes may create a bridge to connect the gap created by these access inequities.

The IPF measures the reticulated platelets in an individual's peripheral blood. Thus, an increased IPF represents increased bone marrow thrombopoietic activity, while a decreased IPF represents lack of bone marrow thrombopoietic activity.[4] A study by Kibum et al. compared various platelet variables, including IPF, absolute immature platelet count (AIPC), and mean platelet volume (MPV). While these listed variables all displayed significant differences in the consumptive thrombocytopenic group in comparison to the hypoproductive thrombocytopenic group, the IPF displayed the greatest significant difference.[1]

While IPF has been shown to be an effective diagnostic and maintenance tool for thrombocytopenic conditions, accessibility remains a challenge in many communities outside of major cities. This is one reason that IPF has had limited utilization thus far in clinical practice, given the need for special technology.[5] Unlike IPF, MPV is extremely accessible and is available in most laboratory settings across the United States. MPV is a measure of the average size of an individual's platelets and is a component of a complete blood count (CBC) test, which is the most common test run by physicians.[6]

In short, many regions do not have access to the IPF laboratory test but do have access to measuring the widely available and commonly ordered MPV variable. Because IPF is a useful diagnostic measurement in many hematologic conditions, including ITP, direct correlations between IPF and MPV may significantly impact diagnostic capabilities in regions that do not have access to IPF laboratory measures. Thus, this project has the potential to improve health care accessibility to rural and underserved communities.

Methods *(≥250 words)*

This retrospective chart review study includes 73 pediatric patients aged 3-18 who had laboratory variables obtained at and received care for ITP at Oregon Health and Science University (OHSU). No study participants were excluded on the basis of gender, race, or ethnicity. There was also no exclusion based on current clinical status. Because this is a retrospective chart review study, all eligible subjects were able to be utilized for the purpose of this study without an individualized recruitment process. No adherence or follow-up was necessary for this study design. Application and approval through

the electronic Institutional Review Board (eIRB) took place prior to collection of data from the electronic medical record. Patient charts were identified by utilizing patient lists managed by the hematology healthcare team. Deidentified patient information was pulled from patient charts utilizing the Epic electronic medical record system. The deidentified data recorded from each chart included the patient's IPF and MPV values (obtained during the same blood draw), platelet count, as well as age, sex, and disease state (e.g. acute versus chronic ITP). After all data was collected, a linear correlation analysis between IPF and MPV at the time of initial ITP diagnosis was completed. Subanalysis of this cohort was conducted to determine correlation between MPV and IPF in patients with less than 40,000 and less than 30,000 platelets at the time of diagnosis. Further correlations to test the relationship between platelet count and MPV, as well as platelet count and IPF, were also conducted. The second subanalysis group to test the correlation between IPF and MPV included those who were undergoing treatment for ITP, while the third subanalysis group included only those who were not undergoing medical management for ITP. The fourth subanalysis group included all timepoints for all 73 subjects where simultaneous values of IPF and MPV had been collected, regardless of if any medical management had taken place. Subanalysis of the second, third, and fourth groups described here were further subdivided by platelet counts of less than 40,000 and less than 30,000. Pearson correlation coefficients were utilized to complete the statistical analysis for all calculations in this report.

Results *(≥500 words)*

Initial Values (Time of Diagnosis)

17 of the 73 subjects with ITP had MPV and IPF indices evaluated at time of diagnosis. Within this cohort of 17 patients, there was a moderately positive correlation of 0.44 between MPV and IPF (Figure 1). There was a low positive correlation between MPV and IPF of 0.35 when only including subjects who presented with a platelet count of <40,000 at diagnosis (n=10), and a very high negative correlation of –0.87 when comparing MPV and IPF observed in subjects with an initial platelet count of <30,000 at diagnosis (n=4).

Subanalysis to compare platelet count and IPF displayed a very low positive correlation of 0.03 when including the entire 17-subject cohort. This subanalysis comparison resulted in a low negative correlation of –0.31 when only including subjects whose initial platelet count was <40,000 (n=10). Subanalysis to compare platelet count and MPV displayed a low positive correlation of 0.24 within the entire 17 subject cohort and a very low negative correlation of –0.12 in the 4-subject cohort of those with <40,000 platelets at diagnosis.

Treatment vs. No Treatment

Across all timepoints for subjects who were not undergoing medical management for ITP, there were 56 simultaneous lab value collections of MPV and IPF. This trend reflected a moderately positive relationship, with a Pearson correlation of 0.49 (n=56) (Figure 2). Subanalysis of this cohort when limiting for a platelet count of <40,000 displayed a low positive correlation of 0.22 (n=17), with a low negative correlation of –0.33 when limiting for a platelet count of <30,000 (n=9). Across all timepoints for subjects who were undergoing medical management for ITP, there were 17 simultaneous lab value collections of MPV and IPF. This trend reflected a highly positive relationship, with a Pearson correlation of 0.78 (n=17) (Figure 3). Subanalysis of this cohort when limiting for a platelet count of <40,000 displayed a low positive correlation of 0.37 (n=5), with a very high negative correlation of -1.00 when limiting for a platelet count of <30,000 (n=2).

Cumulative Data

The correlation between MPV and IPF across all collected timepoints for all subjects irrespective of platelet count displayed a moderately positive relationship, with a Pearson correlation of

0.52 (n=73) (Figure 4). When limiting for a platelet count of <40,000, subanalysis of this cohort displayed a very low positive relationship, with a Pearson correlation of 0.19 (n=23). When limiting for a platelet count of <30,000, subanalysis of this cohort displayed a low negative relationship, with a Pearson correlation of –0.38 (n=11).

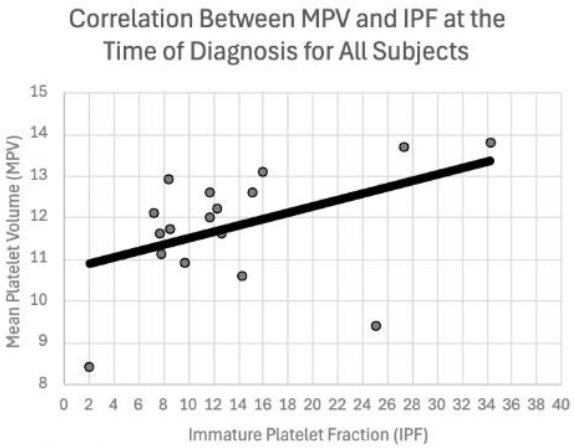

Figure 1: Initial MPV and IPF values simultaneously collected at the time of ITP diagnosis. These values were obtained prior to initial treatment. The linear trend line displays a moderately positive relationship, with a Pearson correlation of 0.44.

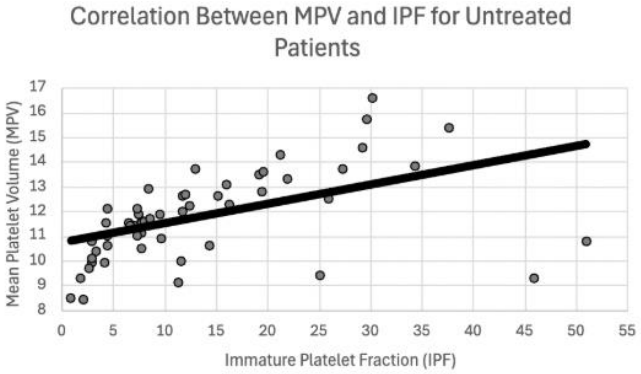

Figure 2: MPV and IPF values simultaneously collected throughout the course of ITP disease monitoring in untreated patients. The linear trend line displays a moderately positive relationship, with a Pearson correlation of 0.49.

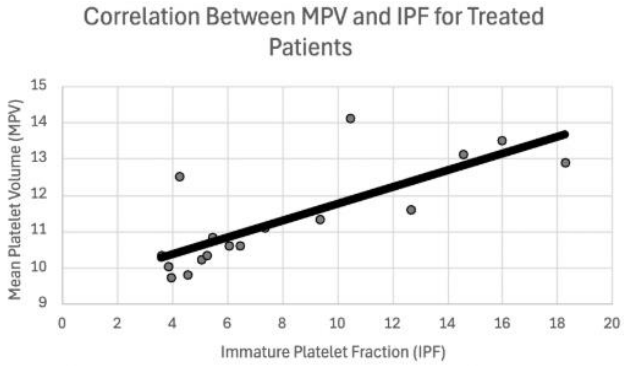

Figure 3: MPV and IPF values simultaneously collected throughout the course of ITP disease monitoring in patients who were undergoing medical treatment. Treatment modalities included steroids, intravenous immunoglobulin (IVIG), and thrombopoietin receptor agonists (TPO-RAs). The linear trend line displays a highly positive relationship, with a Pearson correlation of 0.78.

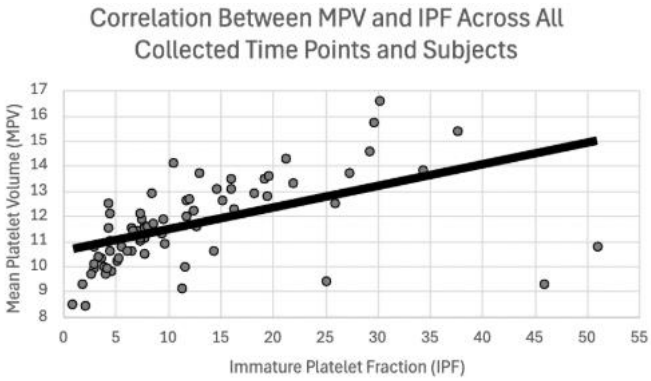

Figure 4: MPV and IPF values simultaneously collected throughout the course of ITP disease monitoring across all patients. All lab values with simultaneous data collection of MPV and IPF were included in this correlation. The linear trend line displays a moderately positive relationship, with a Pearson correlation of 0.52.

Discussion *(≥500 words)*

These results display a moderate to high positive correlation between MPV and IPF in pediatric patients diagnosed with ITP among all four main analyses, including initial, on-treatment, off-treatment, and cumulative simultaneous MPV and IPF measurements. IPF is known to increase in patients with ITP, as megakaryocytes within the bone marrow are stimulated to produce higher amounts of platelets to offset the peripheral destruction of platelets within the spleen and liver. The formation and release of these young large platelets from the bone marrow into the bloodstream likely reflect the elevated MPV displayed by our results. Thus, this positive correlation between IPF and MPV reflects the bone marrow's compensatory response to peripheral platelet destruction, by increasing "the platelet retic" to release large newly formed platelets into the bloodstream. Altogether, this data suggests MPV may be a useful diagnostic measurement for ITP when IPF is not attainable, such as in regions that do not have access to IPF laboratory measures.

In all subanalysis cohorts of patients presenting with a platelet count less than 30,000, which includes at the time of diagnosis, on-treatment, off-treatment, and the cumulative of all simultaneously collected values of MPV and IPF, there was a persistent high negative correlation between IPF and MPV. The negative correlation coefficient most likely reflects the low subject count, as these cohorts were limited to only four, two, nine, and eleven subjects, respectively. Given the positive correlations reflected across the other subanalyses of larger cohorts, I would expect this subanalysis to reflect a positive relationship if the subject number were greater in size. Moreover, this correlation is further nuanced as all IPF and MPV values within every ITP patient at diagnosis were elevated outside of the range of normal. While limited sample size is the most likely explanation for these results, the high negative correlation may also be attributed to the severity of splenic platelet destruction. When analyzing the data closer, the most elevated MPV values tended to present with IPF values that, while still elevated, were less elevated than in patients where MPV was only slightly out of the range of normal. This could be explained by less of a bone marrow response in milder cases of ITP, where IPF is mildly elevated and platelets are much larger on average given less splenic platelet destruction. Conversely to this, in severe cases, the bone marrow may be significantly more active to counteract this very rapid destruction of platelets, resulting in a significantly elevated IPF. In continuation of this theory, the rapid production of platelets may be being balanced by the rapid destruction of platelets, as MPV while elevated, tends to be less elevated when compared to milder cases where less platelet destruction is taking place.

Importantly, platelet count does not determine the severity of ITP. This is displayed by the very low to low correlation between platelet count and IPF, as well as between platelet count and MPV. MPV is

a reflection of marrow activity, similar to IPF, as this index does not reflect the balance between platelet production and destruction. Patients with a high MPV and a significantly low platelet count have aggressive platelet destruction in the presence of functioning bone marrow. Alternatively, patients with a high MPV and an only mildly low platelet count have comparatively less platelet destruction in the presence of similarly functioning marrow platelet production.

Notably, 76% of all patients with ITP had an elevated MPV at diagnosis. 100% of these patients had an elevated IPF at diagnosis. While other studies have shown a non-elevated IPF to suggest a diagnosis other than ITP, these results echo that finding while also suggesting that a non-elevated MPV may similarly reflect a non-ITP diagnosis.

Limitations:

Limitations of this study design include small sample size given the rarity of the disease. Additionally, there is potential for analytical errors associated with laboratory test results. This type of error may affect reliability of reported variables including MPV and IPF, which could negatively affect the validity of our conclusions. However, given the consistency of all data having been obtained by OHSU laboratory facilities, the risk for significant laboratory reporting errors affecting reliability is extremely low. A limitation to all data collected from one institution is that the generalizability of the study becomes limited. Finally, lack of exclusion of subjects with comorbid conditions, such as other hematologic or autoimmune diseases, may present a limitation of study accuracy resulting from the effects of these confounding variables. Replication of this study with inclusion of a more comprehensive patient population across multiple institutions with the addition of extensive exclusion criteria to reduce the effects of confounding variables would help to broaden the generalizability and applicability of these study results.

Future directions/application:

Further subanalysis to understand the relationship between the MPV and IPF variables with respect to symptomatic disease severity, acuteness/chronicity of disease, specific treatments received, and/or presence of comorbid conditions, would provide further insight into clinical utilization of MPV when IPF is not an accessible variable. These relationships could also be assessed across a broader patient population to provide applicability to adult populations. Separately, confirming the results of this study with a separate larger cohort of patients who are treated among a variety of healthcare facilities for various hematologic conditions would be useful in eliminating selection bias. If this additional study produced similar conclusions to ours, the clinical applicability of these combined findings would be strengthened and may be useful in creating a guideline for MPV utilization in the diagnosis/treatment of hematologic conditions, such as ITP.

Conclusions *(2-3 summary sentences)*

Our study suggests a positive correlation between MPV and IPF among all four main analyses, including initial, on-treatment, off-treatment, and cumulative simultaneous MPV and IPF measurements. These findings provide insight into the utilization of the MPV variable when the IPF variable is not attainable. This guidance offers practical utility in settings of underserved or resource-depleted healthcare facilities, where providers may rely on inexpensive and easily accessible laboratory testing, such as the CBC, thereby improving healthcare accessibility.

References *(JAMA style format)*

1. Jeon K, Kim M, Lee J, Lee JS, Kim HS, et al. “Immature platelet fraction: A useful marker for identifying the cause of thrombocytopenia and predicting platelet recovery.” Medicine vol. 99,7 (2020): e19096. doi:10.1097/MD.0000000000019096

2. Jeon MJ, Yu ES, Kang KW, Lee BH, Park Y, et al. Immature platelet fraction based diagnostic predictive scoring model for immune thrombocytopenia. *Korean J Intern Med*. 2020;35(4):970-978. doi:10.3904/kjim.2019.093
3. Tefferi A, Hanson CA, Inwards DJ. How to interpret and pursue an abnormal complete blood cell count in adults. *Mayo Clin Proc*. 2005;80(7):923-936. doi:10.4065/80.7.923
4. Kickler TS, Oguni S, Borowitz MJ. Clinical evaluation of high fluorescent platelet fraction percentage in thrombocytopenia. *Am J Clin Pathology.* 2006;125(2):282-287. doi:10.1309/50H8-JYHN-9JWC-KAM7
5. Ruisi MM, Psaila B, Ward MJ, Villarica G and Bussel JB. Stability of measurement of the immature platelet fraction. *Am. J. Hematol*. 2010;85(8):622-624. doi.org/10.1002/ajh.21748
6. Marin MJ, van Wijk XMR, Boothe PD, Harris NS, Winter WE. An introduction to the complete blood count for clinical chemists: Red blood cells*. J Appl Lab Med.* 2024;9(5):1025-1039. doi:10.1093/jalm/jfae031