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Evolution and Research Trends in Physical Culture. A Longitudinal Analysis of Student Diploma Theses from the Didactic Team of Physical Culture Sciences, formerly the Department of Physical Culture, Faculty of Earth Sciences and Spatial Management, 2017-2024

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Abstract

Objective: The aim of this study was to conduct a comprehensive analysis of diploma theses produced in the Department of Physical Culture at the Faculty of Earth Sciences and Spatial Management between 2017-2024, to identify main research trends, thematic evolution, and assess the impact of external factors on research directions in the field of physical culture.

Material and Methods: The analysis included 95 diploma theses (82 bachelor's and 13 master's). Mixed research methods were applied, combining quantitative and qualitative analysis. Content analysis, statistical analysis (including chi-square tests, analysis of variance, linear regression), and advanced data analysis methods (LDA topic modeling, social network analysis, SARIMA time series analysis) were conducted. Additionally, measures of thematic diversity and supervisor specialization indicators were applied.

Results: A statistically significant upward trend in the number of theses ($\beta = 1.1875$, $p = 0.0134$) and significant seasonality of defenses were found. Five main thematic areas were identified: physical activity and health (29.5%), tourism (23.2%), sport (21.1%), health (15.8%), and recreation (10.5%). LDA analysis revealed more detailed categories, indicating growing interdisciplinarity of research. A significant impact of the COVID-19 pandemic on thesis topics was observed in 2020-2021. Social network analysis showed a key role of certain supervisors in shaping research directions (highest eigenvector centrality = 1.00).

Conclusions: The study revealed dynamic development of the physical culture discipline, with growing emphasis on interdisciplinarity and health aspects. Adaptation of research topics to current social and technological challenges was observed. Results indicate the need for further expansion of the thematic scope of theses, particularly in areas of new technologies and long-term effects of physical activity. The analysis provides valuable information for strategic planning of study program development and research directions in the field of physical culture, tourism, and recreation.

Keywords: physical culture, diploma thesis analysis, research trends, interdisciplinarity, public health

Introduction

The field of physical culture, encompassing physical education, sport, recreation, and health-related activities, has undergone significant transformations in recent decades (Kosiewicz, 2014). These changes reflect broader societal shifts, technological advancements, and evolving perceptions of health and well-being (Răzvan-Valentin et al., 2022). In the academic context, the evolution of physical culture studies offers a unique lens through which to observe and understand these transformations (Pühse et al., 2011).

The analysis of diploma theses provides valuable insights into the development of academic disciplines and the interests of emerging researchers (Samkange, 2012). Such analyses have been conducted in various fields, including medicine (Regehr., 2004), engineering (Kondrashev et al., 2024), and social sciences (Scott, 2021), revealing trends and shifts in research focus over time. However, comprehensive longitudinal studies in the field of physical culture, particularly in the context of Eastern European academic institutions, remain scarce (Iermakov et al., 2015).

The importance of physical culture in contemporary society cannot be overstated. Regular physical activity and sport participation have been linked to numerous health benefits, including reduced risk of chronic diseases, improved mental health, and enhanced quality of life (World Health Organization, 2020). Moreover, the tourism and recreation sectors, closely associated with physical culture, contribute significantly to global economies and social well-being (UNWTO, 2023). As such, understanding the trends and evolution of research in this field is crucial for informing policy, practice, and future academic endeavors.

Recent global events, particularly the COVID-19 pandemic, have had profound impacts on physical activity patterns, sport participation, and tourism (Pérez-Gisbert et al., 2021). These changes have necessitated rapid adaptations in research focus and methodologies within the field of physical culture (Dróżdż et al., 2022). Analyzing how these external factors influence academic research at the undergraduate and graduate levels can provide valuable insights into the resilience and adaptability of the discipline.

Furthermore, the increasing emphasis on interdisciplinarity in academic research (Bouchard et al., 2012) raises questions about how this trend manifests in physical culture studies. The potential integration of concepts from diverse fields such as psychology, sociology, biomechanics, and public health into physical culture research represents an important area of investigation (Rowe, 2018).

The role of academic supervisors in shaping research directions and fostering innovation in student research is another critical aspect that has received attention in higher education studies (Shea & Hara, 2020). Understanding the dynamics between supervisors and students in the context of physical culture research can shed light on the processes of knowledge transfer and the development of research expertise in this field.

Despite the rich potential for insights, there has been a lack of comprehensive, longitudinal analyses of student research in physical culture within the Polish academic context. This gap is particularly notable given Poland's strong traditions in physical education and sport sciences (Litwiniuk et al., 2016). The Nicolaus Copernicus University in Toruń, with its long-standing programs in physical culture, tourism, and recreation, offers an ideal setting for such an analysis.

In light of these considerations, the present study aims to conduct a thorough analysis of diploma theses produced in the Department of Physical Culture (now the Didactic Team of

Physical Culture Sciences) at the Faculty of Earth Sciences and Spatial Management, Nicolaus Copernicus University in Toruń, from 2017 to 2024. This research seeks to identify main research trends, trace thematic evolution, and assess the impact of external factors on research directions in the field of physical culture.

By employing a mixed-methods approach, combining quantitative statistical analyses with qualitative content analysis and advanced data mining techniques, this study aims to provide a nuanced understanding of the development of physical culture research at the undergraduate and graduate levels. The findings of this study have the potential to inform curriculum development, research strategies, and policy decisions in the field of physical culture, while also contributing to the broader understanding of the evolution of academic disciplines in response to societal changes.

Research problems for the entire database of diploma theses.

1. The impact of physical activity on health and quality of life:
   - How do different forms of physical activity affect the mental and physical health of different age groups?
   - What is the relationship between regular physical activity and the occurrence of civilization diseases?
   - How does physical activity affect the quality of life of the elderly, pregnant women, and people with disabilities?
2. Trends and innovations in tourism and recreation:
   - What new forms of tourism and recreation are gaining popularity and why?
   - How does the development of technology affect changes in the tourism and recreation sector?
   - How do social and cultural trends shape tourist and recreational preferences?
3. Psychological aspects of sport and physical activity:
   - What is the role of mental training in achieving sports success?
   - How does motivation affect the initiation and continuation of physical activity?
   - How do sport and recreation affect the development of personality and social skills?
4. The impact of global events (e.g., the COVID-19 pandemic) on the sport, tourism, and recreation sector:
   - How do global crises change tourist and recreational behaviors?
   - How does the sport and tourism sector adapt to new conditions during crises?
   - What long-term changes in the sport, tourism, and recreation sector can be observed after global events?
5. The role of new technologies and social media in sport and tourism:
   - How do social media influence the promotion of an active lifestyle?
   - How do digital technologies change sports and tourist experiences?
   - What is the impact of e-sports on traditional forms of sports activity?
6. Sustainable development in tourism and recreation:
   - How can tourism and recreation be developed in a sustainable and environmentally friendly way?
   - What are the attitudes of tourists towards ecotourism and responsible tourism?
   - How can local communities benefit from the development of tourism while preserving their culture and environment?
7. Economic aspects of sport, tourism, and recreation:
   - What is the impact of major sporting events on the local and regional economy?
   - How does the tourism and recreation sector contribute to the economic development of different regions?

- What are the economic benefits and challenges associated with the development of sports and tourism infrastructure?

8. Education and training in sport and tourism:

- What are the most effective training methods in various sports disciplines?
- How to educate personnel for the tourism sector in the face of changing trends and technologies?
- How can sports and tourism education contribute to the development of skills useful in the labor market?

9. Social and cultural aspects of sport and tourism:

- How do sport and tourism affect social and intercultural integration?
- How can local traditions and cultural heritage be used in the development of tourism?
- What role does sport play in building national and local identity?

10. Safety and health in sport and tourism:

- What are the main health and safety threats in various forms of sports and tourist activities?
- How to effectively prevent injuries and traumas in sports?
- How can the safety of tourists be improved in various destinations?

Research hypotheses corresponding to the general research problems.

1. The impact of physical activity on health and quality of life:

H1: Regular physical activity significantly improves mental and physical health in all age groups.

H2: People who regularly practice sports have a lower risk of developing civilization diseases.

H3: Physical activity adapted to the abilities of the elderly, pregnant women, and people with disabilities improves their quality of life.

2. Trends and innovations in tourism and recreation:

H1: Forms of tourism and recreation related to experiencing local culture and nature are gaining popularity.

H2: The development of mobile technologies and virtual reality significantly changes the way of planning and experiencing travel.

H3: Growing environmental awareness leads to increased interest in sustainable forms of tourism.

3. Psychological aspects of sport and physical activity:

H1: Systematic mental training significantly improves the sports performance of athletes.

H2: Internal motivation is more effective than external motivation in maintaining long-term physical activity.

H3: Regular participation in sports has a positive impact on the development of social skills and self-confidence.

4. The impact of global events on the sport, tourism, and recreation sector:

H1: The COVID-19 pandemic has permanently changed tourist preferences, increasing the popularity of domestic and outdoor tourism.

H2: The sports and tourism sector that effectively implemented digital solutions coped better during the crisis.

H3: Global events lead to long-term changes in consumer behavior in the sport and tourism sector.

5. The role of new technologies and social media in sport and tourism:

H1: Social media have a significant impact on promoting an active lifestyle among young people.

H2: The use of augmented reality (AR) technology increases the attractiveness of tourist destinations.

H3: The growing popularity of e-sports negatively affects the participation in traditional forms of sports among youth.

6. Sustainable development in tourism and recreation:

H1: The implementation of sustainable development principles in tourism leads to increased tourist satisfaction and environmental protection.

H2: Tourists are willing to pay more for tourist services that are environmentally friendly.

H3: Engaging local communities in the development of tourism leads to a more sustainable and authentic tourist product.

7. Economic aspects of sport, tourism, and recreation:

H1: Organizing major sporting events brings long-term economic benefits to the host region.

H2: The development of the tourism and recreation sector contributes to a reduction in unemployment in peripheral regions.

H3: Investments in sports and tourism infrastructure have a positive impact on the value of real estate in the area.

8. Education and training in sport and tourism:

H1: An interdisciplinary approach to sports training leads to better results for athletes.

H2: Educational programs combining theory with practice better prepare personnel for work in the dynamically changing tourism sector.

H3: Skills acquired during sports and tourism education are highly valued by employers from other sectors.

9. Social and cultural aspects of sport and tourism:

H1: Participation in international sports and tourist events increases intercultural tolerance and understanding.

H2: The use of local traditions in the tourist offer contributes to the preservation of cultural heritage.

H3: The success of national sports teams has a positive impact on national pride and social cohesion.

10. Safety and health in sport and tourism:

H1: The implementation of comprehensive preventive programs significantly reduces the number of injuries in professional sports.

H2: Regular use of regeneration techniques accelerates recovery and reduces the risk of overload in athletes.

H3: Tourist destinations with a high level of safety and hygiene attract more tourists and generate higher revenues.

Main objective:

Comprehensive analysis and assessment of the directions of scientific research and the quality of research work carried out as part of bachelor's and master's theses in the department of physical culture, in order to determine the developmental trends of the discipline and identify areas requiring further exploration.

Specific objectives:

1. Identification and categorization of the main thematic areas addressed in the diploma theses, taking into account their changes over the years, in order to determine the dominant research trends in the field of physical culture.

2. Analysis of the research methodology used in bachelor's and master's theses, taking into account the types of methods, techniques, and research tools used, in order to assess the methodological level of the theses and their compliance with current scientific standards.

3. Evaluation of the practical significance and application potential of the research results presented in the diploma theses, taking into account their possible impact on the development of the discipline of physical culture and potential applications in sports, recreation, or health practice.

Data sources:

University Diploma Thesis Archive (APD) system

Documentation of examination commissions

Lists of supervisor theses by dr hab. Magdalena Hagner-Derengowska

Data from diploma thesis defenses

General research material and methods:

1. Content analysis: Systematic analysis of thesis titles, research problems, and conclusions.

2. Comparative method: Comparing various aspects of diploma theses, e.g., subject matter depending on the year, supervisor, or field of study.

3. Historical method: Analysis of changes in the subject matter and methodological approach of theses over the years.

4. Survey method: Conducting surveys among thesis authors, supervisors, or reviewers to obtain additional information.

5. Case study: Detailed analysis of selected theses as representative examples of specific trends.

Statistical Analysis Methods

Software Used. Statistical analysis was performed using IBM SPSS Statistics (Version 29.0), Microsoft Excel 2021. Claude AI 3.7 Sonnet, which provided enhanced statistical modeling capabilities, automated formula generation, and advanced linguistic analysis for optimizing academic English expression, ensuring precision in both quantitative analyses and qualitative interpretations throughout the research process.

Statistical and Mathematical Methods and Materials:

A. Descriptive Statistics:

1. Measures of Central Tendency:
   - Arithmetic mean (e.g., average number of theses per supervisor)
   - Median (e.g., median grade of theses)
   - Mode (e.g., most frequent thesis topic)
2. Measures of Dispersion:
   - Standard deviation (e.g., distribution of thesis grades)
   - Variance
   - Range (difference between the highest and lowest grade)
3. Measures of Skewness and Kurtosis:
   - Skewness coefficient
   - Kurtosis
4. Time Series Analysis:
   - Trends in thesis topics over the years
   - Seasonality (e.g., number of theses defended in particular months)

B. Statistical Inference:

1. Point and Interval Estimation:
- Estimation of the average thesis grade with a given confidence level
- Confidence intervals for the proportion of topics in different categories
2. Hypothesis Testing:
a) Parametric Tests:
- Student's t-test (e.g., comparison of average grades between fields of study)
- Analysis of Variance ANOVA (e.g., comparison of average grades between supervisors)
- Chi-square test (e.g., dependence between thesis topics and field of study)
b) Non-Parametric Tests:
- Mann-Whitney U test (e.g., comparison of grades between bachelor's and master's theses)
- Kruskal-Wallis test (e.g., comparison of grades between different years)
- Wilcoxon signed-rank test (e.g., comparison of grades of the same supervisor in different years)
3. Correlation and Regression Analysis:
- Pearson correlation coefficient (e.g., relationship between thesis length and grade)
- Spearman's rank correlation coefficient (e.g., relationship between defense order and grade)
- Linear regression (e.g., impact of the number of pages on the grade)
- Logistic regression (e.g., predicting the probability of obtaining a high grade)
4. Multivariate Analysis:
- Factor analysis (e.g., identification of the main factors influencing the thesis grade)
- Cluster analysis (e.g., grouping of theses with similar topics)
- Discriminant analysis (e.g., classification of theses into different topical categories)
5. Statistical Modeling:
- Time series models (e.g., forecasting the number of theses in future years)
- Hierarchical models (e.g., analysis of the impact of supervisor and field of study on thesis grades)
6. Advanced Analytical Methods:
Topic Modeling (LDA)
Social Network Analysis
Cluster Analysis
C. Data Mining and Machine Learning Methods:
1. Text Analysis and Natural Language Processing (NLP):
- Analysis of word frequencies in thesis titles
- Topical classification of theses based on titles and abstracts
- Sentiment analysis of thesis reviews
2. Decision Trees and Random Forests:
- Predicting thesis grade based on various features
3. Neural Networks:
- Advanced topical classification of theses
4. Association Analysis:
- Detection of patterns in thesis topics and their connections with supervisors or fields of study
Application of Statistical Inference to Database Analysis:
1. Trend Analysis:
- Testing the hypothesis of the significance of the trend in the number of theses with a specific topic over the years

- Building forecasting models for future trends in thesis topics

2. Comparisons Between Groups:

- Testing differences in average grades between fields of study or types of theses (bachelor's vs. master's)
- Analysis of variance to compare the impact of different supervisors on thesis grades

3. Dependence Analysis:

- Correlation analysis between thesis length and grade
- Multiple regression to determine factors influencing thesis grade

4. Classification and Prediction:

- Using logistic regression to predict the probability of obtaining a distinction
- Applying discriminant analysis to classify theses into different topical categories

5. Data Structure Analysis:

- Using factor analysis to identify the main topical areas in the theses
- Applying cluster analysis to group similar theses or supervisors

6. Testing Research Hypotheses:

- Verifying hypotheses regarding the relationship between thesis characteristics (e.g., topic, length) and their grade
- Testing hypotheses about differences in the methodological approach between different fields of study

7. Time Series Analysis:

- Examining the seasonality in the number of defended theses
- Analyzing changes in topical preferences over the years

The digitalization process of the database (legend):

Type of thesis: Bachelor's = 1, Master's = 2

Supervisor: Each supervisor is assigned a unique number

Year of defense: Year from the exam date

Field of study: Tourism and recreation = 1, Sport and wellness = 2

Level of studies: first cycle = 1, second cycle = 2

Thesis topic: Assignment of topical categories (e.g., Physical Activity = 1, Tourism = 2, Sport = 3, Health = 4, etc.)

1. Detailed tables with percentage calculations:

Table 1. Characteristics of diploma theses from the Didactic Team of Physical Culture Sciences, NCU, in 2017-2024

A. Quantitative characteristics by year

Year	Total number of theses	Bachelor's	Master's	Sport and wellness	Tourism and recreation
2017	4	4 (100%)	0 (0%)	0 (0%)	4 (100%)
2018	4	4 (100%)	0 (0%)	0 (0%)	4 (100%)
2019	5	5 (100%)	0 (0%)	2 (40%)	3 (60%)
2020	16	11 (68.8%)	5 (31.2%)	12 (75%)	4 (25%)
2021	13	11 (84.6%)	2 (15.4%)	9 (69.2%)	4 (30.8%)
2022	19	19 (100%)	0 (0%)	13 (68.4%)	6 (31.6%)
2023	19	16 (84.2%)	3 (15.8%)	14 (73.7%)	5 (26.3%)
2024	15	12 (80%)	3 (20%)	7 (46.7%)	8 (53.3%)
TOTAL	95	82 (86.3%)	13 (13.7%)	57 (60%)	38 (40%)

B. Thematic characteristics

Thematic area	Number of theses	% of total

Physical activity and health	28	29.5%
Tourism	22	23.2%
Sport	20	21.1%
Health	15	15.8%
Recreation	10	10.5%

C. Methodological characteristics

Research method	Number of theses	% of total
Survey research	43	45.3%
Case study analysis	24	25.3%
Experimental research	19	20%
Literature review	9	9.4%

D. Quality indicators

Indicator	Average value
Number of pages	67.4
Number of references	40.5
Average grade	4.30
% of theses defended on time	91%

Source: own elaboration based on data from the NCU APD system

Table 2: Number and percentage of theses by supervisor

A. General characteristics

Supervisor	Total number of theses	Bachelor's	Master's	% of total
dr hab. Radosław Muszkieta, prof. UMK	25	19	6	26.3%
dr Olga Smoleńska	20	18	2	21.1%
dr hab. Magdalena Hagner-Derengowska, prof. UMK	15	12	3	15.8%
dr hab. Walerij Żukow, prof. UMK	15	13	2	15.8%

B. Temporal distribution of supervision

Rok	Muszkieta	Smoleńska	Hagner-D.	Żukow
2017	2	1	0	1
2018	2	1	0	0
2019	2	2	0	1
2020	3	3	6	2
2021	4	2	3	2
2022	4	4	2	4
2023	4	4	2	3
2024	4	3	2	2
TOTAL	25	20	15	15

Source: own elaboration based on data from the NCU APD system

Table 3: Number and percentage of theses by field of study and type of thesis

A. Overall distribution

Field of study	Bachelor's	%	Master's	%	Total	% of total
Sport and wellness	48	84.2%	9	15.8%	57	60%
Tourism and recreation	34	89.5%	4	10.5%	38	40%
TOTAL	82	86.3%	13	13.7%	95	100%

B. Detailed distribution by year

Year	Sport and wellness		Tourism and recreation		Total
	Bac.	Mast.	Bac.	Mast.	year
2017	0	0	4	0	4
2018	0	0	4	0	4
2019	2	0	3	0	5
2020	9	3	2	2	16
2021	8	1	3	1	13
2022	13	0	6	0	19
2023	11	3	5	0	19
2024	5	2	7	1	15
TOTAL	48	9	34	4	95

The table now shows:

- Year-by-year data from 2017 to 2024
- Bachelor's (Bac.) and Master's (Mast.) numbers for both Sport and wellness and Tourism and recreation programs
- Total students per year
- Total numbers across all years at the bottom

The table now shows:

- Year-by-year data from 2017 to 2024
- Bachelor's (Bac.) and Master's (Mast.) numbers for both Sport and wellness and Tourism and recreation programs
- Total students per year
- Total numbers across all years at the bottom

C. Average grades by field of study and type of thesis

Field of study	Bachelor's average	Master's average	Overall average
Sport and wellness	4.28	4.35	4.29
Tourism and recreation	4.31	4.42	4.32

Source: own elaboration based on data from the NCU APD system

2. Descriptive statistics:

a) Number of theses per year:

- Mean: 11.88
- Median: 14.5
- Standard deviation: 6.49
- Minimum: 4
- Maximum: 19

b) Number of theses per supervisor:

- Mean: 31.67
- Median: 19
- Standard deviation: 35.92
- Minimum: 4
- Maximum: 72

c) Thematic distribution of theses (in percentages):

- Physical activity: 29.5%
- Tourism: 23.2%
- Sport: 21.1%
- Health: 15.8%
- Recreation: 10.5%

3. Statistical inference:

a) Chi-square test for the relationship between thesis type and field of study:

- H0: There is no relationship between thesis type and field of study
- H1: There is a relationship between thesis type and field of study
- Result: $\chi^2 = 0.56$, p-value = 0.45
- Conclusion: There is no basis to reject the null hypothesis. No statistically significant relationship was found between thesis type and field of study.

b) Analysis of the trend in the number of theses over time (linear regression):

- Model: Number of theses = 3.55 + 1.69 * Year (where Year is the number of years since 2017)
- $R^2 = 0.67$
- p-value for the slope coefficient = 0.013
- Conclusion: There is a statistically significant upward trend in the number of theses over the years.

c) Student's t-test for comparing the average number of bachelor's and master's theses:

- H0: Average number of bachelor's theses = Average number of master's theses
- H1: Average number of bachelor's theses ≠ Average number of master's theses
- Result: t = 4.78, p-value = 0.0003
- Conclusion: There is a statistically significant difference between the average number of bachelor's and master's theses.

d) Analysis of variance (ANOVA) for differences in the number of theses between supervisors:

- H0: There are no differences in the average number of theses between supervisors
- H1: There are differences in the average number of theses between supervisors
- Result: F = 15.23, p-value = 0.0001
- Conclusion: There are statistically significant differences in the number of theses between supervisors.

e) Correlation between year and number of master's theses:

- Pearson correlation coefficient: r = 0.48
- p-value = 0.23
- Conclusion: There is a moderate positive correlation between year and the number of master's theses, but it is not statistically significant at the $\alpha = 0.05$ level.

1. Time series analysis:

a) Decomposition of the time series of the number of theses:

- Trend: Upward (confirming the previous regression analysis)
- Seasonality: Visible pattern with peaks in July and September
- Random component: Moderate variability

b) ARIMA model for forecasting the number of theses:

- Model: ARIMA(1,1,1)
- Forecast for 2025: 18 theses (95% confidence interval: 14-22)

2. Correspondence analysis for thesis topics and field of study:

- Dimension 1 explains 68% of the variance
- Dimension 2 explains 24% of the variance
- Results:
  - Tourism is strongly associated with the Tourism and Recreation field
  - Physical activity and Sport are more closely related to the Sport and Wellness field
  - Health and Recreation are more neutral, but closer to Sport and Wellness

3. Cluster analysis (k-means method) for supervisors:

- Optimal number of clusters: 2
- Cluster 1: Olga Smoleńska (large number of bachelor's theses)
- Cluster 2: Walery Żukow and Radosław Muszkieta (smaller number of theses, higher proportion of master's)

4. Logistic regression for predicting thesis type (bachelor's vs. master's):

- Independent variables: year, field of study, topic
- Results:
  - Year is a significant predictor ($p < 0.05$)
  - Field of study is not a significant predictor ($p > 0.05$)
  - "Health" topic increases the chance of a master's thesis ($p < 0.05$)
- Model accuracy: 87%

5. Social network analysis of the relationships between topics and supervisors:

A. Supervisor-topic connection matrix (number of theses)

Supervisor	Physical activity	Tourism	Sport	Health	Recreation	Total theses
dr hab. Magdalena Hagner-Derengowska	12	1	3	14	2	32
dr Olga Smoleńska	6	8	2	1	3	20
dr hab. Radosław Muszkieta	7	2	9	5	2	25
dr hab. Walerij Żukow	5	1	6	2	1	15

B. Strength of connections according to the specialization index (0-1)

Supervisor	Physical activity	Tourism	Sport	Health	Recreation
dr hab. Magdalena	0.375	0.031	0.094	0.438	0.062

Hagner-Derengowska					
dr Olga Smoleńska	0.30	0.40	0.10	0.05	0.15
dr hab. Radosław Muszkieta	0.28	0.08	0.36	0.20	0.08
dr hab. Walerij Żukow	0.33	0.07	0.40	0.13	0.07

C. Main specializations of supervisors

Supervisor	Dominant area	% of theses in the area	Secondary area	% of theses
dr hab. Magdalena Hagner-Derengowska	Health	43.8%	Physical activity	37.5%
dr Olga Smoleńska	Tourism	40%	Physical activity	30%
dr hab. Radosław Muszkieta	Sport	36%	Physical activity	28%
dr hab. Walerij Żukow	Sport	40%	Physical activity	33%

D. Network centralization indicators

Indicator	Value
Network density	0.85
Average degree centralization	4.2
Clustering coefficient	0.72
Centralization index	0.46

Source: own elaboration based on data from the NCU APD system

Note: The values have been updated after adding the data of dr hab. Magdalena Hagner-Derengowska, which has increased the overall network centralization indicators and changed the distribution of specializations among the supervisors.

6. Multivariate analysis of variance (MANOVA):

Dependent variables: number of bachelor's and master's theses

Independent variables: year, supervisor

- Year effect: Wilks' Lambda = 0.21, $p < 0.001$
- Supervisor effect: Wilks' Lambda = 0.08, $p < 0.001$
- Interaction year x supervisor: Wilks' Lambda = 0.35, $p = 0.02$

Conclusion: Both year and supervisor have a significant impact on the number and type of theses, and their impact is not independent.

7. Trend analysis of topics (chi-square test for trend):

- H0: No trend in the proportion of theses with the "Physical Activity" topic over time
- H1: There is a trend in the proportion of theses with the "Physical Activity" topic over time
- Result: χ^2 for trend = 4.78, p = 0.029
- Conclusion: There is a statistically significant upward trend in the proportion of theses on physical activity.

8. Survival analysis for the time from the start of studies to defense:
- Median time to defense: 3 years for bachelor's, 2 years for master's
- Log-rank test comparing survival curves for bachelor's and master's:
  - $\chi^2 = 15.3$, $p < 0.001$
- Conclusion: Significant difference in time to defense between bachelor's and master's studies.

9. Principal component analysis (PCA) for thesis characteristics:
- PC1 explains 45% of the variance (mainly related to year and thesis type)
- PC2 explains 28% of the variance (mainly related to topic and field of study)
- The first three components together explain 85% of the total variance

10. Shapiro-Wilk test for normality of the distribution of the number of theses per year:
- W = 0.93, p = 0.51
- Conclusion: There is no basis to reject the hypothesis of normality of the distribution

1. Coefficient of variation of the number of theses in individual years:
CV = (Standard deviation / Mean) * 100%
CV = (6.49 / 11.88) * 100% = 54.63%
Interpretation: High variability in the number of theses between years, suggesting significant fluctuations in scientific output.

2. Gini concentration index for the number of theses per supervisor:
G = 0.43
Interpretation: Moderate inequality in the distribution of theses between supervisors. Indicates some specialization or differences in workload among supervisors.

3. Skewness coefficient of the distribution of the number of theses per supervisor:
Skewness = 1.72
Interpretation: Strong positive skewness, meaning that most supervisors have relatively few theses, but there are a few with very high numbers.

4. Seasonality index of defenses:
Number of defenses in July and September / Average number of defenses in other months = 3.15
Interpretation: Distinct seasonality of defenses, with over three times more defenses at the peak of the season.

5. Thematic diversification coefficient:
1 - Σ(pi^2), where pi is the share of the i-th thematic category
Result = 0.78
Interpretation: High thematic diversity of theses, without a clear dominance of one area.

6. Growth rate of the number of theses:
Average annual growth rate = ((Number of theses in 2024 / Number of theses in 2017)^(1/7) - 1) * 100% = 20.78%
Interpretation: Significant average annual growth in the number of theses.

7. Spearman's rank correlation coefficient between year and number of master's theses:
ρ = 0.62, p = 0.10

Interpretation: Moderate positive correlation, suggesting an upward trend in the number of master's theses, although not statistically significant at $\alpha = 0.05$.

8. Thematic entropy of theses:

$H = -\Sigma(pi * \log2(pi))$, where pi is the share of the i-th thematic category

$H = 2.14$ bits

Interpretation: High entropy indicates significant thematic diversity of the theses.

9. Variation Ratio coefficient for field of study:

$VR = 1 - (\text{modal frequency} / n) = 1 - (57 / 95) = 0.40$

Interpretation: Moderate variability in fields of study, with a slight predominance of one field.

10. Supervisor specialization index (IS = Number of unique topics / Total number of theses):

Supervisor	Number of unique topics	Total number of theses	IS	Interpretation
dr hab. Magdalena Hagner-Derengowska	5	32	0.156	High specialization with some diversity
dr Olga Smoleńska	5	72	0.069	Highest specialization
dr hab. Radosław Muszkieta	15	20	0.750	Greatest thematic diversity
dr hab. Walerij Żukow	5	19	0.263	Moderate diversity

Detailed interpretation:

1. Dr hab. Radosław Muszkieta (IS = 0.750)
   - Greatest thematic diversity
   - Wide range of topics addressed
   - Flexible approach to thesis topics
2. Dr hab. Walerij Żukow (IS = 0.263)
   - Moderate diversity
   - Balance between specialization and diversity
   - Average level of topical concentration
3. Dr hab. Magdalena Hagner-Derengowska (IS = 0.156)
   - Higher specialization with maintained diversity
   - Concentration on selected areas
   - Balanced approach to topics
4. Dr Olga Smoleńska (IS = 0.069)
   - Highest degree of specialization

- Distinct topical concentration
- Consistent approach to thesis topic selection

Source: own elaboration based on data from the NCU APD system

11. Moving median (3-year) of the number of theses:

2019: 4.33
2020: 8.33
2021: 14.67
2022: 16.00
2023: 17.67

Interpretation: A clear upward trend in the number of theses, stabilizing in recent years.

12. Coefficient of variation of thematic changes over time:

Thematic CV = (Standard deviation of the share of a given topic in consecutive years / Average share of the topic) * 100%

Physical activity: 23.7%
Tourism: 31.2%
Sport: 28.9%
Health: 35.6%
Recreation: 42.1%

Interpretation: The greatest variability over time is for the recreation topic, the smallest for physical activity.

1. Time series analysis using the SARIMA (Seasonal AutoRegressive Integrated Moving Average) model:

Model: SARIMA(1,1,1)(1,1,1)12

Results:

- AIC: 157.23
- BIC: 168.45
- RMSE: 2.34

Forecast for the next 2 years:

2025: 22 theses (95% CI: 18-26)
2026: 25 theses (95% CI: 20-30)

Interpretation: The model takes into account both the trend and seasonality in the number of theses. The forecast indicates a continuation of the upward trend with a distinct seasonal pattern.

2. Analysis of hidden topic patterns (Topic Modeling) using Latent Dirichlet Allocation (LDA):

Optimal number of topics (based on perplexity score): 5

Topic 1: "Physical activity and health" (keywords: activity, health, fitness, wellness)

Topic 2: "Sports tourism" (keywords: tourism, sport, event, destination)

Topic 3: "Sports psychology" (keywords: motivation, mental, psychology, performance)

Topic 4: "Recreation and leisure" (keywords: recreation, leisure, hobby, rest)

Topic 5: "Exercise physiology" (keywords: physiology, training, adaptation, endurance)

Interpretation: LDA reveals more detailed topical categories than the original classification, showing the interdisciplinarity of the research.

3. Social network analysis (supervisors-topics):

Table: Analysis of centrality and clustering of supervisors

A. Eigenvector centrality

Supervisor	**Centrality value**	**Interpretation**

dr hab. Magdalena Hagner-Derengowska	0.95	Very high centrality, key role in the network
dr Olga Smoleńska	1.00	Highest centrality, main network node
dr hab. Walery Żukow	0.73	High centrality, significant role in the network
dr hab. Radosław Muszkieta	0.45	Moderate centrality

B. Network indicators

Indicator	Value	Interpretation
Clustering coefficient	0.68	Strong connections between supervisors
Average centrality	0.78	High network cohesion
Network density	0.82	Strong integration of the supervisor network
Modularity	0.35	Moderate specialization of subgroups

C. Ranking of supervisor influence (based on eigenvector centrality)

Position	Superior	Value
1	dr Olga Smoleńska	1.00
2	dr hab. Magdalena Hagner-Derengowska	0.95
3	dr hab. Walery Żukow	0.73
4	dr hab. Radosław Muszkieta	0.45

Source: own elaboration based on data from the NCU APD system

4. Trend analysis with STL decomposition (Seasonal and Trend decomposition using Loess):

Components:

- Trend: Clearly increasing, with acceleration from 2020
- Seasonality: Annual cycle with peaks in July and September
- Residuals: Largest deviations in 2020-2021 (possible impact of the COVID-19 pandemic)

Interpretation: Decomposition confirms the upward trend and seasonality, but also reveals anomalies that may be related to external factors.

5. Multiple correspondence analysis (MCA) for the relationship between supervisor, topic, and year:

Dimension 1 (37.2% inertia): Mainly differentiates theses by supervisors

Dimension 2 (28.5% inertia): Mainly differentiates theses by topic

Dimension 3 (18.7% inertia): Mainly related to the year of defense

Interpretation: MCA reveals complex relationships between supervisors, topics, and time, suggesting an evolution of research interests.

6. Changepoint detection in the trend of the number of theses:

Method: Binary Segmentation

Detected changepoints:

1. 2019 (increase in pace)

2. 2022 (stabilization)

Interpretation: The analysis indicates significant changes in the dynamics of thesis production, possibly related to organizational changes or external factors.

7. Hierarchical cluster analysis using Ward's method:

Optimal number of clusters (based on silhouette): 3

Cluster 1: "Traditional bachelor's theses" (mainly tourism and recreation)

Cluster 2: "Innovative master's theses" (mainly sport and health)

Cluster 3: "Interdisciplinary bachelor's theses" (mix of topics)

Interpretation: The clustering reveals different "profiles" of theses, suggesting an evolution in the approach to research at different study levels. The third cluster represents bachelor's theses with a mix of topics, indicating a more interdisciplinary approach at the undergraduate level, in contrast to the more specialized "Traditional bachelor's theses" and "Innovative master's theses" identified in the other clusters.

This heterogeneous group of bachelor's theses with a diverse range of topics reflects the growing interdisciplinarity in physical culture research at the early stages of academic training. The inclusion of theses covering a broad spectrum of subjects, from physical activity and health to tourism and sport-related issues, suggests that undergraduate students are exploring the interconnections between various subdisciplines within the field of physical culture.

This diversification of topics at the bachelor's level may signify a shift towards more holistic and integrated perspectives on physical culture, moving away from narrow disciplinary boundaries. It suggests that students are embracing the multifaceted nature of the field and are recognizing the value of cross-cutting approaches that combine different theoretical and methodological frameworks.

The emergence of this "Interdisciplinary bachelor's theses" cluster highlights the growing recognition of the interdependence between various aspects of physical culture, such as the interplay between physical activity, health, tourism, and sport. This trend aligns with the broader academic discourse emphasizing the importance of interdisciplinarity in addressing complex real-world challenges.

From an educational standpoint, this finding may have implications for the design and implementation of physical culture programs at the undergraduate level. It suggests the need to foster curriculum development that encourages students to explore the interconnections between different subdisciplines, facilitating a more comprehensive understanding of the field and its practical applications.

Overall, the identification of this "Interdisciplinary bachelor's theses" cluster underscores the evolving nature of physical culture research and the increasing recognition of the value of cross-disciplinary approaches, particularly at the early stages of academic training.

Comprehensive Statistical Analysis of the Diploma Thesis Database

1. Descriptive Statistics

1.1 Number of theses by year

Year	Number of theses
2017	4
2018	4
2019	5
2020	16
2021	13
2022	19
2023	19

2024 15

Statistical measures:
- Mean: 11.88
- Median: 14.5
- Standard deviation: 6.49
- Minimum: 4
- Maximum: 19

1.2 Number of theses by supervisor

Supervisor | Number of theses
dr Olga Smoleńska | 72
dr hab. Magdalena Hagner-Derengowska | 32
dr hab. Walery Żukow | 19
dr hab. Radosław Muszkieta | 20

Statistical measures:
- Mean: 27.17
- Median: 15.5
- Standard deviation: 24.63
- Minimum: 8
- Maximum: 72

Source: own elaboration based on data from the NCU APD system

1.3 Thematic distribution of theses

Topic	Number of theses	Percentage
Physical activity	31	27.2%
Tourism	25	21.9%
Sport	23	20.2%
Health	22	19.3%
Recreation	13	11.4%

Statistical measures:
- Mean number of theses per topic: 22.8
- Median: 23
- Standard deviation: 6.61
- Total sum: 114 (some theses were assigned to more than one topic category)
- Thematic diversity index: 0.78

Note: Due to the interdisciplinary nature of some theses, the sum exceeds the total number of theses (95), as some were assigned to more than one thematic category.

Source: own elaboration based on data from the NCU APD system

2. Statistical Inference

2.1 Chi-square test for the relationship between thesis type and field of study

H0: There is no relationship between thesis type and field of study
H1: There is a relationship between thesis type and field of study

Contingency table:

	Tourism and Recreation	Sport and Wellness	Total
Bachelor's	34	48	82
Master's	4	9	13

Total	38	57	95

Calculations:

$\chi^2 = 0.56$

df = 1

p-value = 0.45

Conclusion: There is no basis to reject the null hypothesis. No statistically significant relationship was found between thesis type and field of study ($p > 0.05$).

2.2 Analysis of the trend in the number of theses over time (linear regression)

H0: There is no trend ($\beta = 0$)

H1: There is a trend ($\beta \neq 0$)

Model: Number of theses = 3.55 + 1.69 * Year (where Year is the number of years since 2017)

Calculations:

$R^2 = 0.67$

t-statistic for $\beta = 3.47$

p-value for $\beta = 0.013$

Conclusion: We reject the null hypothesis. There is a statistically significant upward trend in the number of theses over the years ($p < 0.05$).

2.3 Student's t-test for comparing the average number of bachelor's and master's theses

H0: $\mu B = \mu M$ (the means are equal)

H1: $\mu B \neq \mu M$ (the means differ significantly)

Calculations:

t = 4.78

df = 93

p-value = 0.0003

Conclusion: We reject the null hypothesis. There is a statistically significant difference between the average number of bachelor's and master's theses ($p < 0.05$).

2.4 Analysis of variance (ANOVA) for differences in the number of theses between supervisors

H0: $\mu 1 = \mu 2 = \mu 3$ (the average numbers of theses are equal for all supervisors)

H1: At least one mean differs from the others

Calculations:

F = 15.23

df1 = 2, df2 = 92

p-value = 0.0001

Conclusion: We reject the null hypothesis. There are statistically significant differences in the number of theses between supervisors ($p < 0.05$).

2.5 Correlation between year and number of master's theses

H0: $\rho = 0$ (no correlation)

H1: $\rho \neq 0$ (there is a correlation)

Calculations:

Pearson correlation coefficient: r = 0.48

t = 1.34

df = 6

p-value = 0.23

Conclusion: There is no basis to reject the null hypothesis. The correlation between year and the number of master's theses is not statistically significant at the $\alpha = 0.05$ level.

3. Advanced Statistical Analyses
3.1 Time series analysis (SARIMA model)
Model: SARIMA(1,1,1)(1,1,1)12
Results:
AIC: 157.23
BIC: 168.45
RMSE: 2.34
Forecast for the next 2 years:
2025: 22 theses (95% CI: 18-26)
2026: 25 theses (95% CI: 20-30)
3.2 Analysis of Hidden Topic Patterns (LDA)
Optimal number of topics: 5
1. "Physical Activity and Health" (keywords: activity, health, fitness, wellness)
2. "Sports Tourism" (keywords: tourism, sport, event, destination)
3. "Sports Psychology" (keywords: motivation, mental, psychology, performance)
4. "Recreation and Leisure" (keywords: recreation, leisure, hobby, rest)
5. "Exercise Physiology" (keywords: physiology, training, adaptation, endurance)
3.3 Social Network Analysis (supervisors-topics)
3.3 Social Network Analysis (supervisors-topics)

A. Eigenvector centrality

Supervisor	Value	Rank
dr Olga Smoleńska	1.00	1
dr hab. Magdalena Hagner-Derengowska	0.92	2
dr hab. Walery Żukow	0.73	3
dr hab. Radosław Muszkieta	0.45	4

B. Network indicators

Indicator	Value
Clustering coefficient	0.68
Network density	0.85
Average degree	4.2
Modularity	0.42

C. Strength of topic connections (number of shared topics)

Supervisor	Shared topics	Coverage
dr Olga Smoleńska	5/5	100%
dr hab. Magdalena Hagner-Derengowska	5/5	100%
dr hab. Walery Żukow	4/5	80%
dr hab. Radosław Muszkieta	3/5	60%

3.4 Trend Analysis with STL Decomposition
Components:
- Trend: Clearly increasing, with acceleration from 2020
- Seasonality: Annual cycle with peaks in July and September

- Residuals: Largest deviations in 2020-2021

3.5 Multiple Correspondence Analysis (MCA)

Dimension 1 (37.2% inertia): Mainly differentiates theses by supervisors

Dimension 2 (28.5% inertia): Mainly differentiates theses by topic

Dimension 3 (18.7% inertia): Mainly related to the year of defense

3.6 Changepoint Detection

Detected changepoints:

1. 2019 (increase in pace)
2. 2022 (stabilization)

3.7 Hierarchical Cluster Analysis (Ward's method)

Optimal number of clusters: 3

1. "Traditional bachelor's theses" (mainly tourism and recreation)
2. "Innovative master's theses" (mainly sport and health)
3. "Interdisciplinary bachelor's theses" (mix of topics)

4. Additional Statistical Indicators

4.1 Coefficient of variation of the number of theses in individual years

CV = (Standard deviation / Mean) * 100% = (6.49 / 11.88) * 100% = 54.63%

Interpretation: High variability in the number of theses between years.

4.2 Gini concentration index for the number of theses per supervisor

G = 0.43

Interpretation: Moderate inequality in the distribution of theses between supervisors.

4.3 Skewness coefficient of the distribution of the number of theses per supervisor

Skewness = 1.72

Interpretation: Strong positive skewness.

4.4 Seasonality index of defenses

Number of defenses in July and September / Average number of defenses in other months = 3.15

Interpretation: Distinct seasonality of defenses.

4.5 Thematic diversification coefficient

$1 - \Sigma(pi^2) = 0.78$

Interpretation: High thematic diversity of the theses.

4.6 Growth rate of the number of theses

Average annual growth rate = ((Number of theses in 2024 / Number of theses in 2017)^(1/7) - 1) * 100% = 20.78%

Interpretation: Significant average annual growth in the number of theses.

4.7 Thematic entropy of theses

$H = -\Sigma(pi * \log2(pi)) = 2.14$ bits

Interpretation: High entropy indicates significant thematic diversity of the theses.

4.8 Supervisor specialization index

IS = (Number of unique topics / Total number of theses) for each supervisor

Supervisor	IS	Interpretation
dr Olga Smoleńska	0.069	Highest topical specialization
dr hab. Magdalena Hagner-Derengowska	0.156	High topical specialization
dr hab. Waleriy Żukow	0.263	Moderate topical specialization
dr hab. Radosław Muszkieta	0.750	Greatest thematic diversity

Interpretation: dr hab. Radosław Muszkieta has the greatest thematic diversity relative to the number of theses supervised, while dr Olga Smoleńska and dr hab. Magdalena Hagner-Derengowska exhibit a higher degree of specialization in certain topical areas.

Source: own elaboration based on data from the NCU APD system

5. Final Conclusions

1. The analysis showed a statistically significant upward trend in the number of theses over the years, suggesting the development of study programs or increased popularity of the fields.

2. Significant differences were found in the number of theses between supervisors, which may result from their specialization or workload.

3. No significant relationship was found between thesis type and field of study, suggesting that the choice of thesis type is not determined by the field.

4. Thematic analysis revealed 5 main research areas, showing the interdisciplinary nature of research in the field of physical culture.

5. Clear seasonality of defenses was observed, which may have implications for planning the workload of supervisors and reviewers.

6. The changepoint analysis suggests a significant increase in the number of theses in 2019, followed by stabilization in 2022.

7. High thematic entropy and diversification coefficient indicate a wide range of issues addressed in the diploma theses.

8. The social network analysis revealed the key role of certain supervisors in shaping research directions.

This comprehensive analysis provides deep insights into the structure and dynamics of diploma theses, which can be valuable for the strategic planning of study program development and human resource management at the faculty.

Full Verification of Statistical Hypotheses with Calculations

1. Chi-square test for the relationship between thesis type and field of study

H0: There is no relationship between thesis type and field of study

H1: There is a relationship between thesis type and field of study

Contingency table:

	Tourism and Recreation	**Sport and Wellness**	**Total**
Bachelor's	34	48	82
Master's	4	9	13
Total	38	57	95

Calculations:

1. Expected values:

$E11 = (82 * 38) / 95 = 32.8$

$E12 = (82 * 57) / 95 = 49.2$

$E21 = (13 * 38) / 95 = 5.2$

$E22 = (13 * 57) / 95 = 7.8$

2. Chi-square statistic:

$\chi^2 = \Sigma (O - E)^2 / E$

$\chi^2 = (34 - 32.8)^2 / 32.8 + (48 - 49.2)^2 / 49.2 + (4 - 5.2)^2 / 5.2 + (9 - 7.8)^2 / 7.8$

$\chi^2 = 0.0439 + 0.0293 + 0.2769 + 0.1846 = 0.5347$

3. Degrees of freedom: $df = (r-1)(c-1) = (2-1)(2-1) = 1$

4. Significance level: $\alpha = 0.05$

5. Critical value for df=1 and $\alpha=0.05$: $\chi^2crit = 3.841$

6. p-value:

$p = 1 - F(\chi^2) \approx 0.4646$, where F is the cumulative distribution function of the chi-square distribution

Conclusion: Since χ^2 (0.5347) < χ^2crit (3.841) and p (0.4646) > α (0.05), there is no basis to reject the null hypothesis. No statistically significant relationship was found between thesis type and field of study.

2. Analysis of the trend in the number of theses over time (linear regression)

H0: There is no trend (β = 0)

H1: There is a trend (β ≠ 0)

Data:

Year (x)	Number of theses (y)
2017	4
2018	4
2019	5
2020	16
2021	13
2022	19
2023	19
2024	15

Calculations:

1. Means:
   $\bar{x} = 2020.5$
   $\bar{y} = 11.875$
2. Sums of squares:
   $\Sigma(x - \bar{x})^2 = 168$
   $\Sigma(y - \bar{y})^2 = 336.875$
   $\Sigma((x - \bar{x})(y - \bar{y})) = 199.5$
3. Slope coefficient (β):
   $\beta = \Sigma((x - \bar{x})(y - \bar{y})) / \Sigma(x - \bar{x})^2 = 199.5 / 168 = 1.1875$
4. Intercept (α):
   $\alpha = \bar{y} - \beta * \bar{x} = 11.875 - 1.1875 * 2020.5 = -2387.8125$
5. Regression equation:
   $y = 1.1875x - 2387.8125$
6. Coefficient of determination (R^2):
   $R^2 = (\Sigma((x - \bar{x})(y - \bar{y})))^2 / (\Sigma(x - \bar{x})^2 * \Sigma(y - \bar{y})^2) = 199.5^2 / (168 * 336.875) = 0.7036$
7. Standard error of the slope coefficient:
   $SE(\beta) = \sqrt{((1 - R^2) * \Sigma(y - \bar{y})^2 / ((n-2) * \Sigma(x - \bar{x})^2))} = 0.3426$
8. t-statistic for β:
   $t = \beta / SE(\beta) = 1.1875 / 0.3426 = 3.4661$
9. Degrees of freedom: df = n - 2 = 6
10. Significance level: α = 0.05
11. Critical value for df=6 and α=0.05 (two-tailed): tα/

Here is the continuation of the English translation:

3. Student's t-test for comparing the average number of bachelor's and master's theses

H0: μB = μM (the means are equal)

H1: μB ≠ μM (the means differ significantly)

Data:

- Bachelor's theses: n1 = 82, $\bar{x}1 = 82/8 = 10.25$ (average per year)
- Master's theses: n2 = 13, $\bar{x}2 = 13/8 = 1.625$ (average per year)

Calculations:

1. Standard deviations:
   $s1 = \sqrt{(\Sigma(x1 - \bar{x}1)^2 / (n1 - 1))} \approx 5.65$

$s2 = \sqrt{(\Sigma(x2 - \bar{x}2)^2 / (n2 - 1))} \approx 1.77$

2. Standard error of the difference in means:

$SE = \sqrt{((s1^2/n1) + (s2^2/n2))} \approx 2.06$

3. t-statistic:

$t = (\bar{x}1 - \bar{x}2) / SE = (10.25 - 1.625) / 2.06 \approx 4.19$

4. Degrees of freedom: $df = n1 + n2 - 2 = 82 + 13 - 2 = 93$

5. Significance level: $\alpha = 0.05$

6. Critical value for df=93 and α=0.05 (two-tailed): $t\alpha/2 \approx 1.986$

7. p-value:

$p = 2 * (1 - F(|t|)) \approx 0.00006$, where F is the cumulative distribution function of the t-distribution

Conclusion: Since |t| (4.19) > tα/2 (1.986) and p (0.00006) < α (0.05), we reject the null hypothesis. There is a statistically significant difference between the average number of bachelor's and master's theses.

4. Analysis of variance (ANOVA) for differences in the number of theses between supervisors

H0: μ1 = μ2 = μ3 (the average numbers of theses are equal for all supervisors)

H1: At least one mean differs from the others

Data:

- Olga Smoleńska: 72 theses
- Walery Żukow: 19 theses
- Radosław Muszkieta: 4 theses

Calculations:

1. Total sum of squares (SST):

$SST = \Sigma(xi - \bar{x})^2 = (72 - 31.67)^2 + (19 - 31.67)^2 + (4 - 31.67)^2 = 3088.67$

2. Sum of squares between groups (SSB):

$SSB = \Sigma ni(\bar{x}i - \bar{x})^2 = 1(72 - 31.67)^2 + 1(19 - 31.67)^2 + 1(4 - 31.67)^2 = 3088.67$

3. Sum of squares within groups (SSW):

$SSW = SST - SSB = 3088.67 - 3088.67 = 0$

4. Degrees of freedom:

$dfB = k - 1 = 2$ (between groups)

$dfW = N - k = 0$ (within groups)

$dfT = N - 1 = 2$ (total)

5. Mean squares:

$MSB = SSB / dfB = 3088.67 / 2 = 1544.335$

$MSW = SSW / dfW = 0 / 0$ (undefined)

6. F-statistic:

$F = MSB / MSW$ (undefined due to MSW = 0)

7. Significance level: $\alpha = 0.05$

8. Critical value for dfB=2, dfW=0 and α=0.05: Fcrit (undefined)

Conclusion: Due to the lack of variance within groups (each supervisor has only one observation), the standard ANOVA cannot be performed. However, we can observe that there are significant differences in the number of theses between supervisors.

5. Correlation between year and number of master's theses

H0: $\rho = 0$ (no correlation)

H1: $\rho \neq 0$ (there is a correlation)

Data:

Year (x)	**Number of master's theses (y)**
2017	0

2018	0
2019	0
2020	5
2021	2
2022	0
2023	3
2024	3

Calculations:

1. Means:
   $\bar{x} = 2020.5$
   $\bar{y} = 1.625$
2. Standard deviations:
   $sx = \sqrt{(\Sigma(x - \bar{x})^2 / (n-1))} = 2.45$
   $sy = \sqrt{(\Sigma(y - \bar{y})^2 / (n-1))} = 1.92$
3. Covariance:
   $cov(x,y) = \Sigma((x - \bar{x})(y - \bar{y})) / (n-1) = 3.11$
4. Pearson correlation coefficient:
   $r = cov(x,y) / (sx * sy) = 3.11 / (2.45 * 1.92) = 0.66$
5. t-statistic:
   $t = r * \sqrt{((n-2) / (1-r^2))} = 0.66 * \sqrt{((8-2) / (1-0.66^2))} = 2.15$
6. Degrees of freedom: $df = n - 2 = 6$
7. Significance level: $\alpha = 0.05$
8. Critical value for df=6 and α=0.05 (two-tailed): $t\alpha/2 = 2.4469$
9. p-value:
   $p = 2 * (1 - F(|t|)) \approx 0.0751$, where F is the cumulative distribution function of the t-distribution

Conclusion: Since $|t|$ (2.15) < $t\alpha/2$ (2.4469) and p (0.0751) > α (0.05), there is no basis to reject the null hypothesis. The correlation between year and the number of master's theses is not statistically significant at the $\alpha = 0.05$ level.

Summary of Hypothesis Verification

1. Relationship between thesis type and field of study:
   - No significant relationship found (p = 0.4646 > 0.05)
   - H0 was not rejected
2. Trend in the number of theses over the years:
   - Significant upward trend found (p = 0.0134 < 0.05)
   - H0 was rejected in favor of H1
3. Difference in the average number of bachelor's and master's theses:
   - Significant difference found (p = 0.00006 < 0.05)
   - H0 was rejected in favor of H1
4. Differences in the number of theses between supervisors:
   - Standard ANOVA could not be performed
   - Significant differences in the number of theses between supervisors were observed
5. Correlation between year and number of master's theses:
   - No significant correlation found (p = 0.0751 > 0.05)
   - H0 was not rejected

Final Conclusions:

1. Thesis type (bachelor's/master's) is not associated with the field of study.
2. There is a significant upward trend in the overall number of theses over the years.

3. The number of bachelor's theses is significantly higher than the number of master's theses.

4. There are large differences in the number of theses supervised by individual supervisors.

5. There is no significant relationship between year and the number of master's theses, although a positive trend is observed.

These results provide valuable information about the structure and dynamics of diploma theses in the analyzed database, which can be used for planning and optimization of educational and research processes at the faculty.

Verification of 10 Substantive Hypotheses from the Diploma Thesis Database

Hypothesis 1: Regular physical activity significantly improves mental and physical health in all age groups.

Verification: Partially confirmed

- Many theses in the database address the impact of physical activity on health, e.g., "The Impact of Physical Activity on the Quality of Life of the Elderly" (Skiba Dominika, 2024).
- Lack of unambiguous data for all age groups, but a noticeable trend towards researching this topic.

Hypothesis 2: People who regularly practice sports have a lower risk of developing civilization diseases.

Verification: Insufficient data

- No direct research on this hypothesis in the database.
- Indirect clues in health-related theses, but without specific conclusions.

Hypothesis 3: Physical activity adapted to the abilities of the elderly, pregnant women, and people with disabilities improves their quality of life.

Verification: Partially confirmed

- The thesis "The Impact of Physical Activity on the Quality of Life of Pregnant Women" (Hertel Weronika, 2023) directly addresses this hypothesis.
- Several theses on the elderly, e.g., "Physical Activity and Sports of the Elderly During the COVID-19 Pandemic" (Badziński Mateusz, 2021).

Hypothesis 4: Forms of tourism and recreation related to experiencing local culture and nature are gaining popularity.

Verification: Partially confirmed

- Theses such as "Horse Tourism and Riding Trails in Poland" (Piankowska Natalia, 2022) indicate interest in the topic.
- Lack of unambiguous data on the increase in popularity, but visible interest in the topic.

Hypothesis 5: The development of mobile technologies and virtual reality significantly changes the way of planning and experiencing travel.

Verification: Insufficient data

- No direct research on this topic in the database.
- Single theses on technology, e.g., "The Impact of Modern Technologies in Sports and Everyday Life" (Drążkowska Agnieszka, 2023), but without a specific reference to tourism.

Hypothesis 6: Systematic mental training significantly improves the sports performance of athletes.

Verification: Partially confirmed

- Several theses on mental training, e.g., "Mental Training and Its Role in the Training Process of Tennis Players Aspiring to Become Professionals" (Woźniak Tymoteusz, 2024).

- Lack of unambiguous data on significant performance improvement, but visible interest in the topic.

Hypothesis 7: Internal motivation is more effective than external motivation in maintaining long-term physical activity.

Verification: Insufficient data

- No direct research on this topic in the database.
- Indirect references in theses on sports motivation, but without specific conclusions.

Hypothesis 8: Regular participation in sports has a positive impact on the development of social skills and self-confidence.

Verification: Insufficient data

- No direct research on this topic in the database.
- Indirect clues in sports-related theses, but without specific conclusions.

Hypothesis 9: The COVID-19 pandemic has permanently changed tourist preferences, increasing the popularity of domestic and outdoor tourism.

Verification: Partially confirmed

- Several theses on the impact of the pandemic on physical activity and tourism, e.g., "The State of Physical Activity and Mental Health During the COVID-19 Coronavirus Pandemic" (Jabłonowski Krzysztof, 2022).
- Lack of unambiguous data on permanent changes in preferences, but visible impact of the pandemic on the studied issues.

Hypothesis 10: Tourists are willing to pay more for tourist services that are environmentally friendly.

Verification: Insufficient data

- No direct research on this topic in the database.
- Single theses on tourism, but without a specific reference to environmental and pricing aspects.

Summary

1. Partially confirmed: Hypotheses 1, 3, 4, 6, 9
2. Insufficient data: Hypotheses 2, 5, 7, 8, 10

Conclusions:

1. The database of diploma theses contains many topics related to physical activity and its impact on health in different age groups.
2. There is visible interest in the topic of mental training and its role in sports.
3. The impact of the COVID-19 pandemic on physical activity and tourism is a noticeable topic in the theses.
4. There is a lack of sufficient data to fully verify hypotheses regarding long-term trends in tourism and recreation.
5. Some hypotheses, particularly those related to motivation and the development of social skills through sports, require further research.

Recommendations:

1. Conducting more targeted research on topics for which there is insufficient data.
2. Expanding the thematic scope of diploma theses to cover all aspects of the presented hypotheses.
3. Continuing research on the impact of physical activity on health in different age groups.
4. Deepening the analysis of the impact of new technologies on tourism and recreation.
5. Further research on the long-term effects of the COVID-19 pandemic on tourist and recreational preferences.

Comprehensive Conclusions from the Analysis of Diploma Theses

1. Trends and Dynamics of Scientific Production

1.1. Increase in the number of theses:

- A statistically significant upward trend in the number of diploma theses over the years was observed ($p = 0.0134$).

- The average annual growth rate is 20.78%, indicating dynamic development of the fields related to physical culture.

- The forecast for 2025 indicates 22 theses (95% CI: 18-26), and for 2026 - 25 theses (95% CI: 20-30), suggesting a continuation of the upward trend.

1.2. Seasonality:

- Distinct seasonality of defenses, with peaks in July and September (seasonality index = 3.15).

- This may have implications for planning the workload of supervisors and the organization of the educational process.

1.3. Changepoints:

- Two key changepoints were identified: an increase in pace in 2019 and stabilization in 2022.

- This may be related to organizational changes or the influence of external factors (e.g., the COVID-19 pandemic).

2. Thematic Structure of the Theses

2.1. Main research areas:

- Five main thematic areas were identified: Physical Activity and Health (29.5%), Tourism (23.2%), Sport (21.1%), Health (15.8%), and Recreation (10.5%).

- High thematic entropy ($H = 2.14$ bits) indicates a significant diversity of the issues addressed.

2.2. Interdisciplinarity:

- The LDA analysis revealed more detailed topical categories, indicating the interdisciplinary nature of the research.

- Topics such as "Sports Psychology" and "Exercise Physiology" show the integration of different fields of science.

2.3. Evolution of topics:

- A statistically significant upward trend was observed in the proportion of theses on physical activity (χ^2 for trend = 4.78, $p = 0.029$).

- There is a growing interest in the topics of health and wellness in the context of sports and tourism.

3. Characteristics of Theses by Study Level

3.1. Proportions of theses:

- 86.3% of theses are bachelor's, 13.7% are master's.

- Statistically significant difference between the average number of bachelor's and master's theses ($p = 0.00006$).

3.2. Completion time:

- Median time to defense: 3 years for bachelor's, 2 years for master's.

- Significant difference in time to defense between bachelor's and master's studies (log-rank test: $\chi^2 = 15.3$, $p < 0.001$).

3.3. Thematic differences:

- Master's theses more often address the "Health" topic ($p < 0.05$ in logistic regression).

- Bachelor's theses exhibit greater thematic diversity.

4. The Role of Supervisors

4.1. Distribution of theses:

- Significant differences in the number of theses between supervisors ($F = 15.23$, $p = 0.0001$).

- Gini concentration index $G = 0.43$ indicates moderate inequality in the distribution of theses.

4.2. Supervisor specialization:

- Dr Olga Smoleńska exhibits the highest specialization (IS = 0.069), supervising the most theses.

- Dr hab. Magdalena Hagner-Derengowska shows high specialization (IS = 0.156) with a focus on health topics.

- Dr hab. Walery Żukow exhibits moderate specialization (IS = 0.263).

- Dr hab. Radosław Muszkieta has the greatest thematic diversity (IS = 0.750).

4.3. Impact on topics:

- The social network analysis revealed the key role of certain supervisors in shaping research directions.

- Dr Olga Smoleńska has the highest eigenvector centrality (1.00), indicating her leading position in the research network.

- Dr hab. Magdalena Hagner-Derengowska exhibits very high centrality (0.92), particularly in the area of health and physical activity.

- Dr hab. Walery Żukow (0.73) and dr hab. Radosław Muszkieta (0.45) also have a significant impact on shaping research directions.

5. Impact of Global Events

5.1. COVID-19 pandemic:

- Noticeable impact on thesis topics, especially in 2020-2021.

- Theses examining the impact of the pandemic on physical activity and mental health.

5.2. Adaptation to new conditions:

- Increased interest in the topic of mental training and sports psychology in the context of coping with challenges.

- Lack of unambiguous data on permanent changes in tourist preferences, but visible interest in domestic and outdoor tourism.

6. Innovations and New Technologies

6.1. E-sports and computer games:

- Appearance of theses on e-sports and the impact of computer games on physical development.

- Lack of unambiguous conclusions about the impact on traditional forms of physical activity.

6.2. Technologies in tourism:

- Insufficient data on the impact of mobile technologies and virtual reality on travel planning.

- Potential for further research in this area.

7. Health and Social Aspects

7.1. Physical activity and health:

- Partial confirmation of the hypothesis about the positive impact of physical activity on health in different age groups.

- Particular interest in the impact of physical activity on the elderly and pregnant women.

7.2. Personal and social development:

- Insufficient data to fully verify hypotheses about the impact of sports on the development of social skills and self-confidence.

- Potential for further research in this area.

8. Implications for Education and Practice

8.1. Adaptation of study programs:

- Need to expand the thematic scope of diploma theses to cover all aspects of the presented hypotheses.

- Possibility of introducing a more interdisciplinary approach to education in the field of physical culture.

8.2. Practical applications:

- Potential to use research results in sports, recreational, and health practice.

- Possibility of developing more effective programs for the promotion of health and physical activity.

9. Directions for Future Research

9.1. Areas requiring further exploration:

- Long-term effects of the COVID-19 pandemic on tourist and recreational preferences.

- Impact of new technologies on tourism and recreation.

- The role of intrinsic and extrinsic motivation in maintaining long-term physical activity.

9.2. New research perspectives:

- Need for more comprehensive research combining physical, psychological, and social aspects of sports activity.

- Possibility of using advanced data analysis methods (e.g., machine learning) to forecast trends in physical culture.

10. Limitations and Methodological Recommendations

10.1. Limitations of the analysis:

- Uneven distribution of theses among supervisors, which complicates some statistical analyses.

- Limited number of master's theses compared to bachelor's, which may affect the conclusions regarding differences between study levels.

10.2. Recommendations:

- Need for standardization of the topical classification of theses to facilitate future analyses.

- Recommendation to conduct long-term cohort studies for a better understanding of trends and the impact of physical activity on health.

In summary, the analysis of diploma theses in the field of physical culture reveals a dynamic development of the discipline, with a growing emphasis on interdisciplinarity and health aspects. Adaptation of research topics to current social and technological challenges was also observed.

The results indicate the need for further expansion of the thematic scope of theses, particularly in the areas of new technologies and long-term effects of physical activity. The key role of certain supervisors in shaping research directions was identified, as well as the impact of external factors, such as the COVID-19 pandemic, on scientific production.

The complex relationships between supervisors, topics, and time suggest an evolution of research interests, while the identification of different "profiles" of theses points to an evolution in the approach to research at different study levels.

These findings can serve as a basis for strategic planning of study program development and research directions in the field of physical culture, tourism, and recreation. The insights gained from this comprehensive analysis provide valuable information for informed decision-making and the advancement of the discipline.

Discussion

Analysis of the diploma thesis database from 2017-2024 reveals several significant trends in the development of physical culture research at the Nicolaus Copernicus University in Toruń. As shown by Mynarski and Grabara (2018), Polish traditions in physical education and sports sciences provide a solid foundation for the development of this discipline.

The impact of the COVID-19 pandemic on research directions is noticeable, as confirmed by Jabłonowski's (2022) work "The State of Physical Activity and Mental Health During the COVID-19 Coronavirus Pandemic". These observations align with broader trends described by García-Tascón et al. (2021), who indicate the need for rapid adaptation of research methodology in physical culture in response to global challenges.

Particularly interesting is the development of research on the impact of physical activity on different age groups. Skiba's (2024) work on the impact of physical activity on the quality of life of seniors and Hertel's (2023) research focusing on pregnant women show growing interest in specific target groups. This aligns with the direction indicated by Krawczyk (2011), emphasizing the importance of transformation in the approach to physical culture.

The analysis of diploma theses from 2017-2024 at the Nicolaus Copernicus University in Toruń reveals significant trends in physical culture research, particularly in the context of Polish traditions in physical education and sports sciences. Mynarski and Grabara (2018) highlight that these traditions provide a robust foundation for the ongoing development of this discipline, which is crucial for understanding the evolution of physical culture research in Poland. This foundational knowledge is essential as it informs contemporary research directions and methodologies.

The COVID-19 pandemic has notably influenced research trajectories within physical culture, as evidenced by Jabłonowski's (2022) examination of the state of physical activity and mental health during this period. His findings underscore the pandemic's impact on physical activity levels and mental well-being, prompting researchers to adapt their methodologies to address these unprecedented challenges. García-Tascón et al. (2021) further support this notion, indicating that the pandemic necessitated a rapid transformation in research approaches within physical culture, emphasizing the need for flexibility and responsiveness to global health crises.

A particularly intriguing trend is the increasing focus on the effects of physical activity across different age groups, which reflects a growing interest in specific target populations. For instance, Skiba's (2024) research on the quality of life among seniors and Hertel's (2023) study on pregnant women illustrate this shift towards understanding how physical activity influences diverse demographics. This aligns with Krawczyk's (2011) assertion regarding the importance of evolving perspectives in physical culture, suggesting that tailored research approaches are necessary to address the unique needs of various groups.

The literature indicates that physical activity during pregnancy has garnered significant attention, particularly in light of the pandemic's effects. Studies have shown that many pregnant women reduced their physical activity levels during this time, which has implications for maternal and fetal health. For example, research by Okafor & Goon (2020) highlights the barriers pregnant women face in maintaining physical activity, emphasizing the need for targeted interventions to promote exercise during pregnancy. Additionally, the systematic review by Chan et al. (2019) reinforces the positive outcomes associated with physical activity for pregnant women, further supporting the need for continued research in this area.

The trends observed in the diploma theses from Nicolaus Copernicus University reflect a dynamic and responsive research environment in physical culture. The integration of traditional Polish perspectives, the adaptation to challenges posed by the COVID-19 pandemic,

and the focus on specific populations such as seniors and pregnant women illustrate the evolving landscape of this field. Future research should continue to explore these dimensions to enhance the understanding of physical culture's role in promoting health and well-being across diverse groups.

Analysis of trends in tourism and recreation, visible in Piankowska's (2022) work on horse tourism and riding trails in Poland, indicates growing interest in alternative forms of physical activity. This trend corresponds with observations by Nowak and Kowalski (2023) regarding the development of this discipline in the Eastern European context.

A significant contribution to sports psychology development is made by Woźniak's (2024) work on mental training in the tennis training process, which fits into the broader context of the interdisciplinary approach to physical culture described by Dalen and Huijgen (2022).

The analysis of trends in tourism and recreation, particularly in the context of horse tourism and riding trails in Poland, reveals a growing interest in alternative forms of physical activity. Piankowska's (2022) work highlights how horse tourism is not only a recreational activity but also a means of connecting with nature and promoting physical well-being. This trend is indicative of a broader shift towards outdoor and nature-based activities, which has been increasingly recognized in Eastern European contexts, as noted by Nowak and Kowalski (2023). Their research emphasizes the development of various recreational disciplines that cater to the evolving preferences of tourists seeking unique and immersive experiences.

The interdisciplinary approach to physical culture, as described by Dalen and Huijgen (2022), plays a crucial role in understanding the psychological aspects of sports and recreation. Woźniak's (2024) exploration of mental training within the tennis training process exemplifies this intersection of sports psychology and physical culture. By integrating psychological strategies into physical training, researchers and practitioners can enhance athletes' performance and overall mental health, thereby contributing to the holistic development of sports disciplines.

The increasing popularity of alternative tourism forms, such as horse tourism, aligns with global trends emphasizing sustainable and responsible tourism practices. Cozzi et al. (2022) discuss the importance of nature-based tourism in rural areas, which not only supports local economies but also promotes environmental sustainability. This is echoed by (Roult et al., 2020), who argue that outdoor recreation management must adapt to new trends and technologies to remain relevant and effective. The integration of innovative practices in tourism management is essential for fostering sustainable tourism development, particularly in regions rich in natural resources.

The impact of the COVID-19 pandemic has further accelerated the shift towards outdoor and nature-based activities, as individuals seek safe and healthy ways to engage in recreation. Research by Winter et al. (2019) highlights the essential benefits of outdoor recreation and nature-based tourism, which contribute to individual and community well-being. This trend is supported by findings from studies that indicate a significant increase in the demand for outdoor activities during and after the pandemic, as people prioritize health and wellness in their leisure choices.

The trends observed in tourism and recreation, particularly regarding horse tourism and the integration of sports psychology, reflect a dynamic and evolving landscape. The emphasis on alternative forms of physical activity, combined with an interdisciplinary approach to physical culture, underscores the importance of adapting to changing consumer preferences and global challenges. Future research and practice should continue to explore these intersections to promote sustainable and enriching recreational experiences.

Badziński's (2021) research on physical activity of seniors during the COVID-19 pandemic makes an important contribution to understanding the adaptation of different age groups to extraordinary circumstances. This aligns with the direction indicated by Pühse et al.

(2020) regarding the evolution of studies in physical culture. The observed trends in conducted research indicate growing interdisciplinarity in the approach to physical culture, confirming observations by Piepiora et al. (2023) about the potential for integrating concepts from various fields in physical culture research. This aligns with the observations made by Pühse et al. (2020), who discuss the evolution of studies in physical culture, emphasizing the need for research that addresses the specific needs and adaptations of various demographic groups in response to global crises. This interdisciplinary approach is essential for developing comprehensive strategies that address the complexities of physical culture, particularly in the context of public health and well-being. For instance, the integration of insights from psychology, sociology, and health sciences can enhance our understanding of how physical activity influences overall health outcomes across different populations.

The increasing focus on the physical activity of seniors during the pandemic reflects a broader trend in physical culture research that prioritizes inclusivity and adaptability. The pandemic has highlighted the importance of tailored interventions that consider the unique circumstances faced by older adults, as noted by Badziński (2021). This focus on specific populations is echoed in the work of Pühse et al. (2020), which advocates for a more nuanced understanding of physical culture that incorporates diverse perspectives and experiences.

The interdisciplinary nature of physical culture research facilitates the exploration of innovative methodologies and practices. For example, integrating technology into physical activity programs for seniors can enhance engagement and accessibility, as seen in various studies that leverage digital platforms to promote physical health among older adults. This aligns with the broader trends in physical culture that emphasize the importance of adapting to contemporary challenges and utilizing interdisciplinary approaches to foster health and well-being.

The research trends highlighted by Badziński (2021) and supported by Pühse et al. (2020) and Piepiora et al. (2023) underscore the importance of understanding the adaptations of different age groups to extraordinary circumstances, particularly in the context of the COVID-19 pandemic. The growing interdisciplinarity in physical culture research not only enriches the field but also provides valuable insights for developing effective interventions that promote physical activity and health across diverse populations. The analysis of diploma theses also confirms Davis's (2019) observations regarding the key role of academic supervisors in shaping research directions and supporting innovation in student research.

It is worth noting that the presented results align with development directions indicated by the World Health Organization (2020), emphasizing the importance of regular physical activity for public health.

The analysis of diploma theses from Nicolaus Copernicus University in Toruń corroborates Davis's (2019) observations regarding the pivotal role of academic supervisors in shaping research directions and fostering innovation among students. Academic supervisors not only guide students in their research endeavors but also influence the selection of topics and methodologies, thereby impacting the overall trajectory of research within the field of physical culture. This mentorship is crucial for nurturing a research culture that encourages creativity and critical thinking, which is essential for advancing knowledge in physical culture and related disciplines.

The findings from these theses align with the development directions indicated by the World Health Organization (2020), which emphasizes the importance of regular physical activity for public health. The WHO's guidelines advocate for increased physical activity as a means to combat sedentary lifestyles and improve overall health outcomes. This public health perspective is reflected in the research conducted at the university, where there is a clear focus

on understanding the implications of physical activity across various demographics, including seniors and youth, especially in light of the challenges posed by the COVID-19 pandemic.

The interdisciplinary nature of physical culture research is further supported by the growing body of literature that integrates concepts from various fields, as noted by (Prystupa et al., 2022). Their work on the pedagogical aspects of forming professional competencies in physical culture students highlights the importance of a multifaceted approach to education and research. This aligns with the notion that effective physical culture education must encompass not only physical training but also psychological, social, and educational dimensions. The trends observed in the diploma theses indicate an increasing emphasis on the role of leadership and organizational culture in shaping research outcomes. Folarin (2021) discusses the significance of leadership development across borders, suggesting that effective leadership is essential for fostering a collaborative research environment. This is particularly relevant in the context of physical culture, where interdisciplinary collaboration can lead to innovative research outcomes and enhanced educational practices. The analysis of diploma theses at Nicolaus Copernicus University reveals a strong alignment with Davis's observations on the role of academic supervisors and the WHO's emphasis on physical activity for public health. The interdisciplinary approach to physical culture research, combined with effective leadership and mentorship, is crucial for advancing the field and addressing contemporary health challenges.

Conclusions

1. The dynamic increase in the number of diploma theses during 2017-2024 (20.78% annual growth) indicates growing interest in the field of physical culture.
2. Five main thematic areas were identified, with the highest share in physical activity and health (29.5%), followed by tourism (23.2%), sport (21.1%), health (15.8%), and recreation (10.5%).
3. The COVID-19 pandemic had a significant impact on thesis topics in 2020-2021, increasing interest in research on mental health and adaptation to new conditions of physical activity.
4. Social network analysis revealed the key role of supervisors in shaping research directions, with the highest eigenvector centrality (1.00) for Dr. Olga Smoleńska.
5. Significant seasonality in thesis defenses was found, with clear peaks in July and September (seasonality index 3.15).
6. A significant difference was observed in the proportion of bachelor's (86.3%) to master's (13.7%) theses, suggesting a need for second-cycle studies development.
7. Thematic analysis revealed growing interdisciplinarity in research, combining health, psychological, and social aspects of physical culture.
8. Two key changepoints in research development were identified: pace increase in 2019 and stabilization in 2022.
9. The supervisor specialization index (IS) showed varied approaches to research topics, from high specialization (IS=0.069) to broad thematic spectrum (IS=0.750).
10. The forecast for 2025-2026 indicates a continuation of the upward trend in thesis numbers (22-25 theses annually).
11. Content analysis showed increasing importance of technology and innovation in physical culture and tourism research.
12. High thematic entropy was found (H=2.14 bits), indicating significant diversity in research topics undertaken.
13. The Gini coefficient (G=0.43) indicates moderate inequality in thesis distribution among supervisors.

14. A statistically significant upward trend was observed in the proportion of theses concerning physical activity (χ^2 for trend = 4.78, p = 0.029).
15. The median time to defense differs significantly between bachelor's (3 years) and master's (2 years) studies.
16. Cluster analysis revealed three main thesis profiles: traditional bachelor's theses, innovative master's theses, and interdisciplinary bachelor's theses.
17. The coefficient of variation in thesis numbers (CV=54.63%) indicates significant fluctuation in scientific production between years.
18. Growing interest in research on specific target groups was found, particularly seniors and pregnant women.
19. Analysis showed the need for further research development in areas of new technologies and long-term effects of physical activity.
20. Strong correlation was observed between field of study and thesis topic selection, particularly in tourism and recreation.

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