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The Multifaceted Effects of Ashwagandha (Withania somnifera) Root Extract on Physical Performance, Cognitive Function, Mental Health, and Safety in Adults

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Abstract

Background: Ashwagandha root extract offers broad therapeutic benefits, enhancing physical performance, mental health, and cognitive function, making it a valuable adaptogenic and nootropic solution.

Methods: This study reviews clinical trials on Ashwagandha's effects in adults, analyzing physical performance, cognitive function, mood, sleep, and hormonal balance using validated measures and biomarkers.

Results: Ashwagandha supplementation enhanced endurance, strength, and hypertrophy, especially with resistance training. It improved memory, attention, anxiety, and depression, boosted sleep quality, balanced hormones in perimenopause, increased testosterone in men, and aided COVID-19 recovery, all without adverse effects.

Conclusion: These findings highlight Ashwagandha's broad-spectrum benefits as a safe and effective therapeutic agent for physical performance, cognitive health, and mental well-being. Further large-scale, long-term studies are needed to refine dosing protocols and expand its clinical applications across diverse populations.

Keywords: Ashwagandha, Physical Performance, Cognitive Function, Mental Health, Adaptogens

Introduction

Ashwagandha (*Withania somnifera*), a cornerstone of traditional Ayurvedic medicine, has gained prominence in modern healthcare due to its adaptogenic and multifaceted therapeutic properties. This herbal supplement has been extensively studied for its potential to enhance physical performance, cognitive function, and mental health while maintaining a favorable safety profile. In an era marked by increasing prevalence of stress-related disorders, chronic fatigue, and cognitive decline, the development of evidence-based natural interventions is paramount.

Emerging clinical evidence underscores Ashwagandha's capacity to improve cardiorespiratory endurance, muscle strength, and hypertrophy, particularly when integrated with resistance training regimens (Verma et al., 2024). Simultaneously, it has been shown to support cognitive health through immediate and long-term enhancements in memory, attention, and reaction times (Leonard et al., 2024). Moreover, Ashwagandha's anxiolytic and antidepressant properties, mediated through neurochemical pathways such as serotonin modulation, further solidify its role as a therapeutic agent for mental well-being (Majeed et al., 2024).

Beyond individual health domains, Ashwagandha's impact extends to specific populations, including perimenopausal women, where it alleviates climacteric symptoms and restores hormonal balance (Gopal et al., 2021). It also enhances sleep quality and reduces fatigue, making it an effective intervention for both insomnia patients and chronically stressed adults (Langade et al., 2021; Smith et al., 2023). Notably, its immunomodulatory properties have shown promise in mitigating symptoms of infectious diseases such as COVID-19, with evidence supporting its efficacy in recovery and inflammatory marker reduction (Devpura et al., 2021).

Despite these advancements, gaps remain in understanding Ashwagandha's mechanisms of action, optimal dosing strategies, and long-term safety across diverse populations. This paper aims to synthesize the current evidence surrounding the multifaceted effects of Ashwagandha root extract, with a focus on its impact on physical performance, cognitive function, mental health, and safety in adults. By consolidating these findings, this study seeks to highlight Ashwagandha's potential as a holistic therapeutic agent while identifying areas for future research and clinical application.

Methods

A comprehensive systematic review was undertaken to evaluate the effects of Ashwagandha (*Withania somnifera*) root extract on physical performance, cognitive function, mental health, and safety in adults. The search strategy was implemented using the PubMed database, employing a combination of targeted keywords, including "Ashwagandha," "Withania somnifera," "physical performance," "cognitive function," "mental health," "anxiety," "depression," "sleep quality," "hormonal balance," and "safety." Boolean operators (e.g., AND, OR) and filters were applied to optimize the search results. The review was limited to studies published in English between January 2019 and November 2024 to ensure the inclusion of relevant and up-to-date evidence.

The inclusion criteria were structured to encompass a broad range of study designs, including clinical trials, epidemiological research, mechanistic studies, meta-analyses, and systematic reviews. Eligible studies focused on adult populations (≥18 years), irrespective of health status, and assessed the use of Ashwagandha root extract in any form (e.g., capsules, powders) with clearly defined dosing regimens. Comparators included placebo, standard care, or other therapeutic interventions.

Following the application of these criteria, 20 recent, high-quality studies were selected for inclusion. Each study was evaluated based on its methodological rigor, relevance to the specified outcomes, and detailed examination of the effects of Ashwagandha. The findings from these studies were critically analyzed to synthesize evidence on the multifaceted influence of Ashwagandha root extract.

Results

The findings of this review are organized into several key domains, reflecting the diverse health benefits of Ashwagandha (*Withania somnifera*) root extract. Evidence demonstrates its significant impact on physical performance, with improvements observed in VO_2max levels, muscle strength, endurance, and hypertrophy when combined with resistance training.

Ashwagandha also exhibited potent cognitive and mood-enhancing properties, with studies highlighting its ability to improve memory, attention, and reaction times, alongside reductions in anxiety, depression, and fatigue. Improvements in sleep quality, particularly in both healthy individuals and those with insomnia, were also prominent, with enhancements in total sleep time and efficiency.

Furthermore, Ashwagandha was effective in addressing climacteric symptoms, including hormonal modulation in perimenopausal women and testosterone regulation in men. Its adaptogenic effects extended to stress and fatigue reduction, where dose-dependent benefits were observed in chronically stressed individuals.

Notably, its immunomodulatory properties showed promise in COVID-19 management, contributing to faster recovery rates, reduced inflammation, and effective virological clearance. These findings collectively underscore Ashwagandha's multifaceted role as a natural therapeutic agent with broad applicability across physical, mental, and immunological health domains.

1. Enhancement of Physical Performance

The effects of Ashwagandha (Withania somnifera) root extract on physical performance parameters were significant across multiple domains, as highlighted in the study by Verma et al. (2024).

Firstly, a notable enhancement in cardiorespiratory endurance was observed (Pérez-Gómez et al., 2024, Tiwari et al., 2021), as indicated by significant improvements in VO_2max levels among both male and female participants following an eight-week supplementation regimen combined with resistance training. This outcome underscores Ashwagandha's potential in augmenting aerobic capacity and overall physical fitness (Verma et al., 2024).

Additionally, participants in the Ashwagandha group exhibited marked improvements in physical endurance during resistance training sessions. The gains in endurance metrics were significantly greater compared to the placebo group for both sexes (males: $p < 0.0001$; females: $p < 0.0001$), reinforcing its role in enhancing sustained performance during exercise (Verma et al., 2024).

Moreover, the study documented substantial gains in muscle strength and size. Significant improvements were recorded in both bench press and leg press strength for males ($p = 0.0084$ and $p = 0.0049$, respectively) and females ($p = 0.0005$ and $p = 0.018$, respectively).

Furthermore, increased muscle girth was observed in the arms, chest, and thighs of participants in the Ashwagandha group compared to the placebo, highlighting its efficacy in promoting hypertrophic adaptations (Verma et al., 2024).

These findings collectively suggest that Ashwagandha supplementation, in conjunction with resistance training, can significantly improve multiple facets of physical performance.

2. Cognitive Function and Mood

The cognitive and mood-enhancing effects of Ashwagandha (Withania somnifera) were demonstrated through acute and repeated supplementation across several studies, revealing significant benefits for mental performance and emotional well-being.

Acute supplementation with liposomal Ashwagandha (225 mg) significantly enhanced cognitive markers, including Word Recall (correct and recalled attempts), Choice Reaction Time (targets identified), Picture Recognition (correct responses and reaction time), and Digit Vigilance (correct reaction time). These results suggest immediate benefits for memory, attention, and processing speed (Leonard et al., 2024).

Repeated supplementation over extended periods further amplified these effects, particularly in mood parameters. A 30-day regimen led to improvements in executive function, attention, and vigilance, accompanied by reductions in tension and fatigue as assessed by the Profile of Mood States (POMS) scale (Leonard et al., 2024). Further evidence demonstrated significant reductions in depressive and anxiety symptoms, as measured by the Hamilton Depression Rating Scale (HDRS) and Hamilton Anxiety Rating Scale (HARS), over 30, 60, and 90 days ($p < 0.001$), as well as notable improvements in Quality of Life (QOL) scores compared to placebo ($p < 0.001$) (Majeed et al., 2024).

Ashwagandha's impact on sleep and energy was also evident in participants with insomnia, who showed significant reductions in anxiety (HAM-A scores, $p < 0.05$) and improved mental alertness ($p = 0.01$) after supplementation (Langade et al., 2021). Over a 12-week period, reductions in fatigue symptoms ($p = 0.016$) were recorded, indicating improved energy levels and mood stability (Smith et al., 2023).

The cumulative evidence positions Ashwagandha as a potent nootropic agent, capable of improving short-term memory, attention, vigilance, and reaction times in younger adults, with benefits observed following both acute and long-term supplementation (Leonard et al., 2024). These findings underscore its broad applicability in enhancing cognitive function and promoting mental health.

3. Alleviation of Climacteric Symptoms

Ashwagandha (Withania somnifera) supplementation demonstrated significant benefits in alleviating symptoms associated with perimenopause, improving hormonal balance, and modulating sex hormone levels in men.

In perimenopausal women, supplementation significantly reduced total Menopause Rating Scale (MRS) scores, with marked improvements in psychological ($p = 0.0003$), somato-vegetative ($p = 0.0152$), and urogenital domains ($p < 0.0001$) compared to placebo. Additionally, reductions in hot flash scores and enhancements in menopause-specific quality of life (MENQoL) scores ($p < 0.0001$) were observed, highlighting its potential to improve overall well-being during this transitional phase (Gopal et al., 2021). Positive effects on hormonal balance were also evident, with increased serum estradiol levels and reductions in serum follicle-stimulating hormone (FSH) ($p < 0.0001$) and luteinizing hormone (LH) ($p < 0.05$), supporting its therapeutic role during perimenopause. However, no significant changes in serum testosterone levels were noted (Gopal et al., 2021).

In men, Ashwagandha supplementation demonstrated hormonal modulatory effects, including significant increases in blood concentrations of free testosterone ($p = 0.048$) and LH ($p = 0.002$), further confirming its potential in endocrine regulation (Smith et al., 2023).

These findings indicate that Ashwagandha may offer multifaceted benefits for managing hormonal changes and improving quality of life across genders.

4. Stress and Fatigue Reduction

Ashwagandha (Withania somnifera) supplementation demonstrated significant effects on reducing stress and fatigue levels in chronically stressed adults, with notable improvements in associated psychological and physiological parameters (Baker et al., 2022).

In the context of chronic stress, supplementation was shown to reduce fatigue and tension levels in younger adults, as measured by the Profile of Mood States (POMS) assessment (Leonard et al., 2024). Consistent dose-dependent reductions in stress, as evaluated by the 14-item Perceived Stress Scale (PSS) and biochemical stress markers, were observed with daily doses of 125 mg, 250 mg, and 500 mg, supporting Ashwagandha's role in modulating the hypothalamic-pituitary-adrenal (HPA) axis (Pandit et al., 2024). Specific benefits were also noted among healthcare workers, with reduced mental stress reported following supplementation (Chopra et al., 2021). However, one study found no statistically significant differences in perceived stress levels compared to placebo ($p = 0.867$), despite reductions over time (Smith et al., 2023).

Ashwagandha supplementation also led to a decrease in fatigue levels, with benefits observed both acutely and after 30 days of use (Leonard et al., 2024). Improvements in vitality and energy parameters further supported its role in reducing fatigue (Pandit et al., 2024). Participants in the Ashwagandha group experienced significantly lower fatigue symptoms compared to placebo ($p = 0.016$), alongside significant improvements in heart rate variability (HRV), a marker of autonomic nervous system balance ($p = 0.003$) (Smith et al., 2023).

These findings highlight Ashwagandha's efficacy in alleviating stress and fatigue, with evidence supporting its role in enhancing mental resilience and energy levels in chronically stressed populations.

5. Anxiety and Depression Relief

Ashwagandha (Withania somnifera) supplementation demonstrated significant efficacy in alleviating symptoms of anxiety and depression (Akhgarjand et al., 2022; Fatima et al., 2024; Arumugam et al., 2024), with associated improvements in biochemical markers linked to mental health.

In terms of anxiety relief, Ashwagandha significantly reduced anxiety levels, as evidenced by improved scores on the Hamilton Anxiety Rating Scale (HARS) compared to placebo ($p < 0.001$) (Majeed et al., 2024). Participants with insomnia also showed reductions in anxiety, with significant improvements in Hamilton Anxiety Scale (HAM-A) scores observed in the Ashwagandha group compared to placebo ($p < 0.05$) (Langade et al., 2021).

For depression symptoms, supplementation with Ashwagandha root extract (ARE) led to a significant decrease in Hamilton Depression Rating Scale (HDRS) scores, indicating marked improvements in depressive states ($p < 0.001$) (Majeed et al., 2024).

Biochemically, these mental health benefits were associated with a significant increase in serum serotonin levels, a neurotransmitter critical to mood regulation (Majeed et al., 2023). Participants in the Ashwagandha group exhibited elevated serotonin levels compared to a decrease observed in the placebo group ($p < 0.001$), supporting the neurochemical basis for its anxiolytic and antidepressant effects (Majeed et al., 2024).

These findings underscore Ashwagandha's potential as a natural therapeutic for anxiety and depression, supported by both clinical and biochemical evidence.

6. Sleep Quality Improvement

Ashwagandha (Withania somnifera) supplementation demonstrated significant improvements in sleep parameters among both healthy individuals and patients with insomnia, highlighting its potential to enhance sleep quality across diverse populations (Cheah et al., 2021; Deshpande et al., 2020).

In healthy volunteers, Ashwagandha supplementation improved overall sleep quality, particularly in chronically stressed individuals (Pandit et al., 2024). Specific benefits were observed in sleep onset latency (SOL) and sleep efficiency (SE), with statistically significant enhancements ($p < 0.0001$ for both), suggesting that Ashwagandha positively impacts sleep even in non-insomnia participants (Langade et al., 2021).

In insomnia patients, supplementation led to significant improvements in key sleep metrics, including total sleep time (TST) ($p < 0.002$), wake after sleep onset (WASO) ($p = 0.040$), and Pittsburgh Sleep Quality Index (PSQI) scores ($p < 0.0001$). Furthermore, mental alertness upon waking was significantly enhanced ($p = 0.01$), indicating broader benefits for sleep quality and daytime function in this population (Langade et al., 2021).

These findings suggest that Ashwagandha supplementation may serve as an effective intervention for improving sleep quality in both healthy individuals and those experiencing insomnia.

7. Potential Role in COVID-19 Management

Ashwagandha (Withania somnifera) demonstrated promising potential as a prophylactic and therapeutic agent against COVID-19, with evidence supporting its efficacy and safety in comparison to hydroxychloroquine (HCQ) and as part of Ayurvedic treatment regimens.

In a comparison with HCQ for chemoprophylaxis, Ashwagandha supplementation was found to be non-inferior to HCQ for COVID-19 prevention among high-risk healthcare workers. The incidence of confirmed COVID-19 cases was lower in the Ashwagandha group (1.3%) compared to the HCQ group (3.7%), and it fell within the pre-specified 15% non-inferiority margin for both symptomatic and asymptomatic cases confirmed via RT-PCR (Chopra et al., 2021).

As part of Ayurvedic treatment regimens for COVID-19 patients, Ashwagandha's immunomodulatory properties contributed to significantly faster recovery rates (Singh et al., 2023). The Ayurvedic treatment group, which included Ashwagandha, achieved a 100% recovery rate by day 7 compared to 60% in the placebo group, representing a 40% absolute reduction in the risk of delayed recovery (Devpura et al., 2021). Furthermore, markers of inflammation, including high-sensitivity C-reactive protein (hs-CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α), were significantly lower in the treatment group, suggesting reduced severity of SARS-CoV-2 infection and a lower likelihood of cytokine response syndrome (Devpura et al., 2021). Additionally, expedited virological clearance was observed in the treatment group, with no adverse effects reported, supporting the safety and efficacy of the Ayurvedic intervention (Devpura et al., 2021).

These findings highlight Ashwagandha's potential as a safer and effective chemoprophylactic and therapeutic option for COVID-19, particularly in settings where vaccination was unavailable.

Discussion

The findings from the reviewed studies on Ashwagandha (Withania somnifera) highlight its multifaceted benefits in enhancing physical performance, cognitive function, mood regulation, sleep quality, and its potential role in managing stress and COVID-19 outcomes. However, while these results are promising, several strengths and limitations warrant a closer examination.

The robust clinical evidence supporting Ashwagandha's efficacy across diverse health domains is a major strength. For instance, its role in improving VO_2max, muscle strength, and endurance underscores its utility as an ergogenic aid, particularly when combined with resistance training. Similarly, its acute and long-term cognitive benefits, as demonstrated by improvements in memory, attention, and mood markers, position it as a potent nootropic. Its ability to alleviate anxiety and depression through measurable biochemical pathways, such as increased serotonin levels, further highlights its therapeutic potential.

The studies also reveal strong effects on sleep quality in both healthy individuals and insomnia patients, with significant improvements in sleep parameters like total sleep time and sleep efficiency. Furthermore, Ashwagandha's immunomodulatory properties, evidenced in faster recovery rates and reduced inflammatory markers in COVID-19 patients, suggest it may play a complementary role in infectious disease management.

Despite the promising results, several methodological and contextual limitations exist. Most studies are limited in scope, often focusing on specific populations such as healthy younger adults or chronically stressed individuals, which may not generalize to broader demographics. The reliance on self-reported scales for mood and stress parameters, though validated, introduces subjectivity that could bias outcomes. Furthermore, while the biochemical mechanisms underlying Ashwagandha's effects are well-supported, many studies do not explore dose-response relationships comprehensively, limiting the ability to determine optimal dosing regimens.

Additionally, some findings, such as the non-significant reduction in perceived stress levels in one study, indicate variability in outcomes that warrants further investigation. Long-term safety data, particularly concerning high doses or prolonged use, remain insufficient, posing challenges for its clinical application.

To strengthen the evidence base, future research should prioritize large-scale, multicenter randomized controlled trials (RCTs) across diverse populations, including older adults, women, and individuals with comorbidities. Longitudinal studies examining the effects of chronic supplementation and potential adverse events are critical for establishing safety profiles. Research into the molecular mechanisms, particularly the role of Ashwagandha in modulating the hypothalamic-pituitary-adrenal axis, neurogenesis, and inflammatory pathways, could provide deeper insights into its therapeutic applications.

Additionally, exploring its effects in combination with other supplements or therapies may reveal synergistic benefits. In the context of its role in COVID-19 management, further trials comparing Ashwagandha with standard treatments are essential to validate its non-inferiority and safety as a chemoprophylactic or therapeutic agent.

Overall, while Ashwagandha's potential is evident, addressing these gaps will enhance its credibility as a natural, evidence-based intervention across multiple health domains.

Conclusion

This study underscores the broad therapeutic potential of Ashwagandha (Withania somnifera), emphasizing its efficacy across physical, cognitive, emotional, and physiological domains. Evidence from clinical studies highlights significant improvements in cardiorespiratory endurance, muscle strength, and hypertrophy, supporting its role as a natural ergogenic aid. Moreover, Ashwagandha's impact on cognitive function, mood regulation, and sleep quality demonstrates its versatility as a nootropic and adaptogen, particularly in reducing anxiety, depression, and stress-related symptoms.

The ability of Ashwagandha to modulate hormonal balance during perimenopause and its positive effects on testosterone levels in men further validate its endocrine benefits. Additionally, its immunomodulatory properties and promising role in COVID-19 management illustrate its potential in addressing emerging health challenges.

Despite these findings, limitations such as variability in population-specific outcomes, insufficient long-term safety data, and limited exploration of dose-dependent effects warrant further investigation. Future research should focus on expanding sample diversity, elucidating molecular mechanisms, and exploring synergistic effects with other therapies. Addressing these gaps will enhance the integration of Ashwagandha into evidence-based clinical practice, solidifying its position as a multifaceted therapeutic agent for optimizing human health.

Disclosure

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