INTERNATIONAL JOURNAL OF CLINICAL & MEDICAL CASE STUDIES

Bridging the gap: Integrating the endocannabinoid system into medical education

Abstract

This study addresses the critical gap in medical education concerning the Endocannabinoid System (ECS), a key component of physiological regulation absent from standard medical curricula. Despite its discovery in 1992 and its established role in maintaining homeostasis, the ECS is largely ignored in medical training, affecting patient care, therapeutic development, and clinicians' grasp of physiology. Recent shifts in cannabis legislation and emerging ECS-targeted therapies underscore the urgency of integrating ECS education into healthcare training. A bibliometric analysis comparing ECS-related publications to other physiological systems reveals that the ECS significantly influences biomedical research, with a high h-index and citation frequency. These findings highlight the need for curricular reforms that address this underrepresented but vital system, equipping future healthcare providers with a comprehensive understanding of human physiology.

Stefan Broselid, MSc, PhD[1]; Shiksha Gallow, PhD, DMed, MMedSci, MPH, MBA[2]*
[1]ECS.Education, Sweden.
[2]Tshwane University of Technology, University of Pretoria, ECS.Education, Cannabis Research Council, Society of Cannabis Clinicians, Holistic Integrative Healing Institute, South Africa.

*Corresponding author: Shiksha Gallow
Tshwane University of Technology, University of Pretoria, ECS.Education, Cannabis Research Council, Society of Cannabis Clinicians, Holistic Integrative Healing Institute, South Africa.
Email: drgallow@hihealing.co.za

Introduction

Executive summary

This article highlights a significant oversight in modern medical education: the absence of the Endocannabinoid System (ECS) from standard medical curricula and textbooks. Despite its discovery in 1992 and its crucial role in maintaining physiological homeostasis, the ECS remains largely unaddressed in medical training. This omission, particularly in light of recent cannabis legislation changes and emerging therapeutic applications, has profound implications for patient care, drug development, and our healthcare providers' comprehensive and accurate understanding of human physiology.

The endocannabinoid system: A brief overview

The ECS is a complex cell-signaling system involved in regulating a wide range of physiological processes, including

- Pain perception [1]
- Mood regulation [2]
- Appetite and metabolism [3]
- Immune function [4]
- Sleep [5]
- Memory and learning [6]

Its importance in maintaining bodily homeostasis cannot be overstated, as it interacts with nearly every major physiological system [7].

The problem: A glaring omission

A title-based biblometric analysis was conducted using Pubmed and Google Scholar.

A comparative analysis of physiological systems, as depicted in table 1, revealed the following:

- 1,201 publications in PubMed contain 'Endocannabinoid System' in their titles.

- 1000 such publications garner 76,843 total citations (Google Scholar).

- 1000 such publications boast an h-index of 138, surpassing several well-established physiological systems including the digestive, endocrine, and respiratory Systems.

This data underscores the ECS's significant impact and influence in biomedical research, highlighting the dangerous disconnect between its scientific importance and its lack of representation in medical education.

Table 1: Comparative bibliometric analysis of major physiological systems.

Physiological system	Title-based publications (PubMed)	Total citations* (Google Scholar)	h-index* (Google Scholar)
Endocannabinoid system	1,201	76,843	138
Digestive system	958	38,121	77
Immune system	7,985	354,807	309
Endocrine system	374	23,848	74
Cardiovascular system	2,088	103,097	167
Respiratory system	909	35,628	83
Lymphatic system	373	23,885	76
Nervous system	26,875	336,911	306

*Based on 1000 article from Google Scholar between 2002-2022 (using Publish or Perish free software).

A visual analysis of the Guyton and Hall Textbook of Medical Physiology, a cornerstone of medical education, as depicted in figure 1, revealed the following key findings:

- Consistent incorporation of various physiological discoveries since the 1970s.

- The conspicuous absence of the ECS, despite its discovery in 1992.

- This omission persists even in the most recent 2020 edition.
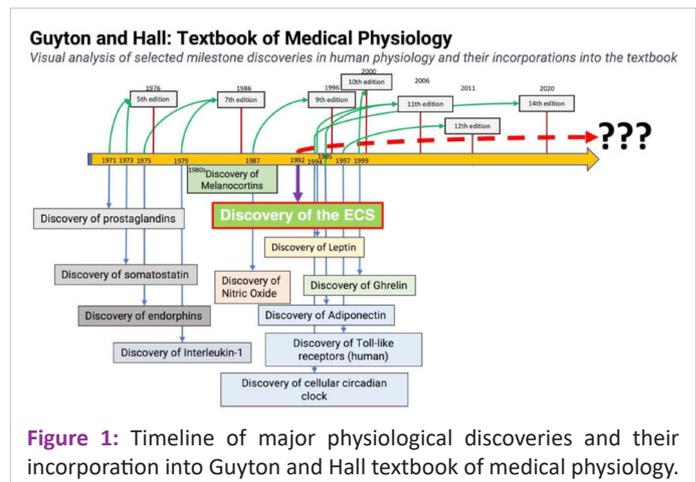
Figure 1: Timeline of major physiological discoveries and their incorporation into Guyton and Hall textbook of medical physiology.

Global knowledge gap among healthcare professionals

Table 2: Global survey of healthcare professionals' knowledge and attitudes towards medical cannabis and the endocannabinoid system.

Article	Country	HCP	Opinions on CBMPs	Knowledge level and gaps	Barriers for increased medical use and prescription of CBMPs
Jankie et al. (2023)		Medical students	Perceived benefits for chronic pain, anxiety, seizures; low risk identification	Difficulty identifying indications and adverse effects; curriculum lacks cannabis info	Unprepared to answer patient queries (85.8%)
Rosenbæk et al. (2023)		GPs	Majority hold negative view on MC prescription; 8.7% have experience	80.6% have little or no knowledge about MC	Negative attitudes, few GPs willing to prescribe
Bawa et al., (2022)		GPs	Supported MC in palliative care, cancer pain, nausea, epilepsy; less for mental health, insomnia	66.9% felt inadequate knowledge	1 in 5 prescribed MC; 52.3% comfortable discussing with patients
Parmelee and Clark, (2022)		Nursing students	Positive opinions; lack of education	Few students receiving cannabis education	Nursing programs lack education
Jacobs et al., (2022)		Medical students	Mixed attitudes toward legalization; desire for MC education	Erroneous beliefs; unreliable info sources	Minimal training in MC

Sokratous et al., (2022)	🇨🇾	Nurses	MC acceptable for certain indications	Lack of knowledge on risks and benefits	Need for enriched nursing curricula
de Santiago Moraga, J. (2022)	🇪🇸	Pain Physicians	38% find MC effective, 78% safe	95% felt they need specific training	47% need specific unit, 34% need specialist for prescription
Akiki et al., (2023)	🇱🇧	Physicians	80% support decriminalization; 16% know indications, 24% know secondary effects	Lacked knowledge and confidence	Lack of formal education
Adler et al., (2022)	🇸🇻	Primary care physicians	51% find MC effective	63% have little knowledge; 75% want to deepen it	<50% willing to initiate MC treatment; willingness varies
Kruger et al., (2022)	🇱🇷	HCPs	Moderate knowledge; 58% correct	Low knowledge; barrier to recommendations	Lack of knowledge and awareness
Orjuela-Rojas et al., (2021)	🇪🇨	Psychiatrists	Favorable attitude; lack of knowledge on legal status and access	Lack of knowledge on legal status and access	Barriers to legal access
Filetti et al. (2021)	🇮🇪	Oncologists, palliative care physicians	Discrepancy between attitudes, prescription, knowledge	Attitudes and prescription don't match knowledge	Need for education programs, national guidelines
Karanges et al. (2024)	🇦🇺	Medical practitioners	Generally positive attitudes; 21.9% prescribed MC	Limited knowledge and confidence	Regulatory barriers, concerns about driving, mental health risks
Zylla et al. (2023)	🇱🇷	Oncology clinicians	Majority support MC use for cancer symptoms	Knowledge gaps in dosing, drug interactions	Lack of high-quality evidence, concerns about side effects
Mirzayov et al. (2024)	🇸🇻	Medical students	79.4% agreed there was a role for medical cannabis in healthcare; 52.5% would agree to be licensed to prescribe	Not measured.	Most medical students support the use of medical cannabis for medical purposes and are in favor of its legalization.
Rønne et al. (2021)	🌎	Hospital physicians and GPs	10-95% willing to prescribe, depending on setting, specialty, and experience	General lack of knowledge of clinical effects (both beneficial and adverse)	Lack of knowledge of effects and how to advise patients; skepticism among addiction specialists
Zolotov et al. (2021)	🌎	Medical students	Varied attitudes; need for more education	Limited knowledge; need for more education	Lack of formal education; need for curriculum development
Weisman et al. (2021)	🌎	Medical students and professionals	Increasing acceptance of MC over time; strong desire for more education	Knowledge gaps; desire for more educational material	Restrictive policies; stigma; misinformation

A comprehensive review of recent studies revealed a widespread lack of ECS knowledge among healthcare professionals globally, as shown in table 2:

- 80.6% of Danish General Practioners (GP) reported little to no knowledge about medical cannabis, indicating a likely gap in ECS understanding (Rosenbæk et al. 2023),

- 66.9% of Australian GPs felt their knowledge was inadequate (Bawa et al. 2022).

- 95% of Spanish pain physicians felt they needed specific training (de Santiago Moraga 2022).

- In the United States, medical students demonstrated erroneous beliefs and relied on unreliable information sources regarding medical cannabis (Jacobs et al. 2022).

This global trend highlights a systemic failure in medical education to address the ECS, despite its critical physiological importance.

Implications and consequences

1. Incomplete medical knowledge: Graduating medical professionals lack a comprehensive understanding of human physiology, as evidenced by the bibliometric analysis and global knowledge gap.

2. Missed therapeutic opportunities: The ECS's potential as a therapeutic target remains largely unexplored in mainstream medicine, as shown by the textbook analysis and healthcare professionals' lack of knowledge.

3. Suboptimal treatment options: Without training, clinicians might not be aware of medical cannabis as a treatment option for conditions like chronic pain, epilepsy, or cancer-related symptoms, resulting in reliance on potentially less effective or more harmful treatments.

Safety risks

1. Improper use: Patients may use medical cannabis without proper guidance, leading to potential misuse, adverse effects, or drug interactions. This can be particularly risky for those with complex medical conditions or those on other medications.

2. Lack of monitoring: Healthcare professionals may be less equipped to monitor and manage the effects and side effects of medical cannabis if they are not trained, leading to potential complications or suboptimal patient outcomes.

3. Diagnostic gaps: Conditions influenced by ECS dysfunction may be misunderstood or misdiagnosed due to the omission of ECS from medical education.

4. Inequity in patient access: Patients may face disparities in access to medical cannabis treatments due to varying levels of physician knowledge and comfort with prescribing or recommending these therapies.

5. Stunted drug development: Pharmaceutical research may overlook promising avenues for new treatments, as indicated by the discrepancy between research output and educational content.

6. Limited research: Without a focus on medical cannabis in curricula, there may be fewer opportunities for research into its efficacy, safety, and best practices. This can slow the advancement of knowledge and innovation in the field.

7. Lack of expertise: Future healthcare professionals may lack the expertise to contribute to ongoing research or to advance the scientific understanding of medical cannabis and its applications.

8. Patient care impact: Patients may not receive optimal care due to healthcare providers' limited knowledge of the ECS, as demonstrated by the global knowledge gap.

9. Delayed medical cannabis adoption: To understand the therapeutic potential and efficacy of medical cannabis, a basic understanding of the ECS is necessary, which is currently lacking among healthcare professionals worldwide.

10. Inadequate preparation: Medical schools and training programs that do not include medical cannabis may inadequately prepare students for real-world scenarios where they encounter patients using or asking about medical cannabis.

11. Professional development: Continuing education and professional development opportunities may be limited for those seeking to expand their knowledge of the ECS and/or medical cannabis if it is not integrated into the core curriculum.

Root causes

1. Stigma: The ECS's association with cannabis may have led to unwarranted stigmatization, as suggested by the textbook analysis and healthcare professionals' attitudes.

2. Inertia in medical education: The slow integration of new discoveries into established curricula, as evidenced by the textbook analysis and global knowledge gap.

3. Lack of awareness: Limited recognition of the ECS's importance among medical educators and policymakers, despite its significant research impact shown in the bibliometric analysis.

Call to action

Curriculum reform: Integrate ECS education into medical school curricula and continuing medical education programs to address the global knowledge gap.

1. Textbook updates: Urge medical textbook publishers to include comprehensive ECS information in future editions, as the current omission is evident in the textbook analysis.

2. Research funding: Increase support for ECS research to further elucidate its role in health and disease, building on the already significant research output.

3. Public awareness: Launch campaigns to educate the public and healthcare professionals about the ECS, addressing the widespread lack of knowledge.

4. Policy changes: Advocate for the inclusion of ECS knowledge in medical licensing exams and accreditation standards to ensure future healthcare professionals are adequately informed.

Conclusion

The omission of the Endocannabinoid System from medical education represents a significant gap in our approach to healthcare. This oversight is evident in the bibliometric analysis, textbook content, and the global knowledge gap among healthcare professionals. Addressing this issue is crucial for advancing medical knowledge, improving patient care, and unlocking new therapeutic possibilities. It is imperative that the medical community, educators, and policymakers take immediate action to integrate ECS education into the core of medical training and practice.

References

1. Finn DP, Haroutounian S, Hohmann AG, Krane E, Soliman N, Rice ASC. Cannabinoids, the endocannabinoid system, and pain: a review of preclinical studies. Pain. 2021; 162: S5-S25.

2. Stampanoni Bassi M, Gilio L, Maffei P, et al. Exploiting the multifaceted effects of cannabinoids on mood to boost their therapeutic use against anxiety and depression. Front Mol Neurosci. 2018; 11: 424.

3. Dörnyei G, Vass Z, Juhász CB, Nádasy GL, Hunyady L, Szekeres M. Role of the endocannabinoid system in metabolic control processes and in the pathogenesis of metabolic syndrome: an update. Biomedicines. 2023; 11: 306.

4. Acharya N, Penukonda S, Shcheglova T, Hagymasi AT, Basu S, Srivastava PK. Endocannabinoid system acts as a regulator of immune homeostasis in the gut. Proc Natl Acad Sci U S A. 2017; 114: 5005-5010.

5. D'Angelo M, Steardo L Jr. Cannabinoids and sleep: exploring biological mechanisms and therapeutic potentials. Int J Mol Sci. 2024; 25: 3603.

6. Zhao S, Gu ZL, Yue YN, Zhang X, Dong Y. Cannabinoids and monoaminergic system: implications for learning and memory. Front Neurosci. 2024; 18: 1425532.

7. Lowe H, Toyang N, Steele B, Bryant J, Ngwa W. The endocannabinoid system: a potential target for the treatment of various diseases. Int J Mol Sci. 2021; 22: 9472.