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- Medication adherence and quality of life in gestational diabetes mellitus: A comprehensive review
- Assessment, localization of hearing loss and rehabilitation in children with cerebral palsy
- NAMS task force report on high altitude
- NAMS task force report on mental stress

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Annals of the National Academy of Medical Sciences (India)

Editorial

The journey of ANAMS in dissemination of quality clinical content

Digambar Behera[1]

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It is an honor for me for becoming the President of the National Academy of Medical Science, the institute which has been the torchbearer of setting ethical standards for clinical practice and research in India under the aegis of the Ministry of Health and Family Welfare, Government of India. As the President, of the prestigious institution, it is not only a matter of huge prestige and honor for me, but also it is a situation of huge responsibility, where I must reflect on the past and current matters at hand at the institute and build up on the same to set high standards for the medical fraternity in the years to come. One such goal would be to ensure, that our official journal, Annals of the National Academy of Medical Sciences (ANAMS), finally establishes itself as a highly reputed, indexed and sought-after journal by students, researchers and academicians from all across the country and even from overseas.

The journal has published diversified content in the recent past, which has addressed the latest developments in several clinical categories. As a Pulmonologist, some of the content which recently addressed my area caught my attention. The journal published topics addressing global initiatives for Asthma and chronic obstructive pulmonary disease.[1] The journal published an interesting but complex investigation discussing the utility of CBNAAT (GeneXpert MTB/RIF assay) in rapid diagnosis of extrapulmonary tuberculosis,[2] besides publishing on an emerging topic of a shift from nebulizers to dry powder inhalers.[3] Such topics from young researchers and students related to my specialization fill my heart with joy and excitement, and I would like to encourage students to submit more of such diversified pulmonology topics in the time ahead with us, so that we can take their findings to a large global reader base.

Besides these topics, ANAMS has recently published some extensive reviews, which not only discuss the development of clinical practice and evolving trends in the country but also serve as a teaching material for students and young clinicians who intend to serve in these clinical categories. Some of the engaging reviews have been on topics like allergic rhinitis,[4] pre-eclampsia,[5] multiple myeloma,[6] proton pump inhibitors with associated related rebound hypersecretion,[7] and role of epigenetics for recovery of memory decline during aging etc.[8]

The journal also brought to its readers, especially students and children, topics that directly address their overall well-being, apart from adding to academic knowledge. These topics hold crucial importance not only for the medical research community but also for the society. Such topics included rehabilitation in children with cerebral palsy,[9] modulation of sleep quality, cardiac autonomic activity, and cognition by yoga in medical students[10] and perspectives of Indian medical students regarding the competency-based medical education curriculum.[11] As the new President of the institution, I can't feel prouder that our journal has published such sensitive and informative topics.

While the journal has published such topics, on the other end, the journal has also published articles addressing hard-core molecular research and genetics. Topics such as bacterial etiology among diarrheal cases, dopamine D4 receptor (DRD4) polymorphisms, Single nucleotide polymorphism of IGF-1R and KCNJ11 gene (rs5219) polymorphism with HOMA-IR and HOMA B values in type 2 diabetes mellitus, found their place in our journal's issues.[12-15] These are extremely complex molecular studies and reflect how well-organized and focused molecular studies are happening in Indian institutions and universities.

In totality, the Annals of National Academy of Medical Sciences is a fantastic multi-disciplinary journal, which is publishing high-quality content addressing several clinical, social and academic topics. Our journal not only serves as

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educational material for the medical fraternity but also acts as a guiding factor for students and clinicians alike to shape their respective endeavors. I am proud of the journal and must congratulate the Editor in Chief, Dr. Anil Kumar Jain, for his hard work and his editorial team of admins and reviewers who are working as a great unit to develop the journal. I must also thank our publishers, Scientific Scholar for their excellent output, who have been support to bring our issues for our readers.

Lastly, I must take this opportunity to thank our authors, who have been enriching our journal with such engaging content and I would like to encourage all of them to continue supporting the journal ahead.

Prof. Dr. Digambar Behera (PADMA AWARDEE)
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Annals of the National Academy of Medical Sciences (India)

Review Article

Medication adherence and quality of life in gestational diabetes mellitus: A comprehensive review

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ABSTRACT

Gestational diabetes mellitus (GDM) is an increasingly significant public health issue with serious implications for both maternal and fetal health. This comprehensive review seeks to explore the factors that affect medication adherence and quality of life (QoL) among pregnant women with GDM in India. We conducted a systematic search of peer-reviewed literature published between 2019 and 2024, utilizing PubMed, Scopus, and other relevant databases. Key findings indicate that the prevalence of GDM in India is on the rise, with recent studies estimating a national prevalence of 13%. Factors that influence medication adherence include patient education, socioeconomic status, and the complexity of treatment. Additionally, the QoL for GDM patients is impacted by social support, knowledge about the condition, and various clinical factors. Our review highlights the necessity for standardized screening protocols, personalized patient education, and comprehensive management strategies to enhance medication adherence and QoL for those with GDM.

Keywords: Fetal health, Gestational diabetes mellitus (GDM), Maternal health, Medication adherence, Quality of life (QoL), Prevalence

INTRODUCTION

Gestational diabetes mellitus (GDM) is an escalating public health issue that impacts a considerable number of pregnant women globally. Defined by the onset of glucose intolerance during pregnancy, GDM presents risks to both maternal and fetal health, such as a heightened likelihood of macrosomia, preterm birth, and the development of type 2 diabetes. Successful management of GDM necessitates a multifaceted approach that emphasizes medication adherence as well as consideration of quality of life (QoL).

Medication adherence is essential for achieving optimal glycemic control and reducing complications associated with GDM. However, various factors—including socio-demographic characteristics, health beliefs, and access to healthcare—can affect adherence rates. Furthermore, GDM can considerably influence the QoL for pregnant women, impacting their physical, emotional, and social well-being.

Recent advancements in GDM research underscore the necessity for a more nuanced understanding of its prevalence, risk factors, and management strategies. This review aims to thoroughly investigate the factors that influence medication adherence and QoL among pregnant women with GDM in India. By exploring these aspects, we intend to identify key challenges and opportunities for enhancing GDM care.

A study examining GDM among pregnant women in India from 2015 to 2021 revealed a significant increase in prevalence. The percentage of GDM cases rose from 0.53% in 2015-2016 to 0.80% in 2019-2021, with this upward trend observed in most Indian states. In contrast, Arunachal Pradesh showed a decline in GDM prevalence, decreasing from 1.61% in 2015-2016 to 0.87% in 2019-2021.[1]

An analysis of 117 studies across India highlights the significant burden of GDM, revealing a pooled national prevalence of 13%. However, notable regional disparities were identified, with higher rates observed in the North and lower rates in the Western, Central, and Eastern regions. This review emphasizes the need for standardized screening and diagnostic strategies to address these variations and ensure effective management of GDM throughout the country.[2]

Elevated maternal blood glucose levels, including prediabetes (preDM), are associated with negative perinatal outcomes.

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When compared to pregnancies that maintain normoglycemia throughout gestation, these conditions significantly increase the risk of macrosomia (large for gestational age, [LGA]) and congenital malformations in neonates. Furthermore, the likelihood of preterm birth, cesarean delivery, and birth trauma is also notably heightened.[3]

GDM is a recognized risk factor for various complications affecting both mothers and their newborns. These complications can include pre-eclampsia (high blood pressure during pregnancy), preterm birth (delivery before 37 weeks), cesarean sections, and even stillbirth. Additionally, GDM is linked to increased risks of macrosomia (large babies), birth defects, and neonatal issues such as low blood sugar and the need for intensive care. Research indicates a potential connection between GDM and a woman's long-term health, elevating her risk of developing type 2 diabetes, metabolic syndrome, and cardiovascular disease later in life. Moreover, children born to mothers with GDM may also be at greater risk for metabolic issues.

Advanced maternal age (AMA) is another established risk factor for both GDM and adverse pregnancy outcomes. The prevalence of GDM is significantly higher in women of advanced age compared to younger mothers. Additionally, AMA is associated with an increased incidence of stillbirth, preterm birth, and both small for gestational age (SGA) and macrosomic infants.[4]

GDM is a significant public health issue that affects pregnant women globally. Characterized by the onset of glucose intolerance during pregnancy, GDM poses risks to both maternal and fetal health. Early identification and management of GDM are crucial to preventing adverse outcomes such as macrosomia, preterm birth, and an increased risk of type 2 diabetes for both the mother and child. Several factors have been identified as risk factors, including a family history of diabetes, ethnicity, age, obesity, polycystic ovary syndrome, high blood pressure, gestational age, and lifestyle factors like diet, physical activity, and smoking. By understanding these risk factors, healthcare providers can implement targeted screening and prevention strategies to reduce the prevalence and impact of GDM. This review aims to explore the prevalence, risk factors, and management of GDM in India, a country facing a substantial burden from this condition.[5]

Gestational diabetes management usually involves a combination of medication, such as insulin or metformin, alongside dietary modifications and exercise programs. Adhering to prescribed medication regimens and attending regular prenatal appointments are essential for achieving optimal health outcomes during pregnancy. However, concerns about medication safety and potential teratogenic effects can lead to non-adherence among some patients. This lack of adherence is a well-documented issue linked to increased maternal and neonatal morbidity and mortality, as well as imposing a significant economic burden on healthcare systems due to poorer pregnancy outcomes.[6]

METHODOLOGY

This systematic review aimed to evaluate the prevalence, risk factors, medication adherence, and QoL among pregnant women with GDM in India. We adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological rigor.

Search strategy

A thorough literature search was conducted using the following electronic databases: PubMed, Scopus, Google Scholar, and ShodhGanga. The search strategy incorporated a combination of medical subject headings (MeSH terms) and free-text terms related to GDM, prevalence, risk factors, medication adherence, QoL, and India. Boolean operators (AND, OR, NOT) were employed to refine the search results.

The search was limited to studies published in English from 2019 to 2024.

Inclusion and exclusion criteria

Studies were included if they met the following criteria:

- Investigated pregnant women diagnosed with GDM
- Reported data on prevalence, risk factors, medication adherence, or QoL
- Published as a full-text article in a peer-reviewed journal

Studies were excluded if they:

- Were case reports, case series, or reviews
- Did not report on the relevant outcomes
- Were conducted in non-English-speaking countries

MEDICATION ADHERENCE: THE KEY TO POSITIVE HEALTH OUTCOMES

Modern medicine depends on effective medications, but their success largely relies on patients taking them as prescribed. This often overlooked aspect is known as medication adherence.

The World Health Organization (WHO) defines adherence as a patient's active participation in their treatment plan, which includes medication use, dietary changes, lifestyle modifications, and collaboration with healthcare providers. Although adherence and compliance are sometimes used interchangeably, adherence emphasizes the patient's active

agreement, promoting a more collaborative approach to healthcare.

Assessing adherence is complex due to its nature. Various methods exist, including:

- **Subjective measures:** Gathering information from patients, family, caregivers, and doctors.
- **Objective measures:** Counting pills, reviewing pharmacy refills, and using electronic monitoring systems.
- **Biochemical measures:** Using tracers in medication to assess their presence in bodily fluids or measuring drug levels.

Researchers often combine these techniques, along with monitoring treatment outcomes, to gain a comprehensive understanding of medication adherence.

Managing GDM often necessitates medications, like insulin or metformin, to control blood sugar levels, which affects both mother and baby. Even highly motivated women may face challenges with adherence. To address this, a multidisciplinary healthcare team should prioritize comprehensive education on GDM, available treatment options, and self-care practices. Empowering women with knowledge throughout their pregnancy can enhance adherence and potentially lead to improved maternal health outcomes.[7]

DETECTING MEDICATION ADHERENCE

- **Direct methods:**
  - **Drug level measurements:** Blood or urine levels can indicate recent medication intake, but may not be reliable for long-acting medications.
  - **Biochemical markers:** Adding tracers to medications and measuring their presence in the body raises ethical concerns.
- **Indirect methods:**
  - **Pill counts:** Counting the remaining pills in the bottle provides a rough estimate.
  - **Refill rates:** Monitoring prescription refills offers insights into adherence patterns.
  - **Electronic monitoring:** Electronic pill bottles track opening times for a more accurate picture.[8]

APPROACHES TO PROMOTE MEDICATION ADHERENCE

Poor medication adherence remains a major healthcare challenge. Here are key strategies healthcare professionals can use to improve it:

- **Streamline regimens:** Simplify schedules and dosages, and use organizers/reminders.
- **Improve knowledge:** Educate patients with clear information and resources.
- **Manage perceptions:** Address beliefs and concerns and consider reward programs.
- **Enhance communication:** Practice active listening, involve patients, and offer appointment flexibility.
- **Eliminate bias:** Tailor education to patients' backgrounds and understanding.
- **Evaluate adherence:** Regularly monitor adherence through various methods.[9]

MEDICATION ADHERENCE EVALUATION

Medication adherence scales offer a multidimensional assessment of a patient's medication-taking behavior. They extend beyond merely evaluating adherence (i.e., taking medications as prescribed) to explore the underlying factors that influences it. These scales typically assess three key dimensions: behaviors related to medication compliance, attitudes toward medication adherence, and perceptions of adverse effects and psychiatric medications.

The more widely used currently available adherence rating scales include:

- Morisky medication adherence questionnaire (MAQ):
  - Researchers used the Morisky Medication Adherence Scale-8 (MMAS-8) to assess medication adherence. This self-reported questionnaire, with eight yes/no and Likert scale questions, evaluates medication-taking behavior. Higher scores (8+) indicate high adherence, while lower scores (<6) suggest lower adherence.[10]
- Medication adherence rating scale (MARS):
  - MARS (Medication Adherence Rating Scale) is a 10-question, self-reported tool used to assess a patient's medication adherence, particularly for those with psychiatric conditions. It combines elements from two existing scales and has been shown to be reliable and valid.[11]

QUALITY OF LIFE IN GDM

GDM extends beyond physical health concerns for mothers and babies; it significantly affects mental and emotional well-being, often increasing anxieties related to health and pregnancy. Research consistently indicates a connection between diabetes and a decline in QoL across various dimensions. Factors such as poor blood sugar control, complications, and the use of insulin are all known to contribute to this decline.

The WHO defines QoL as an individual's perception of their overall well-being, shaped by cultural background, values, and personal aspirations. It encompasses physical and mental

health, environment, work, family, and social interactions. Notably, research indicates a decline in QoL during pregnancy, even in the absence of pre-existing conditions. Factors such as gestational age, number of previous pregnancies (parity), fertility treatments, and other health issues can further impact QoL during this period.[12]

MEASURE QUALITY OF LIFE OR QUALITY OF LIFE SCALE

Measuring health-related quality of life (HRQoL) is increasingly important in healthcare. As the population ages and treatment options advance, patient-reported outcomes, particularly self-assessments of HRQoL, are gaining prominence. HRQoL is now recognized as a crucial factor in evaluating treatment effectiveness, alongside traditional survival rates. However, achieving a consistent definition of HRQoL remains a challenge. Due to its subjective nature, a multidimensional approach is necessary, taking into account physical symptoms, mental well-being, social interactions, and the effects of illness and treatment. A variety of HRQoL instruments are available to assess these different aspects of health, and these tools are continually evolving to become more sophisticated and comprehensive. It is essential to select valid and reliable instruments tailored to each population being studied, but comparisons between studies can be complicated by the use of different measurement tools.[13]

There are different types of QoL measuring tools, some of them are given below:

- **Quality of life scale (QoLS)**
  The QoLS is a multidimensional instrument designed to evaluate overall well-being. It explores various domains that contribute to a person's QoL, including physical health, social relationships, personal development, and leisure activities.[14]
- **Short form 36 [SF 36]**
  The Short Form 36 (SF-36) is a widely used measure of QoL that assesses eight key dimensions: physical functioning, limitations due to physical health, bodily pain, general health perceptions, vitality (energy levels), social functioning, limitations due to emotional problems, and mental health.[15]
- **WHO quality of life [WHOQoL]**
  Developed by the World Health Organization (WHO), the WHOQoL is a tool designed to measure various subjective aspects of quality of life. The WHOQoL-BREF version, available in over 40 languages, is particularly popular for cross-cultural comparisons of QoL.[16]
- **Eq-5D [EUROQoL]**
  The EQ-5D is a versatile and widely used tool for measuring health status. Available in three versions (3L, 5L, and Y), it has been employed in research and healthcare for over 25 years. Translated into many languages, the EQ-5D is easy to use and can be completed quickly. Its strength lies in providing both a detailed health profile and a single score, making it valuable for a variety of applications.[17]

DISCUSSION

Unveiling a troubling trend, two recent studies in India indicate a concerning rise in GDM among pregnant women. Analyzing national survey data, one study revealed a significant increase in GDM prevalence from 2015 to 2021. Meanwhile, a broader review estimated a national prevalence of 13%, highlighting regional variations across the country. Despite differing methodologies, both studies agree that GDM poses a substantial public health burden in India, identifying risk factors such as age, body mass index (BMI), heart disease, and thyroid disorders. Additionally, the findings suggest a potential north-south divide in GDM prevalence, with slightly higher rates noted in urban areas. Researchers emphasize the necessity for a standardized diagnostic approach, potentially incorporating specific testing around 24 weeks of pregnancy, while also recognizing the importance of addressing cost limitations. Combining this evidence underscores the need to explore cost-effective screening methods and implement a unified diagnostic strategy to improve GDM management and ensure better pregnancy outcomes for women throughout India.[1]

The analysis of maternal and neonatal outcomes in pregnancies complicated by GDM reveals significant adverse effects. These include high rates of polyhydramnios (38.4%), pregnancy-induced hypertension (46.1%), preterm labor (16.3%), postpartum hemorrhage (4.8%), and neonatal complications such as hypoglycemia (29.8%), prematurity (16.3%), and macrosomia (10.5%). This prospective study, conducted over a year at a tertiary care hospital in Gujarat with a sample of 104 pregnant women, underscores the critical importance of early antenatal screening and comprehensive management of GDM to enhance both maternal and fetal outcomes. Effective management strategies, including medical nutrition therapy and the use of insulin or oral hypoglycemic agents are vital. The study also highlights the long-term risk of developing type 2 diabetes and identifies significant demographic risk factors, such as advanced maternal age and obesity, which influence the prevalence and complications of GDM. These findings align with global research, emphasizing the need for robust screening and management protocols to address the complex challenges associated with GDM.[18]

Two recent studies on gestational diabetes underscore the importance of patients actively adhering to treatment plans. One study found that ongoing educational programs significantly enhanced patients' knowledge, attitudes, and behaviors, as reflected in improved knowledge, attitude,

practice (KAP) scores regarding the condition. This increased understanding resulted in better medication adherence and ultimately improved blood sugar control, regardless of whether patients were using metformin or insulin. Another study examined adherence to dietary and treatment recommendations, revealing a clear connection between good adherence and positive outcomes for both mothers and babies. Women who closely followed their plans required less insulin during labor and had a lower likelihood of needing a cesarean section. These findings strongly suggest that integrating education and tools to support patient adherence should be standard practice in GDM care. This comprehensive approach has the potential to optimize treatment outcomes and reduce complications for both mothers and their newborns.[4,19]

A cross-sectional research design was employed to evaluate knowledge, attitudes, and practices related to GDM among patients at Hangzhou Women's Hospital in China. Analyzing data from 499 women revealed positive correlations among knowledge, attitudes, and practice scores, highlighting the crucial role of comprehensive understanding and positive perceptions in effective GDM management. Notably, the study identified higher knowledge and attitude scores as independent predictors of better practices, emphasizing the importance of tailored educational interventions to enhance self-management among women with GDM in China. These findings illuminate the current landscape of GDM care and advocate for targeted education and training programs to optimize patient outcomes in this demographic.[20]

Comparing medication adherence in GDM management between two studies reveals nuanced insights. The Palakkad study utilized the Morisky Medication Adherence Scale (MMAS-8) to assess adherence levels, reporting a significant improvement from baseline to follow-up visits among 60 participants. This indicates the positive impact of pharmaceutical care and patient education. In contrast, the Houston study, also employing the MMAS-8 tool, identified challenges affecting adherence, with 37 out of 79 women reporting low adherence. Although birth weight outcomes did not significantly differ between the groups, low adherence was linked to a higher incidence of neonatal hypoglycemia. These findings emphasize the critical role of medication adherence in GDM management, highlighting the necessity for multifaceted interventions to address both patient-specific and systemic barriers, ensuring optimal maternal and neonatal outcomes.[21,22]

A study examined the relationship between socioeconomic status (SES) and adherence to medical recommendations in pregnant women with GDM. Surprisingly, it found that women with lower SES exhibited better adherence compared to those with higher SES, and this inverse association was statistically significant. The authors propose several explanations for this unexpected finding. Lower income may limit treatment options, resulting in stricter adherence to the prescribed regimen. Additionally, women with lower educational levels might have a heightened perception of risk, motivating them to follow medical advice more closely. In contrast, women with higher education may be employed and have less time for self-care, potentially leading to poorer adherence. Furthermore, fear of insulin and prevailing social norms around treatment compliance could also influence adherence behaviors. This study underscores the complex interplay between SES factors and medication adherence, indicating a need for further research to better understand these dynamics within the context of GDM.[14,23]

A retrospective cohort study aimed to explore the potential association between social vulnerability factors at the community level and medication adherence among pregnant women diagnosed with GDM. Conducted from 2007 to 2019, the research focused on Medicaid-enrolled pregnant patients in Tennessee who had filled prescriptions for metformin, glyburide, or insulin for at least 30 days before delivery. The study assessed medication adherence through the proportion of days covered by the medication, reporting a median adherence rate of 91.2%. While the study found no significant association between overall social vulnerability and medication non-adherence, it did identify a notable impact of specific social vulnerability subthemes—particularly Housing and Transportation—on adherence. Patients living in crowded housing conditions with limited access to transportation exhibited higher rates of non-adherence. Additionally, the study highlighted other factors influencing medication adherence, such as younger age, increased parity, and the use of insulin compared to glyburide. Despite the high overall adherence rates observed, the findings underscore the need for further investigation into the influence of social determinants, like housing and transportation, on medication adherence in GDM treatment. This study offers valuable insights into the complexities of medication adherence among pregnant women with GDM, highlighting potential areas for intervention and improvement in clinical practice.[24]

The study by Staynova et al. (2019) highlights the effectiveness of well-structured, easily understandable printed educational materials in enhancing the knowledge and satisfaction of women with GDM. The developed manual addressed essential topics, including the definition, risk factors, diagnostic criteria, and treatment options for GDM, with a focus on balanced nutrition, physical activity, self-monitoring of blood glucose, and insulin administration. Evaluated by a focus group of 20 pregnant women with GDM, the manual received high satisfaction ratings, with 95% of respondents finding the content useful and the presentation clear and accessible.

Feedback indicated that the manual's plain language, relevant information, and engaging illustrations were particularly effective. This study aligns with other research, demonstrating that patient-tailored educational materials can significantly improve knowledge, adherence to treatment, and self-management of GDM, ultimately optimizing therapeutic outcomes and reducing complications. Future research will investigate the long-term impact of these materials on patient knowledge and disease management. Integrating such educational resources into routine GDM care could enhance patient engagement and health outcomes.[25]

In reviewing the existing literature on the QoL in women with GDM during the third trimester of pregnancy, several key findings emerge. Studies consistently demonstrate that GDM negatively impacts QoL, particularly evident in declines in total health and social environment metrics. Standardized questionnaires like EQ-5D-5L and WHOQoL-BREF reveal significant reductions in these areas for women with GDM compared to controls, although psychological health and social relationships seem unaffected.. Interestingly, while the ADDQoL questionnaire generally shows no significant differences between GDM and non-GDM groups, it does indicate a borderline reduction in "current QoL." The mode of GDM treatment—whether through diet alone or in combination with insulin—does not appear to significantly influence QoL outcomes. Additionally, the relationship between QoL and age is significant in controls but not in GDM patients, suggesting a differential impact based on GDM status. Further studies support these findings, indicating moderate to high QoL levels among GDM patients and highlighting significant associations with factors such as age, family type, treatment received, and past obstetric complications. Advanced analytical models reveal that social support is the most influential determinant of QoL, followed by age and body mass index (BMI). Knowledge about GDM also plays a role, indirectly enhancing QoL through improved self-efficacy. These results underscore the multifaceted nature of QoL in women with GDM, where sociodemographic and clinical variables interact to shape overall well-being. This points to the necessity for tailored interventions that address these specific factors to improve QoL during pregnancy. Future research should continue to explore these dynamics and develop comprehensive care strategies that integrate social support, education, and clinical management to enhance QoL outcomes in this population.[12,26,27]

Studies investigating GDM highlight several areas for improvement. One study identified a gap between national guidelines and healthcare professionals' awareness of metformin as a first-line treatment. Another emphasized the need for further research on the long-term effectiveness of current treatment approaches for both mothers and their offspring. These findings, coupled with the recognized importance of medication adherence in GDM management, underscore the necessity for enhanced education for healthcare professionals. Additionally, targeted interventions may be required to optimize treatment strategies and improve health outcomes for women with GDM and their babies.[28-31]

KEY CHALLENGES AND OPPORTUNITIES IN GDM MANAGEMENT

Our comprehensive review has identified several critical challenges and opportunities in the management of GDM:

1. **Standardization of screening and diagnosis**
   - *Challenge*: Inconsistent screening protocols and diagnostic criteria across different healthcare settings.
   - *Opportunity*: Implement uniform, cost-effective screening methods to ensure early detection and timely intervention.
2. **Medication adherence**
   - *Challenge*: Suboptimal adherence rates due to concerns about fetal safety, complex regimens, and lack of understanding.
   - *Opportunity*: Develop patient-centered education programs and leverage technology for medication reminders and support.
3. **Quality of life considerations**
   - *Challenge*: Inadequate attention to the psychosocial impact of GDM on pregnant women.
   - *Opportunity*: Integrate QoL assessments into routine care and provide targeted psychosocial support.
4. **Healthcare access disparities**
   - *Challenge*: Unequal access to GDM care, particularly in rural and resource-limited settings.
   - *Opportunity*: Explore telemedicine and community-based interventions to improve care accessibility.
5. **Long-term follow-up**
   - *Challenge*: Insufficient monitoring of long-term outcomes for mothers and offspring.
   - *Opportunity*: Establish comprehensive follow-up programs to address post-pregnancy risks and improve intergenerational health.

ACTIONABLE RECOMMENDATIONS FOR HEALTHCARE PRACTITIONERS AND POLICYMAKERS

Based on our findings, we propose the following evidence-based recommendations:

For healthcare practitioners:

a) Implement a standardized GDM screening protocol at the first antenatal visit and between 24-28 weeks of gestation.

b) Utilize validated adherence scales (e.g., MMAS-8) to regularly assess medication adherence and identify barriers.
c) Incorporate brief QoL assessments (e.g., WHOQoL-BREF) into routine GDM care visits.
d) Provide culturally sensitive, literacy-appropriate educational materials on GDM management.
e) Offer personalized medication counseling, addressing specific concerns about fetal safety and side effects.
f) Encourage the use of smartphone apps or text message systems for blood glucose monitoring and medication reminders.

For policymakers:

a) Develop national guidelines for GDM screening and management, ensuring consistency across healthcare settings.
b) Allocate resources for community health worker programs to support GDM patients in underserved areas.
c) Invest in telemedicine infrastructure to improve access to specialist care in rural regions.
d) Implement policies to ensure affordable access to essential GDM medications and monitoring supplies.
e) Fund research initiatives focused on long-term follow-up of GDM-affected mothers and their offspring.
f) Collaborate with patient advocacy groups to develop awareness campaigns about GDM risks and management

CONCLUSION

A comprehensive review underscores the critical role of medication adherence and QoL in the management of GDM. The rising prevalence of GDM in India highlights the urgent need for standardized screening protocols and patient-centred interventions. Key findings include:

- The importance of early detection and comprehensive management in minimizing complications.
- The significant impact of patient education and support programs on improving medication adherence and glycemic control.
- The complex interplay between socioeconomic factors and adherence, necessitating tailored approaches to GDM management.
- The multifaceted nature of QoL in GDM patients, influenced by factors such as social support, knowledge, and clinical variables.

Moving forward, healthcare providers must prioritize:

- Implementing standardized screening and cost-effective diagnostic approaches.
- Developing and utilizing tailored educational materials to enhance patient knowledge and self-management.
- Addressing socioeconomic barriers to medication adherence through targeted interventions.
- Incorporating QoL assessments into routine GDM care to provide holistic patient-centred management.

By embracing a multidimensional approach that integrates clinical expertise with patient empowerment, we can strive towards better adherence, enhanced quality of life, and improved maternal and neonatal outcomes in the context of GDM.

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Review Article

Vilanterol vs formoterol in obstructive airway diseases: A comprehensive review of efficacy, safety, and clinical advantages in light of Global Initiative for Asthma 2024 and Global Initiative for Chronic Obstructive Lung Disease 2024 guidelines

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ABSTRACT

This comprehensive review evaluates the comparative efficacy, safety, and clinical advantages of vilanterol versus formoterol in the management of obstructive airway diseases, with a specific focus on the latest Global Initiative for Asthma (GINA) 2024 and Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2024 guideline recommendations. Vilanterol, a novel long-acting β2-agonist (LABA), demonstrates a 24-hour duration of action, allowing for once-daily dosing, compared to formoterol's twice-daily requirement. Clinical trials in both asthma and chronic obstructive pulmonary disease (COPD) have shown vilanterol-containing combinations to be at least as effective as formoterol-based treatments in improving lung function, symptom control, and quality of life. However, the GINA 2024 guidelines emphasize formoterol's role in as-needed and maintenance and reliever therapy (MART) approaches for asthma management. In COPD, vilanterol aligns well with GOLD 2024 recommendations, particularly in fixed-dose combinations. Safety analyses indicate a favorable profile for vilanterol, even in high-risk populations. The once-daily dosing of vilanterol offers potential improvements in patient adherence and satisfaction, especially relevant in COPD management. While direct cost comparisons are limited, improved clinical outcomes suggest potential cost-effectiveness benefits. This review concludes that while vilanterol presents several advantages, particularly in COPD management and once-daily regimens, the choice between vilanterol and formoterol should be individualized based on patient characteristics, disease features, and current guideline recommendations.

Keywords: Asthma, COPD, Formoterol, GINA 2024, GOLD 2024, Vilanterol

INTRODUCTION

Obstructive airway diseases, primarily asthma and chronic obstructive pulmonary disease (COPD), remain significant global health concerns. Long-acting β2-agonists (LABAs) have become a cornerstone in the management of these conditions, often used in combination with inhaled corticosteroids (ICS) or long-acting muscarinic antagonists (LAMA). Among the LABAs, vilanterol and formoterol are widely used. This review aims to compare vilanterol and formoterol in various aspects of obstructive airway disease management, with particular attention to the latest *Global Initiative for Asthma (GINA)* 2024 and *Global Initiative for Chronic Obstructive Lung Disease (GOLD)* 2024 guidelines.

Current guideline recommendations

GINA 2024 Guidelines for Asthma Management.[1] GINA 2024 guidelines emphasize a significant shift in asthma management. For adults and adolescents, GINA now recommends:

- As-needed low-dose ICS-formoterol as the preferred reliever across all asthma severities.
- Regular low-dose ICS-formoterol maintenance and reliever therapy (MART) as the preferred Step 3–5 controller option.

These recommendations highlight the importance of formoterol's rapid onset of action in the context of as-needed and MART approaches. However, the guidelines also acknowledge the role of other LABA-containing combinations, including those with vilanterol, as alternative controller options.

GOLD 2024 Guidelines for COPD Management.[2] The GOLD 2024 report maintains the importance of LABAs in COPD management:

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- LABAs are recommended as initial pharmacological treatment for most COPD patients, either alone or in combination with LAMA.
- For patients with exacerbations, LABA-LAMA or LABA-ICS combinations are recommended based on blood eosinophil counts and exacerbation history.

The GOLD guidelines do not differentiate between specific LABAs but emphasize the importance of individualized treatment based on patient characteristics and preferences.

Pharmacological properties

Vilanterol trifenatate is a novel LABA with a rapid onset and prolonged duration of action. It demonstrates high selectivity and potency for the β2-adrenoreceptor, with minimal activity at β1 and β3 receptors.[3] The molecular structure of vilanterol allows for a longer residence time at the β2-receptor, contributing to its extended duration of action.[4]

Formoterol, on the other hand, is a well-established LABA with a rapid onset of action but a shorter duration compared to vilanterol. While both drugs are effective bronchodilators, the pharmacological profile of vilanterol offers some distinct advantages:

***Duration of action*:** Vilanterol has demonstrated a 24-hour duration of bronchodilation, allowing for once-daily dosing.[5,6] This extended action is a significant improvement over formoterol, which typically requires twice-daily dosing. The longer duration of vilanterol may contribute to improved adherence and potentially better symptom control throughout the day and night.[7,8]

***Onset of action*:** While both vilanterol and formoterol have a rapid onset of action, some studies suggest that vilanterol may have a faster onset in certain patient populations.[3] However, it's important to note that the GINA 2024 guidelines specifically recommend formoterol for its rapid onset in as-needed and MART approaches.[1]

***Potency*:** In vitro studies have shown that vilanterol exhibits greater potency at the β2-receptor compared to formoterol.[3] This increased potency may translate to greater efficacy at lower doses, potentially reducing the risk of dose-related adverse effects.

Clinical efficacy

Asthma:

Several clinical trials have compared the efficacy of vilanterol-containing combinations to formoterol-containing combinations in asthma management:

- *Symptom control*: A retrospective matched cohort study by Averell *et al*. (2022) compared the effectiveness of fluticasone furoate/vilanterol (FF/VI) to budesonide/formoterol (BUD/FOR) in real-world asthma management. The study found that patients using FF/VI had significantly better symptom control and lower short-acting β2-agonist (SABA) use compared to those using BUD/FOR.[9] This suggests that the once-daily dosing of FF/VI may provide more consistent symptom relief throughout the day.
- *Lung function*: In a randomized crossover trial, Furuhashi *et al*. (2019) compared once-daily FF/VI to twice-daily BUD/FOR in patients with controlled stable asthma. The study demonstrated that FF/VI provided similar improvements in lung function (measured by forced expiratory volume in 1 second, FEV1) to BUD/FOR, but with the advantage of once-daily dosing.[7]
- *Quality of life*: Bernstein *et al*. (2018) conducted a study comparing FF/VI to fluticasone propionate/salmeterol in patients with well-controlled asthma. While both treatments maintained asthma control, patients reported higher satisfaction with the once-daily FF/VI regimen, which could potentially lead to improved adherence and long-term outcomes.[8]
- *Exacerbation prevention*: The CAPTAIN study, while not directly comparing vilanterol to formoterol, demonstrated the efficacy of FF/VI in reducing severe exacerbations in patients with uncontrolled asthma.[10] The once-daily dosing of FF/VI may contribute to better adherence and, consequently, improved exacerbation prevention compared to twice-daily formoterol-containing regimens.

COPD:

In COPD management, vilanterol has shown promising results in various clinical endpoints, aligning with the GOLD 2024 recommendations:

- *Lung function*: The early maximization of bronchodilation for improving COPD stability (EMAX) trial, while not directly comparing vilanterol to formoterol, demonstrated the efficacy of umeclidinium/vilanterol in improving lung function compared to monotherapy bronchodilators in symptomatic COPD patients.[11] This supports the GOLD 2024 recommendation for LABA–LAMA combinations in certain patient groups.[2]
- *Exacerbation reduction*: Dransfield *et al*. (2013) conducted two replicate double-blind, parallel-group, randomized controlled trials comparing FF/VI to vilanterol alone in COPD patients. The study found that FF/VI significantly reduced the rate of moderate and severe exacerbations compared to vilanterol monotherapy, highlighting the efficacy of vilanterol-containing combinations

in exacerbation prevention.[12] This aligns with the GOLD 2024 recommendations for using LABA–ICS combinations in patients with high exacerbation risk and elevated blood eosinophil counts.[2]

- *Mortality*: The SUMMIT trial, a large-scale study involving COPD patients with heightened cardiovascular risk, evaluated the effect of FF/VI on all-cause mortality. While the primary endpoint was not met, the study provided valuable data on the safety and potential benefits of FF/VI in a high-risk COPD population.[13,14]
- *Real-world effectiveness*: The Salford Lung Study, a groundbreaking real-world effectiveness trial, compared FF/VI to usual care in COPD patients. The study found that FF/VI was associated with a significantly lower rate of moderate or severe exacerbations compared to usual care, which often included formoterol-containing combinations.[15] This real-world evidence supports the superiority of vilanterol-containing regimens in everyday clinical practice and aligns with the GOLD 2024 emphasis on individualizing treatment based on patient characteristics and preferences.[2]

Safety profile

The safety profile of vilanterol has been extensively studied in both asthma and COPD populations, addressing concerns highlighted in both GINA 2024 and GOLD 2024 guidelines:

***Cardiovascular safety*:** Given the potential for β2-agonists to affect heart rate and blood pressure, the cardiovascular safety of vilanterol has been a focus of research. The SUMMIT trial, which included COPD patients with cardiovascular risk factors, did not show an increased risk of cardiovascular events with FF/VI compared to placebo.[13] This provides reassurance regarding the cardiovascular safety of vilanterol, even in high-risk populations, aligning with the GOLD 2024 recommendations for careful assessment of comorbidities in COPD management.[2]

***Pneumonia risk*:** In COPD patients, there has been concern about the potential increased risk of pneumonia with ICS/LABA combinations. Crim *et al*. (2015) analyzed pneumonia risk in two replicate trials comparing FF/VI to vilanterol alone in COPD patients. While there was a numerical increase in pneumonia events with FF/VI, the overall incidence was low, and the benefit–risk profile remained favorable.[16] A subsequent analysis of pneumonia risk in the SUMMIT trial similarly found a low overall incidence of pneumonia events.[17] These findings are relevant to the GOLD 2024 recommendations, which acknowledge the potential pneumonia risk with ICS use but maintain the role of ICS/LABA combinations in appropriate patient groups.[2]

***Age-related safety*:** Hanania *et al*. (2021) conducted analyses of five randomized clinical trials to evaluate the effect of age on the efficacy and safety of FF/VI and umeclidinium/vilanterol in COPD patients. The study found that the safety profile of vilanterol-containing regimens was consistent across different age groups, suggesting that vilanterol is well-tolerated in both younger and older patients.[18]

***Long-term safety*:** Busse *et al*. (2013) conducted a 52-week study evaluating the safety and tolerability of FF/VI in asthma patients. The study found that FF/VI was well-tolerated over the long term, with no new safety signals identified.[19] This long-term safety data are particularly important given the chronic nature of asthma and COPD management, as emphasized in both GINA 2024 and GOLD 2024 guidelines.[1,2]

Patient adherence and preference

The once-daily dosing of vilanterol-containing combinations offers a significant advantage over twice-daily formoterol regimens in terms of patient adherence and preference, an important consideration in both GINA 2024 and GOLD 2024 guidelines:

***Simplified regimen*:** The ability to use a once-daily inhaler can significantly simplify treatment regimens, potentially leading to improved adherence. This is particularly important in COPD patients, who often have multiple comorbidities and complex medication regimens.[4]

***Patient satisfaction*:** Studies comparing once-daily FF/VI to twice-daily ICS/LABA combinations have consistently shown higher patient satisfaction with the once-daily regimen.[8,20] This increased satisfaction may translate to better long-term adherence and outcomes, aligning with the patient-centered approach advocated in both GINA 2024 and GOLD 2024 guidelines.[1,2]

***Real-world adherence*:** A real-world study conducted in India by Prabhudesai *et al*. (2023) evaluated the use trends and characteristics of FF/VI in patients with obstructive airway disease. The study found high persistence rates with FF/VI treatment, suggesting good real-world adherence to the once-daily regimen.[21] This real-world evidence supports the potential adherence benefits of vilanterol-containing regimens.

Cost-effectiveness

While direct cost comparisons between vilanterol and formoterol-containing regimens are limited, the potential for improved adherence and reduced exacerbation rates with vilanterol may contribute to the overall cost-effectiveness:

***Reduced healthcare utilization*:** The Salford Lung Study demonstrated a reduction in moderate to severe exacerbations with FF/VI compared to usual care in COPD patients.[15] Given the significant healthcare costs associated with COPD exacerbations, this reduction could translate to substantial cost savings, aligning with the GOLD 2024 emphasis on exacerbation prevention.[2]

***Improved productivity*:** The once-daily dosing of vilanterol-containing regimens may lead to improved symptom control throughout the day, potentially resulting in better work productivity and reduced absenteeism. While not directly measured in most clinical trials, this could contribute to the overall economic benefit of vilanterol-based treatments.

Future directions

As our understanding of obstructive airway diseases evolves, so too does the role of LABAs like vilanterol, with several areas of focus aligned with GINA 2024 and GOLD 2024 guidelines:

***Personalized medicine*:** Both GINA 2024 and GOLD 2024 emphasize the importance of individualizing treatment based on patient characteristics and preferences.[1,2] Future research may focus on identifying specific patient subgroups that derive the greatest benefit from vilanterol-containing regimens. For example, studies have begun to explore the role of blood eosinophil counts in predicting response to ICS/LABA combinations in COPD.[22]

***Triple therapy*:** The development of single-inhaler triple therapy combinations containing vilanterol (such as fluticasone furoate/umeclidinium/vilanterol) represents an exciting area of research, particularly relevant to the GOLD 2024 recommendations for certain COPD patient groups.[2] Early studies have shown promising results in terms of exacerbation reduction and potential mortality benefits in COPD patients.[23,24]

***Comparative effectiveness*:** While this review has focused on the comparison between vilanterol and formoterol, future studies may provide more direct head-to-head comparisons with other LABAs or explore the relative efficacy of different LABA/LAMA combinations.[25,26] Such studies will be crucial in refining treatment algorithms in line with GINA and GOLD guidelines.

***Role in asthma-COPD overlap*:** Both GINA 2024 and GOLD 2024 acknowledge the challenges in managing patients with features of both asthma and COPD.[1,2] Future research may explore the specific benefits of vilanterol-containing regimens in this patient population.

CONCLUSION

In light of the GINA 2024 and GOLD 2024 guidelines, the evidence reviewed suggests that vilanterol offers several advantages over formoterol in the management of obstructive airway diseases, particularly in COPD. Its once-daily dosing, prolonged duration of action, and favorable efficacy and safety profile make it an attractive option for COPD management, aligning well with the GOLD 2024 recommendations for individualized treatment and the use of LABA-containing combinations.

The choice between vilanterol and formoterol should be individualized based on patient characteristics, preferences, specific disease features, and treatment goals, as emphasized by both GINA and GOLD guidelines. While vilanterol demonstrates advantages in many aspects, particularly in COPD management and once-daily regimens, formoterol remains an effective and valuable treatment option, especially in the context of current asthma management recommendations.

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Original Article

Assessment, localization of hearing loss and rehabilitation in children with cerebral palsy

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ABSTRACT

Objective: This study was designed to assess hearing loss in children with cerebral palsy (CP) using brainstem evoked response audiometry (BERA), otoacoustic emissions (OAE), pure-tone audiometry (PTA), and impedance audiometry. The prevalence of hearing loss was studied in this group and the location of lesion causing hearing loss was found using the above tests. We also compared the efficacy of OAE and BERA as screening modality for the detection of hearing impairment in such children.

Material and Methods: The study was conducted on 100 patients (200 ears) with CP in the age group of 1–18 years. The patients were selected randomly from those presenting to the Outpatient Department (OPD) with a diagnosis of CP in Kalawati Saran Children's Hospital. Investigations like BERA, transient evoked OAE (TEOAE), distortion product OAE (DPOAE), PTA, and impedance audiometry were done on them.

Results: On BERA, 58.5% children passed as per our criteria, and 41.5% failed the test. In all, 78% cases showed abnormal morphology of wave V. More than 50% of those who passed on BERA had poor morphology of wave V. Latency of wave V at 80 dB was prolonged in most cases. The mean latency of wave V was 6.159 msec. About 83.5% children failed on OAE testing according to our criteria, while only 16.5% passed.

Conclusion: The prevalence of hearing loss was calculated to be 41.5%. In most cases, the site of the lesion was found to be cochlea, as OAE was absent in most cases (83.5% of patients tested). OAE was found to be a less efficacious test as compared to BERA in detecting hearing loss.

Keywords: BERA, Cerebral palsy, Hearing, OAE

INTRODUCTION

Cerebral palsy (CP) is defined as "a group of permanent disorders of the development of movement and posture, causing activity limitation, that is attributed to non progressive disturbances that occurred in the developing fetal or infant brain."[1] The incidence of CP in the general population varies throughout the world at a rate of 0.1%–0.2% of live births in developed countries and is slightly higher in developing countries, with the risk of CP increasing with decreasing gestational age.[2,3]

CP is commonly associated with a spectrum of developmental disabilities. Besides motor abnormalities, a child with CP suffers from multiple handicaps like mental retardation, epilepsy, visual, hearing, speech, cognitive, and behavioral abnormalities.[4] There are few published studies on the prevalence of hearing loss in CP. The incidence of hearing loss was reported to be between 7% and 37.5%, with the majority of studies commenting only on sensorineural hearing loss (SNHL).[5–9] Lesions causing hearing loss potentially involve the organ of Corti, especially at the outer hair cells and the cochlear nerve.

Hearing loss, which is so commonly associated with CP, requires an audiological assessment for a definitive diagnosis.[10] Such children who are not responsive can be tested for hearing loss using an auditory evoked potential that measures the lowest possible sound level, which produces a brain wave in the child.

Although SNHL in patients with CP has been known for more than 50 years, yet the site of lesion in these cases remains in controversy. Also, the assessment of hearing in CP patients has always been a difficult task. Both parents and treating physicians remain uncertain about the cause of deranged/no

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response to any auditory stimulus in these patients. Even in those cases where hearing loss is established, the location of lesion causing hearing loss remains uncertain. It is however possible with the spectrum of investigative means available with us now in the form of distortion product otoacoustic emissions (DPOAE), transient evoked otoacoustic emissions (TEOAE), brainstem evoked response audiometry (BERA), pure-tone audiometry (PTA), impedance audiometry, cortical evoked response audiometry (CERA), and functional magnetic resonance imaging(fMRI) to identify and evaluate the hearing loss and make an endeavor to locate the site of lesion in such cases.

Our patients were investigated by BERA, TEOAE, DPOAE. PTA and impedance audiometry were done in a few cases. BERA is an objective test to evaluate hearing threshold and to diagnose retrocochlear pathologies tests of the cochlear status, specifically outer hair cells.

MATERIAL AND METHODS

Subjects

This study was performed on 100 patients (200 ears) with CP in the age group of 1–18 years. The patients were selected randomly from those presenting to the Outpatient Department (OPD) in Kalawati Saran Children's Hospital with a diagnosis of CP. The study was conducted from October 2005 to February 2007 by conducting BERA, TEOAE, DPOAE, PTA, and impedance audiometry on these patients. The procedure of these hearing tests was explained to the parents and an informed consent was taken for conducting these tests. The tests were carried out in a double-wall sound treated room within permissible noise limits. Patients were followed up thereafter to the extent possible for the hearing rehabilitation.

Methods

BERA was done using Hortmann Neurootometrie BERA Soft @ 1995 by Hortmann Gmbh. Three surface electrodes were applied—one over each mastoid and the third over the forehead. Stimuli were given in the form of clicks which were broadband, in rarefaction phase, with an intensity of 60 dB (decibels). Around 2000 such clicks at the rate of 30/sec were given to the ear being tested. The contralateral ear was suitably masked by white noise. Waves I, III, and V (Jewett and Williston's nomenclature) were looked at for the absolute latency, interpeak latency, and morphology. The passing criteria used for BERA was the presence of wave V at 60 dB HL (hearing loss). A similar procedure was repeated on the other ear of the same child.

TEOAE recordings were obtained using Hortmann Neurootometrie-Octavus (Germany) @ 1994; V5ILO OAE 88 Dpi Otodynamics Limited System. TEOAE probes fitted with disposable soft tips were used for recording TEOAE. Tips of various sizes were used depending on the size of the child's external auditory canal. A snug fit of the probe was ensured. A set of four clicks were given as stimulus. The first three clicks were given for a duration of 80 msec at 80 dB SPL (sound pressure level). The fourth click was of opposite polarity and of three times the amplitude as compared to the first three.

The passing criteria of TEOAE were: (a) The response was reproducible 50% of times the test was performed; and (b) Any of the three frequencies tested (1.0,1.5,2.0,3.0,4.0 kHz) had 3 dB more power in the response spectrum than the noise spectrum.

DPOAE was done using Hortmann Neurootometric-Octa (Germany) 1994; V5 ILO OAE 88 Dpi Otodynamics Limited System. DPOAEs were recorded for both ears using the sweep stimuli ranging from 500 Hz to 8 kHz. L1 and L2 were set at 65 dB. The three points per octave were adopted for examination. Best probe fit was ensured to reduce the noise floor effects. In this study, DPOAE was taken to be present when its amplitude was 3 dB or more above the noise floor level.

Impedance audiometry was done by Impedance Audiometer AT235 Interacoustics A/S; Assens, DC-5610 Assens (Denmark). The type of tympanogram was noted. Tone above 80 dB were presented to the test ear and reflex picked up with a probe. The presence or absence of reflex was noted.

PTA could be done in only a few patients using an advanced Digital Audiometer AD-200 (ALPS) in similar settings. The diaphragm of the headphone was placed over the opening of the external auditory meatus. The hearing thresholds for frequencies of 250, 500, 1000, 2000 Hz were noted.

RESULTS

The distribution of neuromotor disturbance was studied. A maximum number of children (54%) with CP had quadriplegia, 21% hemiplegia, and 19% suffered diplegia. Spasticity was the most common type of neuromotor disturbance found in 91% of the children in this study group.

While 58.5% children passed on BERA according to our criteria, 41.5% failed the test [Figure 1]. The passing criteria used for BERA was the presence of wave V at 60 dB HL; 78% cases showed abnormal morphology of wave V. More than 50% cases that passed in BERA had poor morphology of wave V. Latency of wave V at 80 dB was prolonged in most cases [Table 1]. The mean latency of wave V was 6.159 msec [Table 2].

On otoacoustic emissions (OAE), 83.5% of the children failed the test according to our criteria and only 16.5% passed [Figure 1]. The passing criteria of TEOAE were: (a)

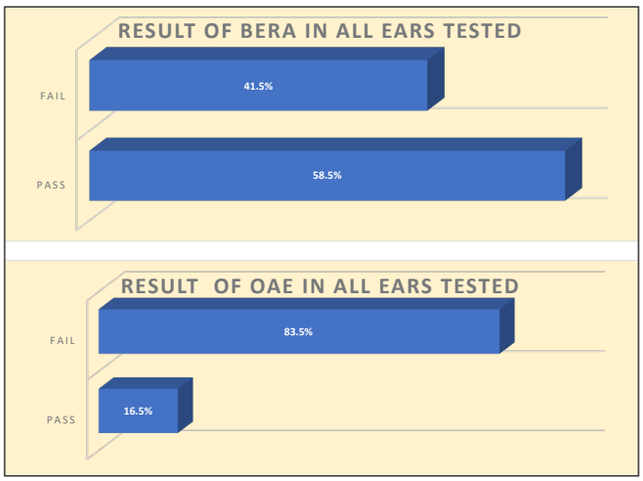

Figure 1: Result of BERA and OAE in all ears tested. BERA: Brainstem evoked response audiometry, OAE: Otoacoustic emissions.

Table 1: Morphology of wave V at 80 dB.

Wave morphology	Frequency	Percent
Normal	44	22
Abnormal	156	78
Total	200	100

Table 2: Latency of wave V at 80 dB.

Ear tested	Number	Minimum	Maximum	Mean	SD
Right side	86	4.3	7.8	6.101	0.5608
Left side	88	5.1	7.6	6.216	0.5675

SD: Standard deviation

The response was reproducible 50% of times the test was performed; and (b) Any of the three frequencies tested (1.0, 1.5, 2.0, 3.0, 4.0 kHz) had 3 dB more power in the response spectrum than the noise spectrum.

DISCUSSION

There are several issues in the assessment of hearing in children with CP and these include the objective test to be chosen as per needs of the child, reliability of these tests, degree of hearing loss, and its precise localization.

In our study, prevalence of hearing loss in children with CP was calculated from patients on the basis of children who failed on BERA. The prevalence was found to be 41.5%. However, the actual prevalence would still be higher because this does not take into consideration the cortical-level hearing loss. The exact prevalence of hearing loss can probably come only from CERA.

Topolska *et al.* in 2002 had performed audiologic examination on 32 patients. Their audiological testing comprised of impedance audiometry, DPOAE, BERA, and psychophysical studies—tonal and speech audiometry. They recognized hypoacusis in 37.5% of the children on the basis of psychophysical studies.[11] They could not perform tonal audiometry in 25% of the cases due to the mental status of the child. Hearing impairment affects a significant proportion of children with CP.

Weir *et al.* (2018) performed audiologic assessment of 940 patients and found hearing loss in 367 (39%).[12] They collected data from their AudGen Database, including pediatric patients with a diagnosis of CP. They collected data from the free field audiometry and ear-specific audiometry tests. According to this study, hearing loss of 15 dB or more on PTA or 20 dB by sound field audiometry was taken as significant. No BERA or OAE was done.

In most cases, there is evidence of involvement of cochlea, as OAE is absent in most cases (83.5%). Children who are BERA pass and OAE pass (14%) should hear normally. If they have hearing loss, it is because of a more central cause. Children who are BERA pass and OAE fail (44.5%) could have fluid in the middle ear or mild SNHL. Children who are BERA fail and OAE pass could have lesion at the spiral ganglion or brainstem or cochlear nerve. Children who are BERA fail and OAE fail (39%) could have purely cochlear or cochlear and brainstem/nerve involvement [Figure 2].

Taking BERA as gold standard, the efficacy of OAE was compared with it using the chi-square test. Chi-square value was 11.30 and p-value was 0. 0007. The difference between the two tests was statistically very significant. Hence, OAE was found to be a less efficacious test as compared to BERA in detecting hearing loss.

In the last few years, cochlear implants (CIs) have been developed for auditory rehabilitation of children having severe to profound hearing loss.[13] Richard *et al.* (2021) did a

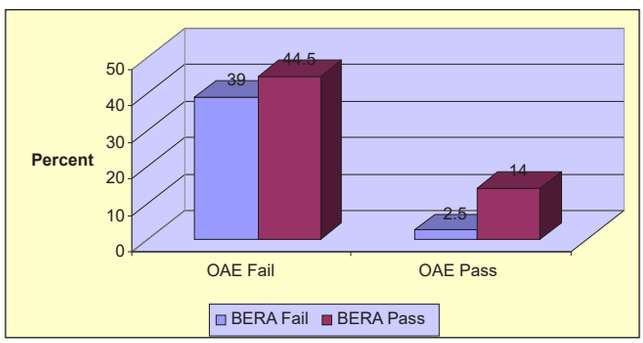

Figure 2: Pattern of results of all ears tested. BERA: Brainstem evoked response audiometry, OAE: Otoacoustic emissions.

systematic review and identified two interventions (hearing aid and cochlear implantation).[14]

Rehabilitation in the form of hearing aid or CI would be required in children who are OAE fail and BERA fail (39%), OAE fail and BERA pass (44.5%), and OAE pass and BERA fail (2.5%).

The children in our study group hardly ever got hearing aids fitted because parents were already occupied with multiple other handicaps of the child. Rehabilitation of hearing loss still remains an unachievable goal in such children with CP.

There are various issues in the assessment of hearing of children with CP. They are unable to speak and respond, so it becomes difficult to ascertain whether hearing loss actually exists. If the hearing loss is due to a defect in hearing pathway before the cortex, the child is expected to improve with hearing aids, CIs, or brainstem implants. However, if this is at cortical level, none of the above-mentioned devices would work. Hence, it is important to establish, quantify, and find the level of defect, and this is a difficult task.

Correlation of results of TEOAE/DPOAE, BERA, PTA with hearing in cerebral palsy

Our results were categorized in six groups:

1. Hearing present—TEOAE/DPOAE present—BERA pass—PTA OK/not possible
   No intervention for hearing is required in this group of children. They require speech training only.
2. Hearing present—TEOAE/DPOAE absent—BERA fail—PTA OK/not possible
   There is no explanation for this scenario. Maybe the tests are unreliable. Nevertheless, no intervention is required for hearing. They require speech training.
3. Hearing deranged—TEOAE/DPOAE absent—BERA threshold raised/fail—PTA threshold raised/not possible
   Such children will benefit from hearing aids/CI and speech training. We also need to treat any conductive element if present.
4. Hearing absent—TEOAE/DPOAE present—BERA fail—PTA no response/not possible
   Such children could be helped with CI/brainstem implants.
5. Hearing absent—TEOAE/DPOAE present—BERA pass—PTA no response/not possible
   CERA could give answers for this group of children. No intervention can be done.
6. Hearing absent—TEOAE/DPOAE absent—BERA fail—PTA no response/not possible
   CI/brainstem implant could help.

Issues in implanting children with cerebral palsy having hearing loss

These children suffer multiple handicaps. The result of speech even after treating hearing handicap remains unpredictable. The high cost of CI puts a burden on the already financially strained family. None of these children in our group were implanted.

Newer modalities like growth hormone administration have found some success in the recovery of hearing but needs exploration.[15]

CONCLUSION

The prevalence of hearing loss amongst CP children was calculated to be 41.5%. In most cases, the site of lesion was found to be cochlea, as OAE was absent in most of such cases (83.5%). OAE was found to be a less efficacious test as compared to BERA in detecting hearing loss.

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Original Article

Disaster management knowledge and practices among nurses: A cross-sectional study

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ABSTRACT

Objectives: Disasters significantly disrupt human life and societal structures worldwide, necessitating robust disaster preparedness systems. Nurses play a crucial role in disaster response; however, ongoing training and specialized skills are essential due to the dynamic nature of these events. This study aims to address the lack of data on nurses' perceptions of disaster education and preparedness. Understanding these perceptions is vital for improving nursing education and enhancing the effectiveness of disaster response.

Material and Methods: An observational cross-sectional study was conducted with a sample of 60 nursing staff working in the OPD, emergency, and ICU wards of Guru Teg Bahadur (GTB) Hospital in Delhi. A self-administered questionnaire on knowledge and practices related to disaster management was provided to the participants, and their responses were recorded. The questionnaire consisted of three sections: questions pertaining to participant and baseline information, knowledge, and practices. Additionally, there was a separate section for participants to offer suggestions on how to improve their knowledge and practices.

Results: The results indicated a significant level of awareness and knowledge (70.9%) among the participants regarding disaster management. However, notable gaps exist in specific expertise and experience related to disaster preparedness and response. It was observed that only 32 participants (53.3%) regularly or occasionally participated in disaster drills, highlighting a lack of practice among them.

Conclusion: The assessment of disaster management practices among hospital staff revealed both strengths and areas for improvement. While there is a general awareness and understanding of disaster management principles, gaps in practical engagement and procedural knowledge remain. There is a strong consensus on the need for more workshops and simulated training. To address these issues, it is essential to implement regular mandatory drills and enhance training programs. These measures will help hospitals cultivate a more resilient workforce capable of effectively responding to disasters and ensuring the safety of patients and the community.

Keywords: Disaster preparedness, Knowledge, Nursing staff, Practices

INTRODUCTION

Disasters cause significant disruptions, impacting human lives, economic stability, and physical structures globally.[1] They range from natural calamities to human-made crises, affecting individuals, families, groups, and communities.[2] Effective disaster management relies on preparedness, risk assessment, and multidisciplinary approaches to address both short-term and long-term health needs.[3,4] The goal of disaster preparedness is to establish robust systems, procedures, and resources for providing seamless assistance to disaster victims, focusing on immediate response and long-term recovery. Continuous learning, strategy adaptation, and community engagement are crucial for building resilience. Nurses play a vital role in disaster management and recovery, but they often lack adequate emergency preparedness. Training, education, and specialized skills are essential for enhancing their preparedness.

A study at Guru Teg Bahadur (GTB) Hospital in East Delhi, a 1,600-bed multi-specialty facility, aims to assess nurses' knowledge and practices regarding disaster preparedness. Given the hospital's comprehensive medical services and its exposure to various disasters, effective preparedness is critical. Using a meticulously designed questionnaire, the study seeks to understand the knowledge and preparedness

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levels of nursing professionals, providing insights for future strategic improvements. The primary objective of the study is to document the level of knowledge and practices of nurses regarding disaster management at GTB Hospital. Secondary objectives include assessing the skill levels and determining the training status of nurses in disaster management.

MATERIAL AND METHODS

An observational cross-sectional study was conducted to address the aims and objectives. We included nursing staff working in the outpatient department, emergency wards, and ICU for at least one year. The study took place at GTB Hospital between April 2024 and August 2024. Participants received a self-administered questionnaire, and their responses were recorded. The questionnaire consisted of three sections: participant and baseline information, questions related to knowledge, and questions related to practices. Additionally, there was a separate section for participants to provide suggestions on how to improve knowledge and practices.

The data was entered into an MS Excel spreadsheet, followed by statistical analysis to address the study's aims and objectives. The data collected using the study tools were converted into a computer-based format and analyzed using SPSS version 20.0 software.

RESULTS

General characteristics of the participants

A total of 60 participants were recruited for the present study, with ages ranging from 24 to 55 years and a mean age of 37.7 years. Among the participants, 27 (45%) were male, and 33 (55%) were female. The participants' experience varied from 1 to 29 years, with a mean experience of 11.5 years. Regarding educational qualifications, 31.7% had completed a diploma, 61.7% had earned a bachelor's degree, and 6.7% had completed a master's degree. It was noted that 38.3% of the participants had no training in disaster management, while 56.7% had received training, and 5% were unsure if they had undergone any training.

Table 1: Knowledge assessment of participants

Knowledge assessment	Yes	No
1. Disasters come in many shapes and sizes.	57(95%)	3(5%)
2. Disaster is a mismatch between event-driven needs and the resources that can be met.	54(90%)	6(10%)
3. Disaster management is the sole responsibility of healthcare workers.	22(36.7%)	38(63.3%)
4. The research literature on disaster management is easily accessible.	39(65%)	21(35%)
5. The research literature on disaster management is understandable.	41(68.3%)	19(32.7%)
6. Know where to find relevant research or disaster management information to fill knowledge gaps.	35(58.3%)	25(41.7%)
7. In case of a disaster, there is sufficient support from local officials on the governance level.	40(66.7%)	20(33.3%)
8. Familiar with the principle of triage	54(90%)	6(10%)
9. Does your hospital have an emergency plan?	55(91.7%)	5(8.3%)
10. Are you aware of the hospital's emergency evacuation procedures during disasters?	39(65%)	21(35%)
11. Realistic on-scene training is vital to an efficient and effective disaster management plan.	53(88.3%)	7(11.7%)
12. Disaster management is truly a system-oriented specialty and involves multiple responding agencies.	58(96.7%)	2(3.3%)
13. Do you know where to find the disaster plan?	26(43.3%)	34(56.7%)
14. Do you know what drills are?	56(93.3%)	4(6.7%)
15. Do staff members understand their roles during a drill?	50(83.3%)	10(16.7%)

Nursing staff's knowledge and practices regarding disaster preparedness

Knowledge assessment of participants

The knowledge assessment of participants is detailed in Table 1. It was observed that 25 participants (41.7%) had experience in dealing with disasters, and 96.7% agreed that Delhi is at risk of both natural and man-made disasters. Among the 60 participants, 16 (26.7%) indicated that they were familiar with the major components of the disaster plan, 20 (33.3%) had partial knowledge, and 24 (40%) were unaware of the components. Additionally, it was noted that 35 participants (58.3%) were aware of the potential risks and emergencies in the country.

Practices assessment of participants

When asked about their participation in drills and exercises related to disaster management, 6 participants (10%) stated that they participate regularly, 20 (33%) said rarely, 22 (36.7%) indicated occasionally, and 12 (20%) reported that they never participate.

It was noted that 6 participants (10%) felt that the disaster management practices in the hospital were very effective, 28 (46.7%) considered them effective, 20 (33.3%) felt neutral, and 6 (10%) deemed them ineffective. Additionally, 38 participants (63.3%) stated that disaster drills are conducted in the hospital. However, the results also indicated that 42 participants (70%) reported there is no ongoing training available in the hospital. Furthermore, 28 participants (46.7%) indicated that the disaster plan in the hospital is updated frequently, and 27 (45%) reported having personal or family emergency plans for disaster situations. When asked if there is a need for more workshops and simulated training to prepare for disasters, 57 participants (95%) agreed. The skill assessment and training status of the participants is detailed in Table 2.

Table 2: Skill assessment and training status of the participants

Skill assessment	**Yes**	**No**	**Don't know**
1. My role in disaster management is clear	35(58.3%)	12(20%)	13(21.7%)
2. Ready to handle whatever potential risks and disaster emergencies exist in the community	40(66.7%)	8(13.3%)	12(20%)
3. Previously attended any workshops/ seminars about disaster management	36(60%)	24(40%)	--
4. If yes, the knowledge gained is enough to practice in real situations	21(35%)	15(25%)	--
5. Nursing education enabled me to be ready to practice in the setting of disaster (natural: e.g.: earthquakes and floods; or human-made: e.g.: embargo or wars)	47(78.3%)	13(21.7%)	--
Training Status		**Yes**	**No**
1. Willing to attend the emergency medicine education incorporated in the continuous professional education programs		56(93.3%)	4(6.7%)
2. Other extracurricular resources (e.g. internet, TV, radio, and newspapers) enable me with a sufficient degree of readiness to practice under disaster		34(56.7%)	26(43.3%)
3. Need more training on providing patient-centered care in the situation of disaster		58(96.7%)	2(3.3%)

Suggestions for improvement in knowledge and practices

Participants were asked to provide suggestions for enhancing knowledge and practices related to disaster management. A significant portion, 22 individuals (36.6%), recommended organizing seminars on disaster management is essential. Additionally, 32 participants (53.3%) expressed the need for more workshops to strengthen their understanding and preparedness.

When asked about improving practical applications, 36 respondents (60%) emphasized the importance of conducting mock drills and realistic training sessions. Additionally, 29 individuals (48.3%) highlighted the value of establishing a skills lab to facilitate hands-on learning and skill development.

DISCUSSION

In our study, we enlisted 60 participants employed as nursing staff at GTB Hospital, Delhi. The results indicated a significant level of awareness and knowledge among participants regarding disaster management; however, notable gaps remain in specific expertise and experience related to disaster preparedness and response. The assessment of disaster management practices revealed various strengths and weaknesses in the current system, providing insights into areas that require improvement to enhance preparedness and response capabilities.

General awareness and perceptions

An overwhelming majority (95%) of participants recognize that disasters come in many forms, indicating a high level of general awareness about their diverse nature. Similarly, 90% understand that a disaster is characterized by a mismatch between event-driven needs and available resources, suggesting a solid conceptual grasp of disaster dynamics. A substantial proportion of participants (96.7%) acknowledged that Delhi is at risk of both natural and man-made disasters. This high level of agreement reflects widespread recognition of the region's vulnerability, which is essential for fostering a culture of preparedness. However, only 41.7% of participants had direct experience in dealing with disasters, highlighting a potential gap between theoretical awareness and practical experience. Consistent with the study by Younis *et al*.[5] (2020) a significant portion (36.7%) mistakenly believes that disaster management is solely the responsibility of healthcare workers, revealing a critical misconception. While 65% of participants find disaster management literature accessible and 68.3% find it understandable, a notable minority (35% and 32.7%, respectively) struggle with these aspects. In a study by Nasir *et al*. (2023) 81.6% of participants agreed that disaster preparation is essential for all healthcare personnel, not just doctors or nurses.[6] In the present study, sufficient support from

local officials (66.7%) suggests confidence in governance-level disaster response; however, one-third of participants remain uncertain, indicating room for improvement in public communication and assurance. The data reveals that only 26.7% of participants were fully knowledgeable about the major components of the disaster plan, while 33.3% had partial knowledge and a significant 40% were not familiar with the components at all. Similar results were found in the study by Younis *et al*.[5] (2020) where 92% of participants knew what a disaster is and what a disaster plan entails. Additionally, Nasir *et al*. (2023) found that 72.4% of participants did not know the major components of the disaster plan.[6] The present study also found that 58.3% of participants were aware of the potential risks and emergencies in the country. While this majority indicates a reasonable level of risk awareness, it also shows that 41.7% of participants may not fully understand the specific risks they face.

Specific knowledge and practical aspects

The principle of triage is well understood by 90% of participants, demonstrating strong knowledge in this critical area. The majority (91.7%) are aware of the hospital's emergency plan; however, there is a slight decrease (65%) in those familiar with the hospital's emergency evacuation procedures, indicating a gap in specific procedural knowledge. In contrast to our findings, a study by Tassew *et al*. (2022) reported that 58.9% of participants were unaware that their hospital had a catastrophe plan.[7] A high percentage (88.3%) agreed that realistic on-scene training is essential, reflecting an appreciation for practical, hands-on training. Nearly all participants (96.7%) recognize that disaster management is a system-oriented specialty involving multiple responding agencies, reinforcing their understanding of the collaborative nature of disaster response. Awareness of the disaster plan's location is low, with only 43.3% knowing where to find it. This represents a critical area for improvement, as quick access to the plan is essential during a disaster. While most participants (93.3%) know what drills are and 83.3% understand their roles during a drill, there remains a portion of staff who may need further clarification and training regarding their specific responsibilities. A cross-sectional study by Nargesi *et al*. (2024) found that knowledge of disaster management among participants was moderate, attributed to the fact that 80.4% had not attended any training courses on disaster management. This indicates that effective knowledge of disaster plans cannot be achieved without proper education on their components.[8]

Recommendations to improve knowledge

Educational initiatives should emphasize that disaster management is multidisciplinary, involving various sectors beyond healthcare. Efforts should focus on enhancing the accessibility and comprehensibility of disaster management literature, along with improving information dissemination through regular training and effective communication channels. Specific training on hospital emergency evacuation procedures and realistic on-scene training is crucial. Regular drills, disaster simulations, and comprehensive educational materials are essential for preparedness. Public awareness campaigns and community involvement should be encouraged, with regular assessments to adjust strategies as needed.

Disaster management practices

The assessment of disaster management practices reveals various strengths and weaknesses in the current system, providing insights into areas that require improvement to enhance preparedness and response capabilities.

Participation in drills and exercises

Only 10% of participants regularly engage in disaster management drills and exercises. While 33% participate rarely, 36.7% do so occasionally, and 20% never participate. This highlights a significant gap in regular involvement with disaster preparedness activities. Consistent participation in drills is crucial for maintaining readiness and ensuring that all individuals are familiar with their roles and responsibilities during a disaster. Perceptions of disaster management practices vary among participants: 10% feel that the practices are very effective, 46.7% consider them effective, a substantial 33.3% remain neutral, and 10% find them ineffective. This mixed perception suggests that while some aspects of disaster management practices are functioning well, others may need reassessment and improvement. In a similar study by Nasir *et al*. (2023) only 36.6% of participants felt that hospital preparedness was adequate.[6] A majority (63.3%) acknowledged that disaster drills are conducted in the hospital; however, the fact that 70% reported no ongoing training indicates a disconnect between the occurrence of drills and the provision of continuous training. Regular and ongoing training is essential to keep skills sharp and ensure that staff remain prepared for emergencies. Similar results were observed in the study by Younis *et al*.[5] (2020) where 48% of participants reported that there was no ongoing training being conducted. The study by Singhal *et al*. (2016) also found that perceptions of disaster preparedness training and the execution of drills were largely negative.[9] Approximately 46.7% of participants stated that the disaster plan in the hospital is updated frequently, which is a positive indication that the hospital is actively maintaining its disaster management strategies. However, this also implies that over half of the participants

may perceive the updates as infrequent or may be unaware of them, highlighting the need for improved communication and transparency regarding plan updates. Less than half (45%) of the participants have personal or family emergency plans, which is concerning. Personal preparedness is a crucial component of overall disaster readiness, and encouraging staff to develop and maintain their own emergency plans can significantly enhance their ability to respond effectively during a crisis. The results in this regard align with findings from the study by Reche *et al*. (2016) where 54.7% of participants agreed that individuals and their families are not adequately prepared for a disaster.[10] A striking 95% of participants agree on the need for more workshops and simulated training. This overwhelming consensus underscores the recognition that current training efforts are insufficient and highlights a strong desire for enhanced educational opportunities to better prepare for disasters. Similarly, a cross-sectional study by Shabbir *et al*. (2017) found poor practices, with 83.3% of participants indicating a need for additional training.[11]

Skills and training assessment

A majority (58.3%) of participants feel their role in disaster management is clear, while 20% do not and 21.7% are unsure. Clarity of roles is vital for an efficient disaster response, and steps should be taken to ensure that all staff understand their specific duties. Additionally, 66.7% feel prepared to handle potential risks and disaster emergencies, whereas 30.3% do not, and 20% are unsure. This indicates a moderate level of confidence but also highlights the need for further training and reassurance. In contrast to our findings, a cross-sectional study by Fung *et al*. (2008) reported that nearly all nurses (97%) felt inadequately prepared for disasters.[12] It was observed that 60% of participants attended workshops or seminars on disaster management, yet only 35% feel that the knowledge gained is sufficient for real situations. This suggests that while educational opportunities exist, their effectiveness may be limited, highlighting the need for a review and improvement of these programs. A high percentage (78.3%) feel that their nursing education has prepared them for disaster scenarios, which is encouraging. However, ongoing professional development is crucial to maintain and enhance these skills. A vast majority (93.3%) are willing to participate in emergency medicine education as part of their continuous professional development, indicating a strong commitment to enhance their skills and knowledge. Over half (56.7%) believe that extracurricular resources such as the Internet, Television, radio, and newspapers provide sufficient readiness for disaster practice, while 43.3% do not. This underscores the importance of incorporating diverse educational tools and resources into disaster preparedness training. Nearly all participants (96.7%) expressed the need for more training focused on providing patient-centered care during disasters, highlighting a critical area for development to ensure that healthcare providers can deliver effective and compassionate care in emergency situations.

Recommendations to improve practices

Mandatory, regular disaster drills and continuous training programs with practical exercises are crucial for staff preparedness. Educational interventions should encompass workshops, seminars, and various tools such as digital media and simulations to enhance knowledge and attitudes. Staff should be educated on personal emergency plans and have a clear understanding of their roles during disasters. Additional training should focus on delivering patient-centered care, emphasizing empathy, communication, and practical skills.

CONCLUSION

The assessment of disaster management practices among hospital staff reveals gaps in practical engagement and procedural knowledge, despite general awareness. There is a strong need for regular, mandatory drills, enhanced training programs, and continuous professional development. By focusing on these areas, hospitals can cultivate a more resilient and prepared workforce capable of effectively responding to disasters and ensuring the safety and well-being of patients and the community.

Authors' contributions: AA: Conceptualize and designed the study; AA and KT: Recruited patients and acquired data; RS and DC: Data analysis and interpretation; AA and DC: Manuscript drafting.

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Case Report

A rare incidence of malignant pleural effusion in multiple myeloma

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ABSTRACT

Multiple myeloma (MM) is one of the most common hematological malignancies. The incidence of pleural effusion (6%) as such is rare in patients with MM, and the incidence of myelomatous pleural effusion is even rarer (1%). The timely diagnosis of this entity is very important because these individuals have a poor overall prognosis. Diagnosis can be made by careful examination of pleural fluid cytology and can be confirmed by flow cytometry. We report a case of myelomatous pleural effusion diagnosed early and successfully managed.

Keywords: Extra-medullary disease , Malignant pleural effusion, MM, Multiple myeloma, Myeloma

INTRODUCTION

Multiple myeloma (MM), a hematological malignancy, is characterized by clonal plasma cells. These cells typically involve the bone marrow found in flat bones (skull, ribs, pelvis, and vertebrae), and the clonal immunoglobulins infiltrate the soft tissues (kidney, nerves, and lungs).[1,2] It is one of the most common hematologic malignancies and constitutes about 1% of all malignancies. However, pleural effusion in patients with MM is rarely reported in the literature with an incidence of about 6%; moreover, malignant myelomatous pleural effusion (MPE) occurs in less than 1% of patients.[3] Sometimes, this may be the first clinical manifestation of myeloma and may also develop during the course of treatment in a few patients. In the last two decades, only about 20 cases of MM with malignant pleural effusion have been published in English literature. We herein report a case of MPE, treated successfully with velcade, pomalidomide, and dexamethasone (VPd) regimen and radiotherapy.

CASE REPORT

We present a 55-year-old male with MM (immunoglobulin G [IgG] kappa, negative myeloma fluorescence in situ hybridization [FISH] panel), who received six cycles of VPd regimen. After completion of six cycles of VPd, he was asymptomatic, discontinued his therapy, and lost to follow-up. He again presented to us with complaints of worsening breathlessness and easily fatigued. He also gave a history of 4 kg weight loss over the last two months. On clinical examination, he was pale and had tachypnea (respiratory rate 28/minute). On chest auscultation, the air entry was decreased on the left side (infrascapular and infra-axillary areas). His blood counts showed hemoglobin (Hb) 10.7g/dL, white blood cells (WBCs) 5400/μL, and platelets 185,000/μL. His bilirubin, aspartate transaminase (AST), and alanine transaminase (ALT) were normal, but kidney function tests revealed azotemia (creatinine 1.56 mg/dL). Serum protein electrophoresis showed an M spike of 3.2 g/dL, IgG kappa band on immunofixation, and free light chain assay showed κ-2384, λ-6.35 with a ratio of 375.4. Chest X-ray posteroanterior (PA) view image showed left-sided cerebellopontine angle (CPA) fullness with a meniscus, suggestive of pleural effusion [Figure 1]. Computed tomography images of the chest showed pulmonary pathology confined to the left side of the lung in the form of loculated pleural effusion with underlying lung collapse. There were also fluids in the fissures [Figure 2a–2c]. The pleural fluid (PF) was straw-colored and biochemical analysis of the PF showed protein 5.5 g/dL (serum protein 6.2 g/dL) and lactate dehydrogenase (LDH) 396 U/L (serum LDH 350 U/L), pathognomic of exudative pleural effusion. Cytological study of the PF showed WBC of 800 cells/μL, with a predominance of lymphocytes. PF Zeihl-Neilsen stain and geneXpert for tuberculosis were negative, adenosine

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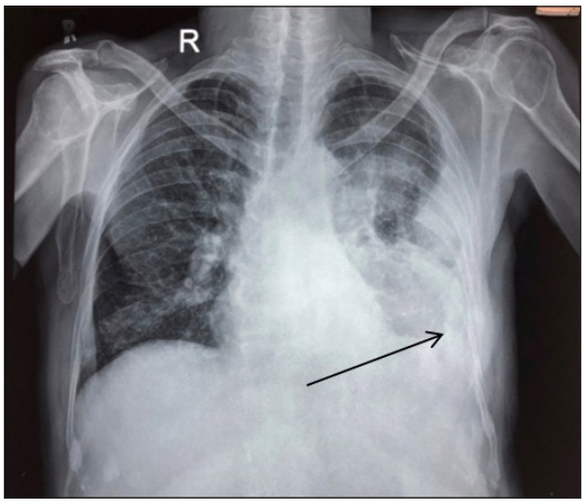

Figure 1: Chest-X-ray showing massive pleural effusion with blunting of costophrenic angle on the left side (black arrow).

deaminase was raised to more than ten times the upper limit of the normal (33 U/L, normal range <30 U/L). PF cultures were sterile. A clinical diagnosis of pleural effusion, likely of tubercular origin, was made, and the patient was treated with four drugs (isoniazid, rifampicin, pyrazinamide, and ethambutol) anti-tubercular therapy (ATT). As the pleural effusion was loculated, therapeutic pleurocentesis was done, followed by pigtail insertion. Subsequent PF cytology showed WBC of 1200 cells/μL with numerous immature plasma cells (bilobed and multilobed plasma cells) [Figure 3a and 3b]. A flow cytometry of the PF showed a predominance of CD38/CD138 positive cells (58% of all nucleated cells) and these cells also expressed positivity for CD56 and CD200 with kappa restriction [Figure 4a–4c].

A final diagnosis of "malignant pleural effusion in a patient with multiple myeloma" was made. His ATT was stopped and restarted on the VPd regimen. He also received radiotherapy over bony lesions. After two weeks, he was subjectively better, with improvement in pain and dyspnea. After four weeks of follow-up, he had complete relief from dyspnea and a repeat X-ray of the chest showed clearing of pleural effusion.

DISCUSSION

MM presents with a variety of symptoms. Though bone pain and anemia are the most common presentation, renal failure, hyperviscosity-related features, and symptoms due to associated amyloidosis are often seen.[4,5]. Lung involvement, especially the effusion, is rarely seen in MM the estimated incidence of effusion is around 5–6% and is mainly non-myelomatous. The occurrence of MPE is even rarer and seen in less than 1% of all cases.[3] In developing countries, tuberculosis is the most common cause of pleural effusion.[6] Other common etiologies of pleural effusion in patients with MM are congestive heart failure, cirrhosis, kidney disease, pulmonary infarcts (pulmonary thromboembolism), hypoalbuminemia, and rarely myelomatous effusion. The proposed pathogenetic mechanisms of MPE include direct extension from chest wall plasmacytomas, invasion from adjacent skeletal lesions, and infiltration of pleura by myeloma.[7] Left-sided effusion is more common and bilateral effusion is seen in only three cases so far in the published literature.[8] However, it is not clear whether this is due to any underlying genetic mutations. The appearance of immature plasma cells is very characteristic on a cytology smear and is considered the best diagnostic technique.[9] Moreover, specific stains, particularly the May-Grunwald-Giemsa (MGG) and Periodic Acid-Schiff (PAS), can also be used to highlight these plasma cells. Whole body positron emission tomography-computed tomography (WB PET-CT) scan can confirm the involvement of the pleura, but it cannot definitively determine the existence of MPE. Flow cytometry is a rapid, accurate, and objective analytic method in diagnosing MPE than conventional cytology. It is imperative to know about this rare entity and needs exclusion

Figure 2: CT chest images showing (a) loculated pleural effusion (green arrow) with fissural effusion (red arrow), (b) with collapse consolidation of underlying lung on the left side (blue arrow). (c) Multiple lytic lesions can be seen in the visualized bones and soft tissue component of the plasmacytoma on the sternum and left first rib (red circle). CT: Computed tomography.

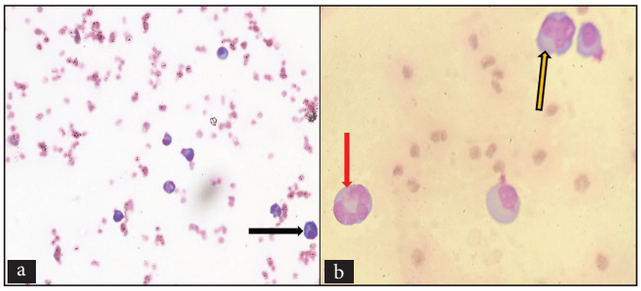

Figure 3: Wright-Geimsa stained smears show mature and immature plasma cells, including (a) 400X, Bilobed plasma cell (black arrow), and (b) 1000X, multilobed plasma cells (red and yellow arrows).

from other common secondary causes of pleural effusion like tuberculosis in patients with MM. MPE typically develops as a late complication of the disease and is known to be a poor prognostic indicator. Previous studies have reported that patients with MPE have a median survival time of less than four months.[10] However, newer drugs like pomalidomide, carfilzomib, and daratumumab are more active in MM and have brought new hopes for myeloma patients, though newer drugs bring newer challenges in the form of associated adverse events.[11–14] A summary of previously published articles have been summarized in Table 1.[15–19] The index patient was treated with pomalidomide-containing regimen (VPd) and showed a good response. However, further follow-ups will be

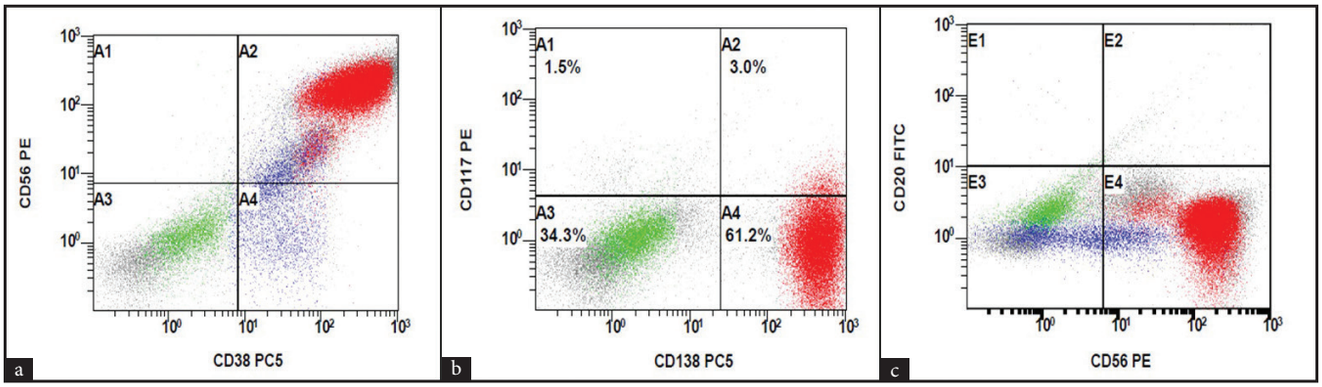

Figure 4: Flow cytometry scatter plots showing (a) CD38, (b) CD138, (c) CD56 positivity.

Table 1: A summary of published literature on myelomatous pleural effusion and the outcome

Author	No. of Pts	Presenting feature	Age/Sex	Disease status at MPE	Unilateral or bilateral	Treatment	Outcome
Iqbal N *et al.*[15] (2016)	N = 1 Case report	Pleural effusion Renal failure	68/M	Inaugural	Unilateral	VRD	Excellent response Well at one year
Ghorbel IB *et al.*[16] (2015)	N = 5 Case series	Bony pains	74/M	Relapse	Bilateral	MP	LTF
		Dull right chest pain	62/M	Inaugural	Unilateral	VAD	Died few months later
		Bony pains	62/F	Relapse	Unilateral	-	Died in few days
		Dyspnoea and chest pain	52/M	Inaugural	Unilateral	VAD	Died at four months
		Dyspnoea and low back ache	55/M	Inaugural	Unilateral	MP	Died few months later
Miller J *et al.*[17] **(2012)**	N=1 Case report	Dyspnoea	66/F	Relapse	Unilateral	VCD → MP	No follow-up available
Maat Z *et al.*[18] (2022)	N = 1 Case report	Cough and chest pain	44/M	Inaugural	Unilateral	VRD	Died in few days (meningitis)
Wada A *et al.*[19] (2020)	N = 1 Case report		50/F	Relapse	Unilateral	VRD → DaraRD	Two years RFS

MPE: Myelomatous Pleural Effusion, VRD: Bortezomib, Lenalidomide, Dexamethasone, MP: Melphalan Prednisolone, LTF: Lost to follow up, VAD: Bortezomib, Doxorubicin, Dexamethasone, VCD: Bortezomib, Cyclophosphamide, Dexamethasone, RFS: Relapse free survival, DaraRD: Daratumumab, Lenalidomide, Dexamethasone

required to assess the survival benefit of newer drugs in MM with pleural effusion.

CONCLUSION

Though MPE is rare, clinicians should not be complacent while investigating MM patients with pulmonary findings suggestive of MPE. Repeated sampling and careful examination of pleural cytology and flow cytometry are crucial in the diagnosis. Though the presence of MPE suggests poor prognosis, an early diagnosis and prompt initiation of anti-myeloma therapy can indeed be the right way for a successful outcome, as in the index case.

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Case Report

Unmasking molluscum contagiosum: Navigating atypical presentations in a clinical mosaic

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ABSTRACT

Molluscum contagiosum is a poxvirus-mediated, highly contagious infection predominantly affecting the face, trunk, and extremities of children and young adults. Although typically characterized by flesh-colored papules with central umbilication, atypical presentations, particularly in immunosuppressed and HIV-infected individuals pose diagnostic challenges. This retrospective study, spanning from January 2013 to January 2016, examined 19 cases of molluscum contagiosum, emphasizing unusual clinical and histopathological features. Three atypical cases were identified, including a 24-year-old female with a subcutaneous lump on the left areola, a 34-year-old male with genital lesions resembling lichen nitidus, and a 17-year-old male with a cystic scalp swelling. Histopathological examination confirmed molluscum contagiosum in all cases, revealing characteristic eosinophilic inclusions within squamous cells. Notably, the study expands the understanding of atypical presentations, such as lesions on the areola and cystic forms, which are infrequently reported in the literature. Despite the absence of immunosuppression or HIV infection in the atypical cases, the study highlights the need for clinicians to consider molluscum contagiosum in diverse clinical scenarios. The accurate diagnosis, often requiring biopsy or cytology, underscores the importance of histopathological evaluation in guiding appropriate treatment strategies, including surgical excision or topical antiviral agents. Overall, these case reports contribute valuable insights into the varied manifestations of molluscum contagiosum, emphasizing the necessity for vigilance in recognizing atypical presentations.

Keywords: Atypical presentation, Histopathological, Inclusions, Molluscum contagiosum, Poxvirus

INTRODUCTION

Molluscum contagiosum is a highly contagious infection caused by the poxvirus that primarily affects children and young adults' faces, trunks, and extremities. The latter could also exhibit genital involvement as a consequence of intercourse.[1,2] Clinical diagnosis of these lesions is aided by typical umbilicated flesh-colored papules and common locations of involvement. Larger versions of these papules have also been documented; however, they most typically measure 3–5 mm.[3] But, not every instance exhibits the traditional clinical traits. Not only are unusual places involved. The lesions' clinical characteristics can also make it difficult for clinicians to make a preoperative diagnosis. These aberrant presentations, which include bigger lesions at odd locations and a peculiar clinical picture, are typical in HIV-positive and immunosuppressed patients.[1,4] As per the study conducted by Al-Hilo *et al.* (2012), a typical presentation of umbilicated papules was found in 92.12% of their study population, while 7.78% patients were clinically atypical.[5]

Only scattered case reports of unusual presentations of molluscum contagiosum are on record without any large-scale studies. Keeping in view these considerations, we retrospectively reviewed all patients with molluscum contagiosum at our institution with special emphasis on atypical case presentations and morphological features on histopathological and cytopathological evaluation.

CASE REPORTS

The archives of the Department of Histopathology were retrospectively reviewed from January 2013 to January 2016. Of the 45,220 pathology case records reviewed, 19 cases of molluscum contagiosum were retrieved. Of these, unusual sites involved and atypical clinical presentations were included in the study. Following surgical excision, the excised specimen was fixed in 10% neutral-buffered formalin and sent for histopathological evaluation. The diagnosis was confirmed on hematoxylin and eosin (H&E)-stained formalin-fixed paraffin-embedded sections. All the fine needle aspiration

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cytology (FNAC) smears and histopathology slides were reviewed by two experienced pathologists.

The mean age of the patients was 24.4 years with an age range of 9–54 years. The male-to-female ratio was 2:1. Of these, three atypical cases were observed and included in the study. The clinicopathological features of these cases are described in Table 1. None of these atypical cases showed evidence of immune suppression, and all were negative for HIV testing.

A 24-year-old female, 34-year old male, and 17-year old male presented with unusual clinical characteristics. The first case was a 24-year-old female with a subcutaneous lump in the left areola for 3 weeks [Figure 1a]. The swelling was firm in consistency, measuring 2 cm × 1 cm. A provisional clinical diagnosis of skin appendageal tumor was made.

The second case was a 34-year-old gentleman with multiple symptomatic skin-colored pinpoint to pinhead papules present discretely as well as grouped over the shaft of the penis for 2 weeks [Figure 1b]. The patient gave a history of unprotected intercourse 4 weeks before presentation. The clinical profile of the patient was suggestive of lichen nitidus. Fine-needle aspiration was performed which revealed whitish material and features suggestive of molluscum contagiosum.

The third atypical case of molluscum contagiosum was in a 17-year-old male who presented with a scalp swelling measuring 4 cm × 3 cm [Figure 1c]. The patient noticed the swelling 1 week prior, and the swelling was increasing in size. On palpation, the swelling was soft to firm in consistency with well-defined margins. FNAC revealed pultaceous material which correlated with the presence of anucleated squamous cells on microscopic examination of smears. No amorphous intracytoplasmic bodies were noted in this case, thus rendering a cytological diagnosis of epidermal inclusion cyst.

Fine-needle aspiration cytology was done in only one case with a provisional diagnosis of sebaceous cyst. The other two

Table 1: Clinicopathological features of atypical cases of molluscum contagiosum

Cases	Age	Sex	Clinical presentation	Provisional clinical diagnosis	FNAC
Case 1	24	F	Polypoidal mass on the left breast (areola) measuring 1 cm × 0.8 cm	Fibroepithelial polyp	Not attempted
Case 2	34	M	Multiple skin-colored pinpoint to pinhead papules over the shaft of the penis	Lichen nitidus	Features suggestive of molluscum contagiosum
Case 3	17	M	Soft to firm swelling on the scalp measuring 4 cm × 3 cm	Sebaceous cyst	Nucleated squamous cells only

FNAC: Fine needle aspiration cytology

Figure 1: (a) Subcutaneous firm lump (black arrow) in the left areola measuring 2 cm × 1 cm. (b) Multiple symptomatic skin-colored pinpoint to pinhead papules (black arrows) present discretely as well as grouped over the shaft of the penis. (c) Young male with a scalp swelling (black arrow) measuring 4 cm × 3 cm. The swelling was cystic with well-defined margins.

cases had a clinical differential diagnosis of a fibroepithelial polyp and lichen nitidus, respectively. Hence, FNAC was not done. Surgical excision of the cases was performed. Histopathological examination revealed skin-covered tissue showing the presence of acanthosis and mild epitheliomatous hyperplasia. There were numerous intracytoplasmic eosinophilic inclusions, molluscum bodies, or Hendersen–Peterson bodies seen within these squamous cells [Figure 2a-2b]. These inclusions showed a change in color from eosinophilic to basophilic at the level of the stratum malpighi. The underlying stroma showed mild lympho-mononuclear inflammatory infiltrate, while a single case of molluscum contagiosum of the breast additionally showed the presence of foreign body giant cell reaction. The atypical case of the scalp and penile swelling also showed similar features; however, the lesion was cystic. This cyst was lined by stratified squamous epithelium with the presence of molluscum bodies [Figure 2c-2d].

The postoperative period was uneventful.

DISCUSSION

The term "molluscum contagiosum infection" was originally used by Bateman in 1817. The disease affects 2%–10% of people globally, with HIV-positive people and other immunocompromised people having an incidence of up to 5%–18%.[6] None of the cases in our study showed any evidence of immunosuppression.

The DNA virus that causes molluscum contagiosum infection is a member of the Poxviridae family.[7] It comprises four genotypes, of which molluscum contagiosum virus genotype-1 (MCV genotype-1) is the predominant genotype, accounting for 75%–90% of cases in the United States of America, while other genotypes mainly affect the populations in other countries as well as immune-compromised individuals.[5,7,8] However, these genotypes are clinically indistinguishable.

MCV is highly contagious, and transmission takes place through direct contact, sexual contact, autoinfection, fomites on towels, salons, and swimming pools. The average incubation period for MCV is 2–7 weeks; however, it can be extended up to 6–18 months. MCV causes epithelial lobules to develop after infecting epidermal keratinocytes. Molluscum bodies are found in these downward-growing lobules of epithelial proliferation. In the event that MCV infection occurs in the hair follicle infundibulum, the patient may occasionally present with comedones or abscesses.

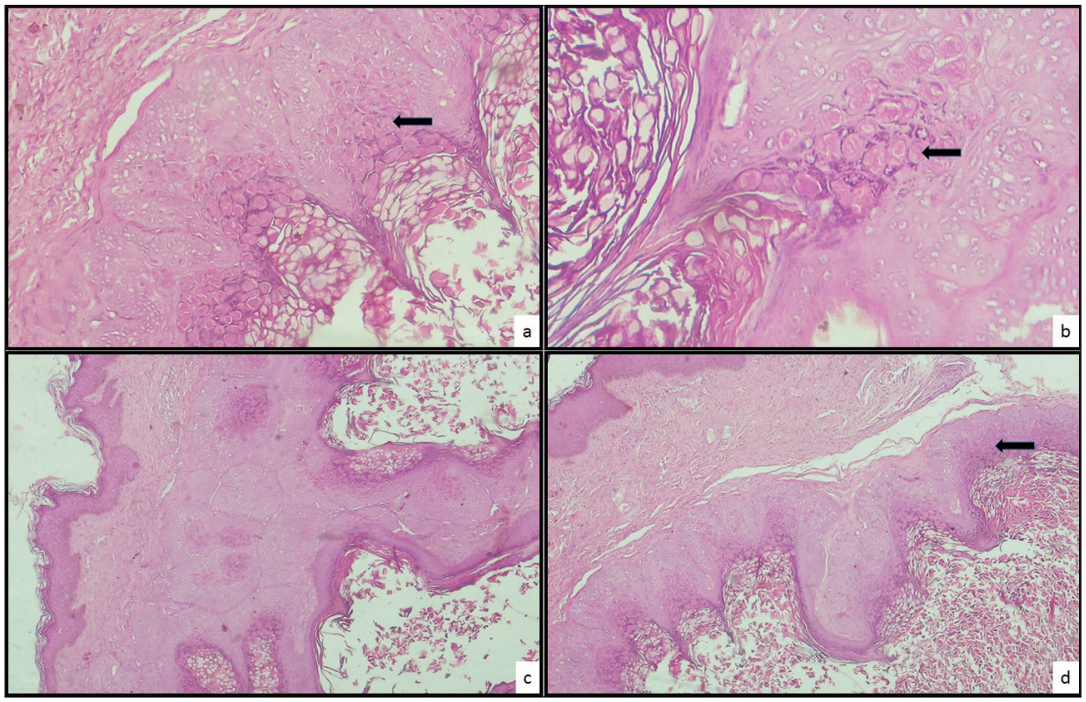

Figure 2: (a) Photomicrograph showing skin-lined tissue with numerous intracytoplasmic eosinophilic inclusions or molluscum bodies (black arrow) within the squamous cells (H & E; × 200). (b) Higher magnification showing molluscum bodies (black arrow) (H & E; ×400). (c & d) Photomicrograph showing skin-lined tissue with the presence of a cyst lined by stratified squamous epithelium showing intracytoplasmic molluscum bodies (black arrow) (H & E; ×200). H&E: hematoxylin and eosin stain.

Clinically, immunocompromised people, sexually active adults, and children are often affected by molluscum contagiosum. While childrens trunk, neck, arms, armpits, and faces are most frequently affected, genital lesions are also seen in sexually active adults. It is also frequently noticed that mucous membranes, such as the tongue, lips, and buccal mucosa, are involved. Finally, immunocompromised people can present with atypical appearances such as large forms and disseminated disease. This can also be seen in immunocompetent patients. However, the etiology of the latter remains elusive.[9,10]

Among the 19 cases of molluscum contagiosum included in our study, we found 3 cases with atypical presentations. Our first case was a 24-year-old female with a molluscum contagiosum lesion over the areola. Firstly, lesions of molluscum contagiosum are small, dome-shaped, skin colored with a characteristic central umbilication. However, in our case, the patient presented with a firm subcutaneous mass misleading the clinician toward a diagnosis of skin appendageal tumor. Secondly, localization of molluscum contagiosum lesions over the nipple and areola is unusual with only eight similar cases reported in the literature [Table 2].[1,11-17] The age range of these patients is 18–45 years with 3 cases on the nipple and 5 cases involving the areola. Thus, our case adds to the list of this common lesion at an uncommon site, i.e., areola. It also highlights that an immunocompetent patient can also have atypical presentations of molluscum. Furthermore, this uncommon localization can be confused with other commonly found diseases such as warts, Paget's disease, and epidermal lesions, thereby making pathological examination a gold standard for diagnosis.

Another unusual case in our study was cystic molluscum contagiosum, simulating a sebaceous cyst. Molluscum contagiosum presenting as a cystic lesion is an extremely rare entity with only two cases reported in literature to date.[5,18] Further borrowing from literature, the coexistence of molluscum contagiosum and epidermal inclusion cyst has also been reported. This rather unusual association can be explained either by co-inoculation of the poxvirus at the time of the cyst formation or invasion of a preexisting cyst by this virus.[19]

Molluscum contagiosum may simulate many common skin diseases as seen in an isolated case in our study. Although clinical features were suggestive of lichen nitidus, needle extraction revealed the final diagnosis of molluscum contagiosum. Clinical differential diagnoses of molluscum contagiosum include folliculitis, warts, nevi, and skin adnexal tumors such as syringoma and keratoacanthoma.[20] However, the exact pathogenesis behind such atypical presentations in immunocompetent patients has not been fully understood.[21]

Diagnosis is mostly made by clinical evaluation; however, biopsy or cytology is required for a definitive diagnosis, especially in cases of unusual presentations. The lesions are confirmed by the demonstration of molluscum bodies. The latter also known as Henderson–Patterson bodies, are cytoplasmic, faintly granular eosinophilic inclusions that displace nuclei in the cells of the stratum malpighi. At the level of the granular layer, the staining reaction of molluscum bodies changes from eosinophilic to basophilic. Special stains like phosphotungstic acid-hematoxylin and carbon-aniline-fuchsin after mordanting with potassium permanganate are used to demonstrate molluscum bodies.[22] The molluscum bodies can also be demonstrated on routine Papanicolau- and Giemsa-stained cytology smears, thus clinching an accurate diagnosis.[23,24]

Treatment can be in the form of curettage, laser, cryotherapy, or salicylic acid. Solitary intact lesions of molluscum contagiosum in immunocompetent patients can be treated by simple surgical excision. On the contrary, resistant cases in the

Table 2: Molluscum contagiosum of breast

Case	Age (years)	Site	Clinical features	Treatment
Carvalho *et al.*[11] (1974)	22	Areola	Initially painless, later infected and painful	Not available
Schmid-Wendtner *et al.*[12] (2008)	20	Areola	Rapidly growing, raised, yellowish papule	Not available
Parlakgumus *et al.*[13] (2009)	Not available	Areola	Pearly popular lesions	5% imiquimod therapy – 3 times a week for 2 months
Kumar *et al.*[1] (2010)	45	Areola	Nodular lesions with ulceration	Not available
Marwah *et al.*[14] (2012)	30	Nipple	Small, papular, nonpainful lesion	Not available
Likhar *et al.*[15] (2014)	18	Nipple	Papulo-nodular lesion with whitish discharge	Excision
Caroppo *et al.*[16] (2016)	24	Nipple	Small, flesh-colored, eczema-like plaques	Curettage
Hoyt *et al.*[17] (2013)	28	Areola	6 × 6 mm flesh-colored flattened papule	Excision
Current case	24	Areola	Subcutaneous mass measuring 2 cm × 1cm	Excision

immunocompromised may be treated with topical antiviral agents like cidofovir or intralesional interferon alpha.[25]

CONCLUSION

Molluscum contagiosum is a benign self-limiting infection which most frequently involves the trunk, extremities, and genitalia. Unusual sites of involvement along with an aggressive course of disease, although seen more frequently in immunocompromised individuals, can also be encountered in healthy individuals. Thus, the clinicians must keep in mind the differential diagnosis of molluscum contagiosum at rare sites such as areola and even in the setting of skin diseases or cystic lesions.

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Case Report

Case of congenital mandibular malformation: A rarity

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ABSTRACT

The condition known as craniofacial duplication, or Diprosopus, is an exceedingly rare occurrence. The term "Diprosopus" originates from Greek, meaning "two-faced person." This condition can involve a wide range of anomalies, from complete duplication of facial features to partial duplication of specific facial structures. It is a congenital developmental abnormality typically identified during prenatal development or in the early stages of a child's growth. Formerly, it was believed to be an anomaly rather than a teratoma. The first documented report of this unique phenomenon was by Mclaughlin in 1948, and it was also recognized as a form of conjoined twinning. The classification system for this condition is based on the specific structures that exhibit duplication, resulting in four distinct types. Notably, this report discusses an extraordinary case involving the irregular growth of the mandible in a seven-year-old girl. This case is marked by the growth of an accessory structure stemming from the lower border of the mandible and is associated with developing tooth buds. The report delves into the diagnosis and management of such a unique and complex case.

Keywords: Congenital mandibular defect, Craniofacial duplication, Diprosopus, Mandible duplication

INTRODUCTION

Diprosopus is the term used to describe craniofacial duplication. Diprosopus is a term with Greek roots meaning "two-faced person." It is an extremely rare congenital malformation where there is partial or complete duplication of the face with normal limbs and trunk. Diprosopus is considered one of the rarest forms of conjoined twins. Literature suggests an incidence of 1 in 180,000 births.[1] The majority of diprosopic newborns with full duplication and single, normal limbs have significant central nervous system abnormalities.[2] The majority of newborns with incomplete diprosopus (duplication of the maxilla, mandible, or mouth cavity) have a normal central nervous system. In these youngsters, the duplicated portions are removed to restore a natural look. It was first described by McLaughlin in 1948. A child with hemimandible duplication is discussed in this case report.[3]

CASE REPORT

The Department of Oral Medicine and Radiology received a seven-year-old female patient accompanied by her parents. The patient's primary complaint was a painless swelling in the lower left side of her face that had been present for the past four years, leading to a disfigurement of the face. According to the patient's mother, she had noticed a small swelling in the left lower side of her daughter's face four years ago, which gradually increased in size over time. The swelling is now at its present size. The patient did not experience any pain associated with the swelling.

The mother provided a history of small tissue growth with discharge on the left lower side of her daughter's face at seven months of age [Figure 1], which was initially diagnosed as a teratoma on the left chin. Subsequently, the growth was excised, resulting in a scar along the left lower border of the mandible. The histopathological examination of the excised specimen revealed it to be a congenital sinus.

During the extraoral examination [Figure 2a-b], facial asymmetry was observed due to a swelling in the left lower third of face. The swelling was diffuse, measuring approximately 3 × 2 cm in the left body of the mandible region. The swelling extended from the left parasymphysis region to the left angle of the mandible region anteroposteriorly and from the inferior border of the mandible extending into the left submandibular region superoinferiorly. There was a surgical scar present on the skin over the swelling. Upon palpation, the swelling was found to be bony hard in

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Figure 1: Congenital sinus tract aged seven months (yellow circle).

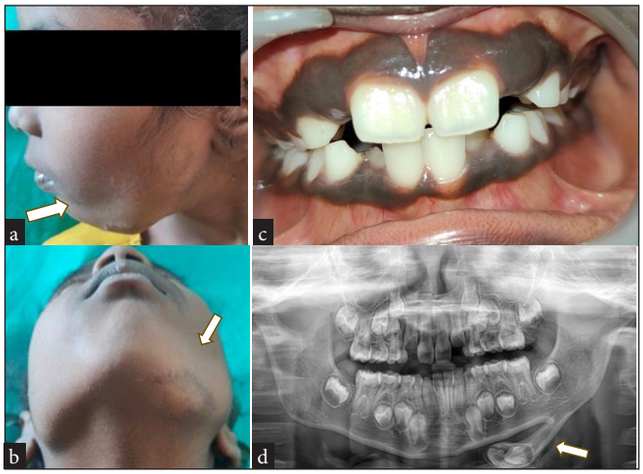

Figure 2: (a and b) White arrow showing Diffuse extraoral swelling in the left lower border of mandible with surgical scar, (c) Intraoral view showing no abnormalities, and (d) White arrow in orthopantomogram showing extraosseous bony growth with enclosed tooth buds.

consistency, non-tender, roughly ovoid, noncompressible, and fixed. There were no visible pulsations. On intraoral examination [Figure 2c], no abnormalities were noted. The history and clinical presentation suggested a benign lesion of the bone. Exostosis of the mandible and osteoma of the mandibles were considered for clinical differential diagnosis.

The ultrasonogram displayed a well-defined hyperechoic solid lesion measuring 11 × 6 mm near the left ramus of the mandible. The orthopantomogram [Figure 2d] revealed a radiopaque structure extending from the left lower border of the mandible to the angle region. This structure featured dense radiopaque formations, resembling developing tooth buds surrounded by radiolucent follicle space. The lateral skull view depicted a bone outgrowth from the left lower border of the mandible in the angle region. Computed tomography of facial bones [Figure 3] displayed that the posterior part of the outgrowth was attached to the lower border of the mandible in the angle region, while the anterior end was unattached and separate from the lower border of the mandible. The Hounsfield unit of the outer bone was similar to cortical bone, while that of the tooth bud-like structures enclosed within it was similar to enamel and dentin. Cone beam computed tomography [Figure 4] revealed an outgrowth measuring about 40 mm in length and 12 mm in maximum diameter originating from the lower border of the mandible at a point 8 mm beneath the tooth bud of 37. The developing supernumerary teeth consisted of enamel, dentin, and pulp space with incomplete root formation enclosed by a follicle. In addition, an accessory nerve/vascular bundle was evident at the junction of the outgrowth and the lower border of the mandible.

Clinical and radiographic features suggested a diagnosis of incomplete duplication of left hemimandible.

Surgical resection followed by recontouring was performed under general anesthesia.

Histopathologic examination [Figure 5] of the H and E stained section of the resected specimen demonstrates normal bone with minimal marrow spaces and dentinal tubules, which correlates with the finding of normal bone and tooth bud that was appreciated radiographically.

Figure 3: Intraoral examination shows no abnormalities.

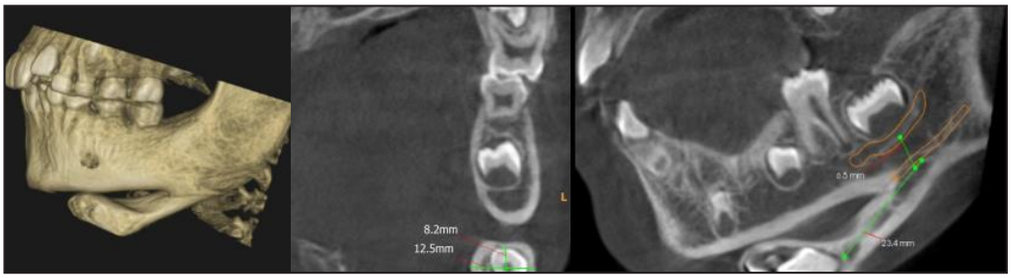

Figure 4: Cone beam computed tomography showing accessory neurovascular bundle.

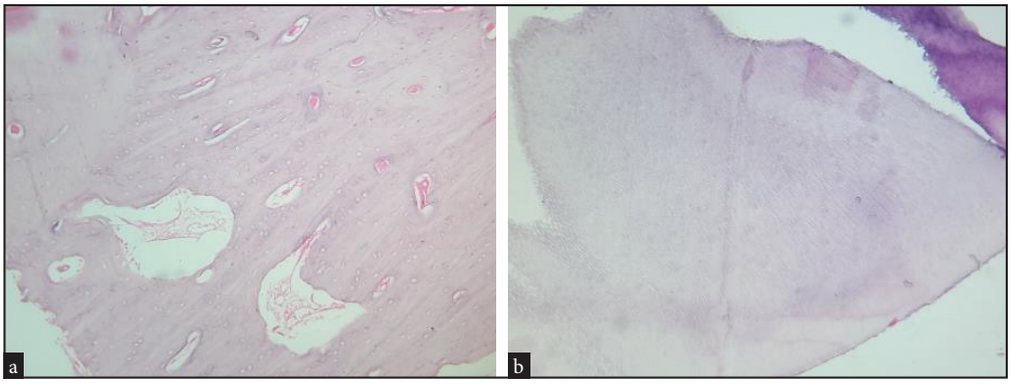

Figure 5: (a) Normal bone with marrow spaces; (b) Dentinal tubules. Histopathologic photomicrograph (a,b: Hematoxylin and Eosin stained section under 10x magnification).

Postoperative [Figure 6] recovery was uneventful. The two-month follow-up revealed normal wound healing without any pain or paresthesia.

DISCUSSION

Diprosopus is a rare condition that can encompass a wide range of congenital anomalies, including complete duplication of facial features or partial duplication of facial structures. Studies have shown a 2:1 female-to-male ratio, indicating a higher prevalence in females.[4] In cases of partial duplication, the maxilla, mandible, or oral cavity are commonly affected. Partial duplication of individual mandibular structures or symmetric double mandibular arches is a common manifestation. These duplicated mandibles may include the accessory condyle, coronoid process, mandibular body, and the canal. Supernumerary teeth are often present, typically in regular tooth shapes, and may be impacted or erupt into functional occlusion.

The pathogenesis of craniofacial duplication remains poorly understood. Various reasons have been attributed to mandibular duplication[5]:

- Duplication of first brachial arch
- Sequestration of totipotent stem cells resulting in developmental anomalies
- Split notochord syndrome
- Mandibular growth center duplication around the margins of the stomatodeal plate
- Amniotic band syndrome

Beatty proposed a hypothesis that partial oral duplication can occur due to developmental excess. He reported a case with accessory mouth. His idea proposes that an auxiliary growth center forms in the regular mandibular process, eventually developing into an accessory mandible and mouth.[6]

Mason Barr identified three forms of facial duplication in 1982[4]:

- Eye and nose duplication, including maxillary or mandible duplication
- Nasal or maxillary duplication
- Maxillary duplication which may or may not include mandible and pituitary duplication; he described pituitary duplication in isolation but was unsure about the presence of isolated mandibular duplication

In 1989, Chen and Noordhoff[7] suggested a technique for classifying stomodeal formations. This was based on the abnormalities seen in the actual mouth, the degree of development of the duplicated lip or jaw, and their location and components:

- Type I (duplicated mouth)

Figure 6: (a) Postoperative images; (b) Postoperative orthopantomogram.

- Type II (duplication of the maxilla upper lip or mandible lower lip complex)
- Type III (centrally located, poorly developed lip-jaw duplication)

Bhuyan *et al.*[1] proposed a categorization approach that focuses on oral duplication in 1990:

- Maxillary duplication with normal mouth
- Rudimentary mandible with duplicated mouth
- Partial duplication of the mandible with a single mouth
- Anencephaly accompanying diprosopus

An additional jaw should be differentiated from a teratoma with osseous toothlike features. Teratomas are encapsulated tumors that contain tissue or organ components derived from three germ layers.

In the case of a duplicated mandible, the accessory structures are well organized, whereas in a teratoma, they are arranged haphazardly. Supernumerary teeth may be found in duplicated jaws. The shapes of these supernumerary teeth associated with diprosopus were found to be normal.[8]

The treatment of choice is surgical resection and recontouring with good cosmetic and functional results.

CONCLUSION

Diprosopus is an exceptionally rare condition that can result in significant cosmetic and functional challenges. It can manifest as partial duplication, involving a single bone or a portion of a bone, or as complete duplication. Additionally, some reported cases have indicated the presence of facial cleft or parotid aplasia alongside mandibular duplication. Surgical resection and recontouring have emerged as highly effective interventions, yielding positive outcomes in addressing these complexities.

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Short communication

Summary of initiatives for treating congenital heart disease: Enhancing quality of life and bridging the knowledge gap

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ABSTRACT

Congenital heart disease (CHD) represents a significant global health concern, contributing to high infant mortality rates, particularly in low and middle-income countries (LMICs) like India. The primary obstacles that need to be addressed include low awareness, delayed diagnosis and referral, unavailability, inaccessibility, and unaffordability of essential medical care, high patient volumes, lack of dedicated research, and widespread malnutrition. In this web-based literature review, we aim to highlight the critical gaps in healthcare access for CHD by summarizing the disease burden and identifying organizations and initiatives that offer free cardiac interventions throughout India.

Key words: Cardiac centers, Congenital heart disease, Free of cost, India, Schemes

CONGENITAL HEART DISEASE—CURRENT SCENARIO AND NEED–SUPPLY GAP

According to the *Global Report of Birth Defects*, approximately 7.9 million children are born annually with various birth defects, of which about 1.35 million cases are attributed to congenital heart disease (CHD), which ranks as the fourth leading contributor to global infant mortality, especially in low and middle-income countries (LMICs).[1] The lack of access to congenital cardiac care and malnutrition are believed to be the primary barriers to progress in addressing CHD [Figure 1]. Evidence suggests that over 90% of patients could survive to a healthy adult life if they received timely screening, diagnosis, and treatment.[2] While around 40% of fetal CHD cases can be detected by prenatal sonography, factors such as the tester's expertise, equipment sensitivity, fetal positioning, and maternal obesity can affect the accuracy.[3]

Unfortunately, nearly 90% of children born with CHD do not have lack to essential diagnostic services. Also, costly interventions, which can range from INR 1.75 to 4.25 lakhs (USD 2,050 to 5,050) can be yet other impediment.[4–6] In Asia, the healthcare infrastructure is strikingly inadequate, with one cardiac center catering to 16 million people, resulting in a surgery ratio of only 0.5 per million in LMICs.[2] In India, CHD affects 1 in 100 live births, resulting in roughly

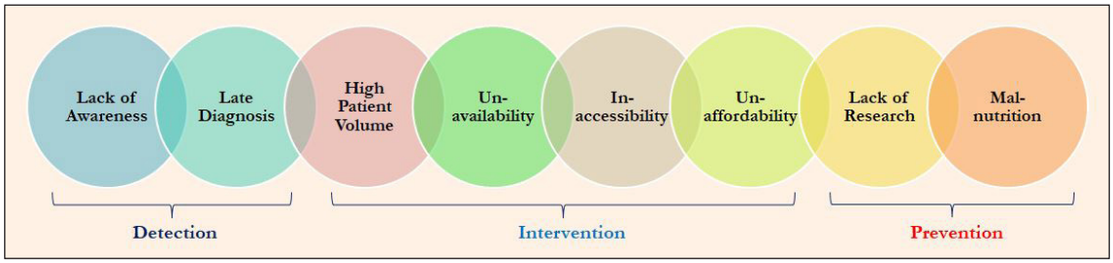

Figure 1: Need–supply gap in pediatric cardiac care.

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0.3 million cases annually.[7] Among these, at least 50,000 children require early intervention. However, only about one-fourth receive surgical treatment.[8] The majority of cases are concentrated in Northern and Eastern India, where birth rates are comparatively higher.[7]

Saxena *et al.* (2020) prepared guidelines for the indications and timing of interventions for CHD within the Indian context, advocating for comprehensive physical and clinical examinations, echocardiograms, chest X-rays, and echocardiography as essential diagnostic tools.[9] However, the availability of pediatric cardiac surgeons remains critically low, with only around 4,000 surgeons available globally, including ~300 in India, serving about 90 cardiac centers.[10,11] Financial constraints further worsen the high disease burden; World Bank's *Poverty, Prosperity, and Planet Report 2024* indicates that around 129 million individuals live in extreme poverty.[12] Most pediatric cardiac facilities are located in major metropolitan areas, leaving a significant proportion of families affected by CHD in rural regions with limited access to medical care. A study conducted in Kerala, India, highlighted that half of the families borrowed money post-surgery to cover expenses during the follow-up period.[13] Moreover, inadequate quality of care can result in higher morbidity and mortality rates than the absence of care altogether.

ORGANIZATIONS AND GOVERNMENT SCHEMES TO HEAL LITTLE HEARTS ACROSS INDIA

The public–private partnership (PPP) model, involving collaboration between hospitals, government entities, charitable non-governmental organizations, and corporate partners, has proven to be an effective strategy for building capacity and ensuring the sustainability of pediatric cardiac

Table 1: Spectrum of government schemes and charitable organizations providing CHD free of cost in India

Scheme/Program	Implementing agency	Benefits
Ayushman Bharat (Pradhan Mantri Jan Arogya Yojana)[14]	Govt. of India	Financial assistance up to INR 5 lakhs/year Approximately, 1929 procedures including CHD for patients of any age group Covers cost of pre-hospitalization, medication, laboratory investigations, boarding and lodging, and 15 days' post-hospitalization follow-up care
Rashtriya Bal Swasthya Karyakram[15]	Govt. of India	Comprehensive screening and treatment of 4Ds—defects at birth, diseases, deficiencies and development delays for children (0–18 years)
Janani Shishu Suraksha Karyakram[16]	Govt. of India	Free care of pregnant woman and sick newborns 30 days after birth Covers cost of delivery, diagnostics, boarding and lodging, blood transfusion, and round-trip from home to hospital cost
Rashtriya Arogya Nidhi[17]	Govt. of India	Suffering from disease related to heart, kidney, liver, cancer, etc. Provides financial assistance up to INR 2 crores to economically weaker patients of any age group living below poverty line (BPL)
Sishu Saathi Scheme[18,19]	Govt. of West Bengal	Free cardiac and neurosurgeries for children (0–12 years)
Hridyam for little hearts[20]	Govt. of Kerala	Registry to screen and treat CHD children (0–18 years)
Rajiv Aarogyasri Scheme[21]	Rajiv Aarogyasri Health Care Trust and Govt. of Telangana	Approximately, 1672 procedures including CHD Financial assistance up to INR 10 lakhs/year to BPL patients of any age group
Ilam Sirar Irudhaya Padukappu Thittam (Adolescent Cardiovascular Protection Program)[22]	Govt. of Tamil Nadu	Screening and treatment of CHD for children (0–18 years)
Delhi Arogya Kosh (DAK)[23]	Govt. of NCT of Delhi	Suffering from any illness including CHD Financial assistance of up to INR 5 lakhs (in govt. hospitals only) to patient of any age group with annual income up to INR 3 lakhs, along with diagnostics cost for ultrasound, ECHO, EEG, EMG, TMT, Doppler studies, and Mammography
Heart Care Program for CHD[24]	Govt. of Assam	Free screening, investigations, and surgeries for CHD of children (0–18 years) with annual income up to INR 6 lakhs Covers travel and accommodation cost

(Contd...)

Table 1: (*Continued*)

Scheme/Program	Implementing agency	Benefits
Mahatma Jyotirao Phule Jan Arogya Yojana[25]	Govt. of Maharashtra	Approximately, 34 medical specialties including cardiac care Financial assistance up to INR 5 lakhs/family/year for BPL patient of any age Covers cost of pre-hospitalization, medication, laboratory investigations, blood transfusion, boarding and lodging, and travel
Mukhyamantri Himachal Health Care Scheme (HIMCARE)[26]	Govt. of Himachal Pradesh	Financial assistance up to INR 5 lakhs/year for BPL and other underprivileged patient of any age
Mukhyamantri Amrutum Yojana[27]	Govt. of Gujarat	Covers surgery cost of cardiovascular, neuro, burns, poly trauma, cancer, renal, and neonatal diseases to BPL patients of any age
Mukhyamantri Chiranjeevi Swasthya Bima Yojana[28]	Govt. of Rajasthan	Covers surgical cost of cancer, heart, neuro, organ-transplantation, Covid-19, black fungus, etc. Financial assistance up to INR 25 lakhs to patients (0–75 years) with annual income up to INR 8 lakhs
Dr. NTR Vaidya Seva Scheme[29]	Govt. of Andhra Pradesh	Covers cost of admission, consultation, medical tests, medicine, surgery, boarding and lodging, travel, and 10 days' post-discharge follow-up care Financial assistance up to INR 5 lakhs to patient of any age with annual income up to INR 5 lakhs
GIVE Model[6]	Sri Sathya Sai Health and Education Trust	Covers cost of screening and treatment of CHD patient of any age along with free boarding and lodging along with free fetal echocardiography and maternal-child care across India
Public Charity[30]	Hans Foundation	Financial assistance for treatment of CHD and other diseases to underserved patient of any age across India
Save Little Hearts[31]	Genesis Foundation	Financial assistance for treatment of CHD children (0–18 years) with annual income up to 2.4 lakhs across India
Little Hearts Program[32]	Being Human—The Salman Khan Foundation	Financial assistance for treatment of underprivileged CHD children (0–18 years) in remote areas across India
Making Heart Smile[33]	Child Heart Foundation	Financial assistance for screening and treatment of BPL CHD children (0–18 years) across India along with training and education
Save a Heart Program[34]	Fortis Foundation	Financial assistance for screening and treatment of underprivileged CHD children (0–18 years) across India
Healing Hearts with Compassion[35]	Amrita Heart Care Foundation	Financial assistance for treatment of CHD children (0–18 years) across India

CHD: Congenital heart disease, ECHO: Echocardiogram, EEG: Electroencephalogram, EMG: Electromyography, NCT: National capital territory, TMT: Treadmill test

programs in India [Table 1]. A notable example of such a partnership is *Hridyam*, a web-based application launched by the Kerala government in 2017. This initiative collaborates with both private and government hospitals to facilitate the registration of children suspected of having CHD for early treatment.[36]

Another classic model is the *GIVE* framework—Government, Institutions and Individuals, Values, and Engagements—proposed by Sri Sathya Sai Sanjeevani Hospitals (India)—an initiative of the "Sri Sathya Sai Health and Education Trust (SSSHET)." This model aims to not only provide sustainable care for CHD patients but also ensure scalability across regions [Figure 2].[6] The present study is conducted at the Sri Sathya Sai Sanjeevani Research Centre Palwal (Haryana)—*a* Department of Scientific and Industrial Researc (DSIR)-recognized Scientific and Industrial Research Organization (SIRO), a research arm of SSSHET, which focuses on unraveling the causal factors of CHD.

Current data indicate that government schemes and PPP initiatives cover approximately 40% and 20% of surgical care, respectively, while families are responsible for funding around 35% of interventions.[7] A recent survey conducted at 24 hospitals across India examined the sources of funding for pediatric cardiac interventions in both government and private hospitals. The findings revealed that government schemes funded ~55.3% in government hospitals and 42.9%

Figure 2: Different domains to address the comprehensive care of congenital heart disease.

in private institutions, while additional government aid accounted for 17.6% and 5.3%, respectively. Family funding represented 24.9% in government hospitals and 31.9% in private ones.[37]

CONCLUSION

Nearly 20% of CHD patients require cardiac interventions within their first year, highlighting the critical need of early diagnosis and timely treatment. Addressing CHD is essential for achieving Sustainable Development Goals 3.2 and 3.4 which aim to reduce child and premature deaths from noncommunicable diseases by one-third by 2030, as CHD accounts for one-third of all birth anomalies.

Efforts to enhance the care of children with CHD must be integrated by research that is locally relevant. Our study seeks to raise awareness of the availability and spectrum of free cardiac facilities across India, thereby assisting policymakers in making informed decisions about resource allocation in resource-limited settings to effectively mitigate the disease burden.

Furthermore, the implementation of a public–private business model can provide a pathway for sustainable and high-quality pediatric care in LMICs, ensuring that vulnerable populations receive the necessary interventions for improving health outcomes.

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Task Force Report

NAMS task force report on high altitude

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INTRODUCTION

High-altitude (HA) medicine, also known as high-altitude physiology or mountain medicine, is a specialized field of medicine that focuses on the effects of high altitudes on the human body and the prevention and treatment of altitude-related illnesses. As more people venture to high-altitude regions for work, recreation, and travel, the importance of research in this field becomes increasingly evident. Here are some key points that highlight the significance of high-altitude medicine and the need for ongoing research:

- **Growing tourism and travel:** High-altitude destinations such as the Andes, Himalayas, and the Rocky Mountains attract millions of tourists and adventurers every year. Understanding the health risks associated with high altitudes and developing effective strategies for prevention and treatment are essential to ensure their safety.
- **Healthcare in remote areas:** Many high-altitude regions have remote access to medical facilities. Research in high-altitude medicine can lead to the development of better healthcare protocols and technologies for these areas.
- **Climate change and altitude:** Climate change is affecting high-altitude regions, leading to shifts in weather patterns, glacial melting, and altered ecosystems. Research is needed to understand how these changes impact human health and adaptation to high altitudes.
- **Occupational health:** Certain occupations, such as mining, military, and research, require people to work at high altitudes. Occupational health research can help ensure the safety and well-being of these workers.
- **Altitude-related illnesses:** Altitude sickness, acute mountain sickness (AMS), high-altitude pulmonary edema (HAPE), and high-altitude cerebral edema (HACE) are common altitude-related illnesses. Research can provide insights into the causes, risk factors, and effective treatments for these conditions.
- **Physiological adaptations:** Understanding how the human body adapts to high-altitude environments can have broader implications for medicine and physiology. Research in this field can shed light on respiratory and cardiovascular adaptations, which may have applications beyond high-altitude settings.
- **Preventive measures:** Developing effective preventive measures, such as gradual acclimatization, pharmacological interventions, and oxygen supplementation, relies on ongoing research to refine and optimize these strategies.
- **Aging population:** As the global population ages, more older individuals may be exposed to high altitudes. Research is needed to understand how aging affects susceptibility to altitude-related illnesses and the efficacy of treatments in this demographic.
- **Genetic factors:** Genetic predisposition can influence an individual's response to high altitudes. Research can help identify genetic markers associated with altitude-related illnesses and potentially lead to personalized preventive and treatment strategies.

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- **International collaboration:** Many high-altitude regions span multiple countries. International collaboration in high-altitude medicine research can lead to the development of standardized guidelines and best practices for healthcare in these regions.

Hence, high-altitude medicine is a vital field with growing relevance due to increased travel, climate change, and occupational exposure. Continued research is essential to improve our understanding of altitude-related health issues and to develop better strategies for the prevention and treatment of altitude-related illnesses, ultimately ensuring the safety and well-being of individuals who visit or work in high-altitude areas.

DEFINITIONS

- **High altitude:** HA is defined as an altitude above 2700 m (9000 feet). Ascent to these altitudes is associated with a significant risk of acute and sub-acute/chronic high altitude illness (HAI). Above this altitude, there is a definite and significant reduction in peak exercise capacity and sub-maximal exercise endurance. This is so since, at this altitude, the low ambient barometric pressure results in an alveolar oxygen partial pressure (PAO2) close to 66 mmHg. At this PAO2, the effects of hypoxia on the human body are obvious and easily recognizable.
- **Extreme altitude:** Altitudes greater than 5500–5800 m (18,000–19,000 feet) are classified as extreme altitude (EA). Ascent to these altitudes is associated with a greater risk of acute and sub- acute/chronic HAI. The physiological response to these altitudes is pronounced as is decrement in maximal exercise capacity and endurance for submaximal exercise. The degree and time course of acclimatization to these altitudes is debatable, and it is believed that the human body does not completely acclimatize to extreme altitudes.
- **Moderate altitude:** Altitudes between 1500 and 2700 m (5000–9000 ft) are classified as moderate altitudes. Certain physiological functions, such as exercise capacity are impaired at these altitudes, and a definite acclimatization response has been reported. Acute HAIs are known to occur at these altitudes; however, their incidence is very low.

ALTITUDE RELATED MEDICAL PROBLEMS

All ailments that affect humans at sea level may affect them at HA also. HAI, however, refers to a set of ailments unique to HA, with hypobaric hypoxia as the central etiological factor. Several other medical problems may also occur at HA that are not specific to HA but are exacerbated or precipitated by the HA environment. Currently, there is no universally accepted classification scheme for these ailments, and this article has grouped them as miscellaneous medical problems at HA and altitude-exacerbated conditions [Table 1].

- **High altitude illness**: HAI or disease refers to clinical syndromes that occur as a consequence of exposure to the HA environment, with hypobaric hypoxia being the central etiological factor. HAI are classified based on their onset time [Table 1]. Acute illnesses occur within hours to days of ascent to HA, subacute within weeks to months, and chronic after months to years of stay at HA. Ascent to HA often produces symptoms such as breathlessness on exertion and palpitations in healthy individuals. These are often the result of the normal physiological responses

Table 1: Altitude-related medical problems

- **High altitude illness (HAI)**
  - A Acute
    - a. Involving the central nervous system
      - i. Acute mountain sickness
      - ii. High altitude cerebral edema (HACE)
    - b. Involving the pulmonary system
      - i. High altitude pulmonary edema (HAPE)
  - B Subacute
    - a. High altitude pulmonary hypertension (HAPH)
  - C Chronic
    - a. Chronic mountain sickness (CMS) (Monge's disease)
    - b. High altitude pulmonary hypertension (HAPH)
- **Miscellaneous altitude-related health problems**
  - a) Thrombotic events (Venous and arterial thrombosis)
  - b) Hypertension at HA
  - c) Cold injuries
  - d) Gastrointestinal problems
  - e) Dermatitis
  - f) HA Retinopathy and other eye illnesses at HA
  - g) Sleep impairment at HA
  - h) Neuropsychiatric effects of HA stay
  - i) Immune suppression in HA
- **Altitude exacerbated health problems e.g.**
  - a) Sickle cell disease and trait
  - b) Symptomatic coronary artery disease
  - c) Primary and secondary pulmonary hypertension
  - d) Decompensated congestive heart failure and COPD
  - e) Bronchial asthma

HA: High altitude, COPD: Chronic obstructive pulmonary disease

of the body to hypobaric hypoxia and should not be confused with acute HAI.

- **Risk factors for HAI:** Several factors may predispose an individual to HAI [Table 2]. Faster rates of ascent, greater sleeping altitude, and physical activity early after ascent to HA are important predisposing factors for acute HAI. The altitude of residence, previous history of HAI, and individual susceptibility are other factors that contribute to the risk of acute and chronic HAI. Acute HAI occurs less in the elderly (probably due to less exertion at HA), while women are known to suffer lesser HAPE than men. This may be an observational bias because a far lesser number of women ascend to HA when compared to men. Physically fitter individuals are believed to suffer a greater incidence of acute HAI. However, once the risk of acute HAI is mitigated, those who continue to stay at HA physically perform better. Obesity has been implicated as a risk factor for AMS. Underlying cardiorespiratory disorders that lead to greater pulmonary arterial pressure (PAP) and concurrent infections of the upper respiratory tract are known to increase the risk of HAPE.

Table 2: Factors influencing the risk of high altitude illness

• Rate of ascent to HA
• The final altitude reached
• Altitude at which the individual sleeps (if different from altitude reached)
• Previous history of high altitude illness
• Acclimatization status of the individual
• Physical activity immediately after ascent to HA
• Individual susceptibility
• Age and gender
• Physical fitness and overweight
• Pre existing medical conditions

HA: High altitude

Table 3: Environmental challenges at high altitude

• **Hypobaric hypoxia**. Barometric pressure - with increasing altitude, reducing the PO2 in ambient, inspired and alveolar air. There is no change in concentration of O2 in air.
• **Low environmental temperature**. The ambient temperature falls by 1°C per 150 m (Approx. 500 ft) ascent. Winds/breeze further decreases body temperature ("wind chill factor").
• **Low absolute humidity in the atmosphere**. This increases the insensible water loss from the body (e.g., through respiration) and predisposes to dehydration.
• **Increased solar and ionizing radiation**. UV radiation - 4% with every 300 m (Approx. 1000 ft) ascent and can harm the eye and skin.

PO2: Partial pressure of oxygen, UV: Ultraviolet

ACCLIMATIZATION

Introduction: The HA environment exposes us to many stressors, principal among which are hypobaric hypoxia, cold, low humidity, and increased ultraviolet (UV) radiation [Table 3]. The most important stressor by far is hypobaric hypoxia. This induces a marked systemic response, introduces the risk of illnesses unique to HA, and reduces individuals' physical work capacity and endurance for the duration of stay. Sojourn at HA may also aggravate pre-existing diseases such as coronary artery disease, bronchial asthma, and thrombophilia.

Any of the stressors listed above could be a cause of illness at HA. Illnesses attributable to a direct effect of hypobaric hypoxia are called HAI, and based on the duration of stay and occurrence, they are classified as Acute HAI, for example, AMS, sub-acute HAI, for example, high altitude pulmonary hypertension (HAPH) (may also occur in a chronic form), and chronic HAI, for example, chronic mountain sickness (CMS). Cold exposure may lead to chilblains and frostbite, low humidity may lead to dehydration during activity, and UV radiation frequently causes dermatitis at HA. These along with other illnesses, are discussed in detail in the section on altitude-related medical problems.

The human body responds to HA by certain systemic changes starting immediately on the ascent and continuing over hours, days, weeks, and months. This response helps us to live and perform better at HA and is known as "acclimatization." Acclimatization is reversible upon descent to lower altitudes.

Continuing acclimatization at a given altitude will lead to:

(a) Reduced risk of acute HAI at the altitude
(b) Reduced risk of acute HAI on further ascent
(c) Improved individual work endurance, however, the peak work capacity never recovers to sea level values.

The rate and magnitude of the acclimatization response depends on the rate of ascent to HA and the actual altitude attained. There is considerable variability in these responses between different individuals. The failure of adequate acclimatization responses or an exaggerated response can both lead to HAI. For example, a blunted ventilatory response to hypoxia or an exaggerated rise in hemoglobin at HA can predispose an individual to AMS and CMS, respectively. The time course of the reversal of changes in acclimatization is not well documented but may take hours to days, weeks,

and maybe months. For example, the upregulated hypoxic ventilatory response seen with a stay at HA may reverse in hours to days, whereas the increased hemoglobin values and hematocrit seen at HA, in all probability, takes over weeks to months to decline.

THE PHYSIOLOGY OF ACCLIMATIZATION

- **Hypoxia of high altitude**: Barometric pressure falls with increasing altitude. This fall is, however, nonlinear, with a more rapid fall near the surface of the earth than at relatively higher altitudes. Dalton's Law of partial pressure states that every gas in a mixture of gasses exerts a pressure proportional to its concentration in the gas mixture. At sea level, the partial pressure of oxygen in ambient air is 159 mmHg. At 9000 ft, partial pressure would be 116 mm Hg. Thus, at high altitudes, the PAO2 in ambient air and, consequently, in inspired and alveolar air is reduced. Since the oxygen partial pressure in the alveoli is the driving force for oxygen diffusion from the alveolus into pulmonary capillary blood, the reduced PAO2 leads to a lowered PAO2 in arterial blood, and this translates finally to lowered oxygen delivery to tissues, resulting in tissue hypoxia. Table 4 shows changes in alveolar gas compositions at high altitudes.

Table 4: Alveolar gas composition at high altitude

Altitude	Barometric pressure (mm Hg)	PO_2 in ambient air (mm Hg)	PO_2 in alveolar air (mm Hg) Without ventilatory acclimatization	PO_2 in alveolar air (mm Hg) With ventilatory acclimatization
Sea level	760	159	104	NA
11,300 ft (altitude of Leh)	510	106	47	57
18,000 ft	390	81	31	50
29,029 ft (altitude of Mt Everest)	253	53	-5	34

Note: The barometric pressure values are measured at locations in Ladakh, India, during September (except for the value at 29,029 ft). These would vary with season, greater in winter and lesser in summer. The PAO_2 is calculated by the alveolar gas equation with and without ventilatory acclimatization. $PACO_2$ values of 40, 32, 26, and 7.5 mmHg have been assumed for the ventilatory acclimatized state.

PO_2: Partial pressure of oxygen, PAO_2: Partial pressure of oxygen in alveolar air, $PACO_2$: Partial pressure of carbon dioxide

The physiological changes that constitute acclimatization are responses of the human body to the hypobaric hypoxia of high altitude. Three physiological systems play a predominant role in altitude acclimatization. These are:

(a) The respiratory system
(b) The hematological system
(c) The cardiovascular system

RESPIRATORY CHANGES AT HIGH ALTITUDE

- **Hyperventilation:** The hypobaric hypoxia of HA causes a fall in the PAO2 in arterial blood. This leads to the stimulation of the peripheral chemoreceptors in the carotid and aortic bodies, which results in hyperventilation. The hyperventilatory response is termed as the "Hypoxic ventilatory response" (HVR) and occurs within minutes of arrival at a high altitude. The magnitude of this hyperventilatory response depends on the rate of onset and magnitude of hypoxia. The initial increase in ventilation is largely due to an increase in tidal volume and the subsequent increase in the rate of respiration. The magnitude of HVR varies from individual to individual, and it has been suggested to correlate positively with physical performance early after arrival at HA and inversely with susceptibility to AMS. The hyperventilation lowers the PACO2, and this factor contributes to raising the alveolar PAO2 by a few millimeters of Hg. The respiratory alkalosis as a result of HVR is partially corrected by a compensatory excretion of bicarbonate by the kidney over the next 48–72 hours, and respiration stabilizes over the next few days to weeks (depending on the altitude) at a new functional level, higher than that at sea level. The respiratory alkalosis at HA has important consequences on transport and tissue delivery of O2 by blood.
- **Hemoglobin-oxygen (Hb-O2) dissociation curve:** The Hb-O2 dissociation curve is sigmoid shaped. At a PAO2 greater than 60 mmHg, the saturation of Hb with O2 is greater than 90% (flat upper part of the curve). However, once the PAO2 falls below 60 mm Hg, a small fall in PAO2 causes a large fall in the saturation of Hb with O2 (steep part of the curve). The respiratory alkalosis at high altitude stimulates the formation of 2-3 Diphosphoglycerate (2-3 DPG) within the red blood cells. Since alkalosis and 2-3 DPG exert opposing influence on the Hb-O2 dissociation curve, the curve is not significantly affected at HA. However, with a further increase in altitude, the effect of alkalosis predominates, leading to a left shift of the curve. This facilitates O2 uptake in the lungs at low PO2 of air.

- **Hypoxic pulmonary vasoconstriction (HPV):** The pulmonary vasculature constricts in response to hypoxia and results in elevated pulmonary arterial pressures. This response is uneven in the pulmonary vascular bed with some areas showing greater vasoconstriction when compared to others. The heterogeneity of vasoconstriction reflect the inherent differences in the ventilation of different lung segments. Those segments with lower ventilation are likely to exhibit greater vasoconstriction when compared to better-ventilated segments. The magnitude of HPV varies in different individuals as does the resultant elevation of the PAP. The uneven HPV and raised PAP at HA are important factors underlying the development of HAPE. Factors such as exercise and low environmental temperatures aggravate the rise in pulmonary arterial pressures and increase the risk of HAPE.

HEMATOLOGICAL CHANGES AT HIGH ALTITUDE

An acute rise in the hematocrit is often seen during the first few days after arrival at a high altitude. This is the result of hemoconcentration that occurs due to (a) plasma volume shrinkage due to increased fluid loss compared to fluid intake and (b) redistribution of fluid from the intravascular to extravascular compartment in the initial days at HA.

- **Hemoglobin, hematocrit, and blood volume:** Hypoxia is a potent stimulus for increased erythropoiesis. The effects of the erythropoietic response begin to manifest in about 3–4 days and probably reach a maximum after about 3 weeks of stay at HA. This response may last for months depending on the altitude of stay and an individual's erythropoietic response. At EA, this may lead to the expansion of the total blood volume and hyperviscosity. The increased hemoglobin concentration offsets the effect of decreased saturation at HA by increasing oxygen content per volume of blood. This, along with the increased cardiac output at HA allows the blood–tissue O2 gradient to be maintained and tissue extraction of O2 to be achieved without a significant fall in venous oxygen tension.

CARDIOVASCULAR CHANGES AT HIGH ALTITUDE

- **Cardiac output:** The hypoxic environment of high altitude is a challenge for adequate oxygen delivery to tissues. The cardiovascular system responds to this challenge by a central activation of the sympathetic nervous system and the compensatory changes in the local tissue blood flow regulatory mechanisms. The cardiac output is seen to increase during acute ascent to HA. This increase is principally due to an increase in the heart rate. The magnitude of the increase in cardiac output depends on the altitude. A 40% increase in the resting cardiac output has been reported following acute ascent to altitudes between 3600 and 4250 m (12,000–14,000 ft), although increases to the tune of 75% have been reported on acute ascents to altitudes greater than 4500 m (15,000 ft). With acclimatization, the resting cardiac output approaches near sea-level values, but the cardiac output during exercise is lower than at sea level.
- **Peripheral vascular resistance (PVR) and blood pressure:** During the first few hours of ascent to HA, the systemic arterial blood pressure remains unchanged or might be slightly lower than sea level values. It is then often seen to rise over the next few weeks. This alternating trend of systemic arterial blood pressure is due to the opposing influences of increased sympathetic activity (leading to increased PVR and raised blood pressure) and hypoxia-induced vasodilatation in tissue beds (leading to decreased PVR and lowered blood pressure). Certain individuals, however, do not show a reduction of systemic arterial blood pressure at HA. The exact mechanism responsible for changes in systemic arterial blood pressure at HA and reasons for individual variation in responses are still unclear and are an important area of research.

OTHER IMPORTANT PHYSIOLOGICAL ALTERATIONS AT HIGH ALTITUDE AREA (HAA)

Physical performance at high altitude: Physical work capacity, peak as well as endurance for sub-maximal exercise, reduces with an increase in altitude beyond 1500 m, (5000 ft). There is an approximate 11% reduction in maximum oxygen consumption (VO2max) per 1000 m (3280 m) gain in altitudes above 1500 m. Acclimatization causes an improvement in the VO2max and endurance for submaximal exercise, but individuals do not attain sealevel values while at HA. The VO2max has been reported as being 85% of the sea level value at 3000 m, (10,000 ft) 60% of the sea level value at 5000 m (16,500 ft) and 20% of the sea level at 8848 m (29,021 ft).

Note: The physiological changes that constitute altitude acclimatization are specific to that altitude. Any further ascent of more than 500 m (approx. 1600 ft) by individuals acclimatized to a particular altitude would render them susceptible to HAI until they acclimatize to the new altitude.

ACUTE MOUNTAIN SICKNESS (AMS)

- **Definition and epidemiology**: AMS is a syndrome of nonspecific symptoms and is defined as the occurrence of headache along with the presence of one or more of the following: gastrointestinal symptoms, dizziness, lassitude,

or fatigue in an unacclimatized individual, usually within 3 days of arrival at HA. The incidence of AMS varies with the altitude and rapidity of ascent and ranges from 3.1% at 2000 m (7000 ft) to 53% at 5000 m (16,000 ft).[1]

- **Etiopathogenesis**: The exact pathophysiological mechanisms responsible for AMS are yet to be established. The critical factor in the pathogenesis of AMS is hypoxemia. It is postulated that AMS may represent the benign end of a clinical spectrum, with the malignant end being HACE. Evidence of cerebral edema and raised intracranial tension in AMS is, however, inconsistent. Some other postulated pathophysiological mechanisms include hypoxia-mediated release of vasogenic substances, activation of the trigeminovascular system, and free radical–mediated alteration of the blood brain barrier permeability. Hypobaria may contribute to AMS by causing blunting of ventilation, impaired lymphatic drainage from the lung, and changes in autonomic functions. Current evidence does not support the role of generalized fluid retention in the pathogenesis of AMS.[2]
- **Clinical features**: The predominant symptom of AMS is headache, which is generally frontal, throbbing, aggravated by exertion and more severe in the mornings. It may be accompanied by malaise, giddiness, anorexia, nausea, and vomiting. Symptoms of AMS typically develop within 6–10 hours after ascent to HA, sometimes as early as within 1 hour, but invariably within the first 3 days of ascent to HA. The greater the ascent, earlier the onset of symptoms; predisposed individuals may also develop symptoms earlier. Usually, AMS is worst after the first night of sleep at a given altitude. Recovery usually occurs within 72 hours with rest and no further gain in altitude. In rare instances, the headache or another symptom of AMS may persist for weeks after arrival at HA. The onset of symptoms after 3 days of arrival at HA or failure to respond to oxygen or descent should raise the suspicion of alternative diagnosis.
- **Diagnosis**: AMS is a clinical diagnosis. A commonly used tool to diagnose AMS is the lake louise scoring system (LLS-2018),[3] which comprises a self-reported questionnaire of symptoms consisting of headache, gastrointestinal symptoms, fatigue, and dizziness. The symptoms are rated in severity on a scale of 0–3. (Appendix A). A self-reported score greater than or equal to 3 suggests AMS. Self-reported score of 3–5 implies mild AMS, and score "6" implies moderate to severe AMS. It is apparent that any illness with symptoms similar to AMS will form a differential diagnosis of AMS. Thus, the decision to treat as AMS must be guided by the occurrence of symptoms in the "setting of a recent gain in altitude" and the exclusion of other likely causes of the symptoms [Table 5]. Conditions such as dehydration and fatigue after a long trek also involving ascent often mimic AMS. When uncertain of the diagnosis, it may be good to treat as AMS until proven otherwise.

Table 5: Differential diagnosis of AMS/HACE

• Dehydration
• Exhaustion
• Hypoglycemia
• Diabetic ketoacidosis
• Hyponatremia
• Hypothermia
• Carbon-monoxide poisoning
• Migraine, High altitude headache
• Cerebrovascular spasm
• CNS infections
• Acute psychosis
• Stroke/TIA
• CNS tumor
• Ingestion of drugs, alcohol, or toxins
• Seizure disorder

AMS: Acute mountain sickness, HACE: High altitude cerebral edema, TIA: Transient ischemic attack, CNS: Central nervous system

- **Treatment**: The treatment of AMS consists of treatment for relief of symptoms such as headache and nausea and specific treatment to correct the underlying pathophysiological mechanisms responsible for the condition. Symptomatic treatment should be started even if the LLS score is below 3. An algorithm for the management of AMS in the resource-poor or periphery setting is shown in Figure 1.
- **Treatment of AMS in an institutional setting**: Symptomatic therapy is advisable for all cases of mild AMS and comprises nonsteroidal anti-inflammatory drugs for the relief of headaches and antiemetics for the treatment of nausea. Oxygen must be administered at the rate of 1–2 L/min via nasal prongs for 12–24 h, and this generally leads to the resolution of symptoms. In cases of moderate to severe AMS or if no relief with the above treatment, the specific treatment for AMS comprises Acetazolamide tablet in a dose of 250 mg 12-hourly or 125 mg 8-hourly. Tablet Dexamethasone 4 mg 6-hourly is a useful alternative in moderate AMS and may be used in patients with sulfonamide sensitivity. Supportive measures include rest and avoidance of exertion, avoidance of alcohol and sedatives, and ensuring adequate fluid intake. Reascent may be allowed on the complete resolution of symptoms.
- **Complications**: AMS may progress to HACE in rare cases if not promptly managed or if the hypoxemia is worsened with physical exertion and/or a further gain in

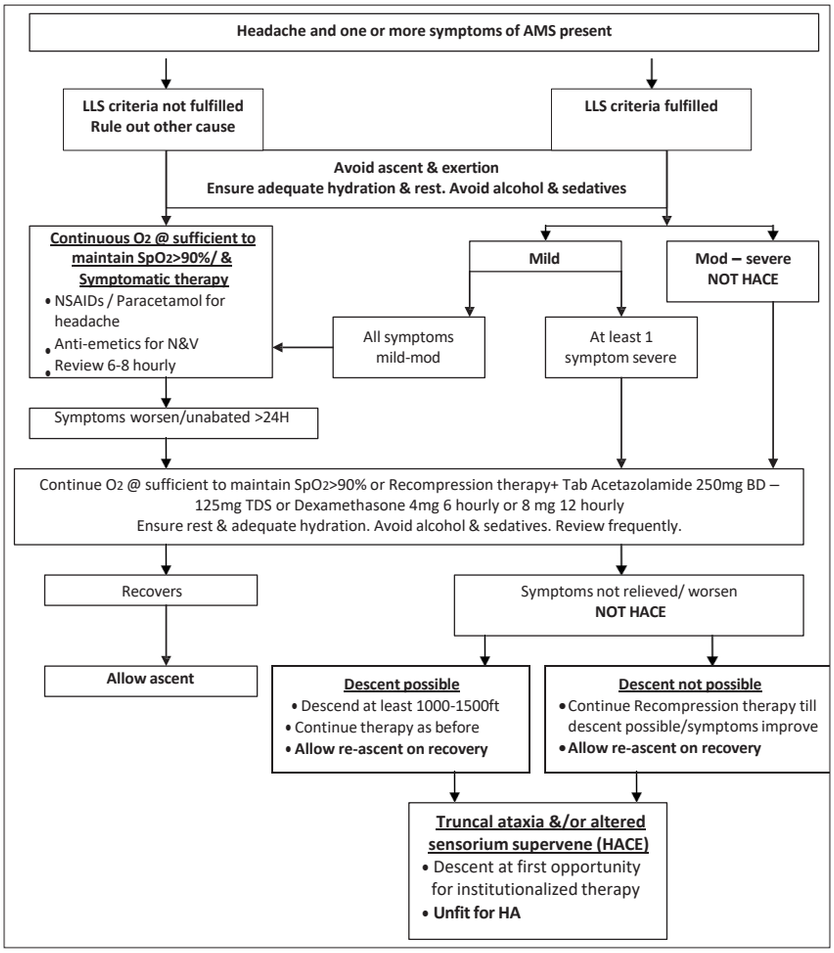

Figure 1: Algorithm for treatment of AMS in the peripheral setting. AMS: Acute mountain sickness, LLS: Lake Louise acute mountain sickness score, NSAIDs: Nonsteroidal anti-inflammatory drugs, N&V: Nausea and vomiting, HACE: High altitude cerebral edema, HA: High altitude

altitude. The appearance of change in mental status and/or ataxia indicates onset of HACE and must be managed accordingly.

- **Prognosis**: AMS is usually a benign, self-limiting condition that recovers spontaneously within 48–72 hours of onset; most cases subsides with rest and cessation of ascent. Once recovered, the individuals may be allowed to ascend. Usually, symptomatic therapy is all that is required; moderate to severe cases require specific therapy but may ascend after recovery.
- **Prevention**: The options available for the prevention of AMS, and also for acute HAI, are as follows:
  (a) ***Staged ascent:*** A staged ascent is an excellent method to reduce the incidence and severity of AMS. Staged ascent allows time for the body for sufficient acclimatization to prevent acute HAI. A number of staging protocols exist and are tailored to topographical and logistic requirements and to the availability of time. The staging schedule used by the Indian Army has been proven to definitely lower the incidence and severity of AMS [Table 6].[4]
  (b) ***Drug prophylaxis:*** Is advisable when staged ascent may not be an option or an individual is known to be prone to AMS.

Table 6: Recommended rates of ascent at high altitude

Above 2700 m altitude:
• Gain in sleeping altitude should not exceed 500 m per day
• Allow one rest day for every 1000–1500 m gain in altitude
• Do not ascend if symptoms of AMS appear. Ascend only after symptoms completely regress
• Descend to lower altitude if symptoms persist or deteriorate.

AMS: Acute mountain sickness

(i) Tablet Acetazolamide (125 mg 12-hourly or 250 mg sustained release preparation once a day) started 24 hours prior to the ascent of HA and continued for 3 days at HA is the drug of choice for prevention of AMS.
(ii) Tablet Dexamethasone (2 mg 6-hourly/4 mg 12-hourly) reduces the incidence and severity of AMS. It has the additional advantage of enhancing exercise capacity at HA for the duration of use. It may be used in individuals.
  (a) Known to be sulphonamide-sensitive
  (b) Where immediate activity is required after sudden ascent, for example, airlift to 3300 m with immediate need for activity.

Dexamethasone is known to interfere with the normal acclimatization process and a rebound increase in AMS may occur on discontinuing the drug at HA, especially in individuals engaged in physical activity. The acute adverse effects of steroid therapy, such as euphoria and disorientation, must be borne in mind when using Dexamethasone.

(c) ***Pre-acclimatization:*** Stay at moderate altitudes of 1800 m (5000–6000 ft) for a period of 2–8 months has been reported to provide a definite degree of acclimatization and reduce the severity and incidence of AMS on further ascent.

HIGH ALTITUDE CEREBRAL EDEMA (HACE)

- **Definition and epidemiology**: HACE is a potentially fatal condition that is diagnosed clinically as per the LakeLouise consensus criteria as the presence of ataxia and/or altered consciousness in an individual who may or may not have AMS/HAPE. HACE can present within 3 to 5 days of arrival to elevations as low as 2700 m (9000 ft). HACE may occur within a shorter time frame during rapid ascent to greater altitudes, and thus, the features of preceding AMS may be masked and absent. The incidence of HACE varies principally with the rate of ascent and the sleeping altitude attained during a particular ascent. It has been reported as less than 0.1% in studies. Up to 14% of cases of HAPE are known to have concomitant HACE, probably a result of the accentuated hypoxia consequent to HAPE.[1,2]
- **Etiopathogenesis**: The exact pathophysiological basis of HACE is not well established. Some of the postulated mechanisms are increased capillary permeability coupled with increased cerebral blood flow and capillary hydrostatic pressure seen in the early days at HA. It is also hypothesized that fluid retention may have a role to play in the development of HACE.
- **Clinical features**: Altered mental status and truncal ataxia are the diagnostic clinical features of HACE. The tandem gait test is the best test for evaluating this; HACE does not affect finger-to-nose tests for ataxia. Mental status changes may range from irrational behavior progressing rapidly to lethargy, depressed sensorium, hallucinations, and coma. Associated findings may include papilledema, retinal hemorrhages, cranial nerve palsies, and abnormal reflexes. Focal neurological deficit is usually rare.
- **Diagnosis**: HACE is diagnosed clinically. The presence of altered mental status or ataxia in an individual showing features of AMS or the presence of an altered mental status AND ataxia in the absence of features of AMS, in individuals within 3–5 days of ascent to HA is HACE unless proved otherwise. A number of conditions can mimic HACE/AMS [Table 5], and the evidence for these must be sought where features of AMS/HACE occur in atypical settings, that is, no history of recent gain in altitude, absence of a precipitating factors such as unusual exertion, and failure to respond to therapy or unusually rapid response to therapy.[3]

  Where computed tomography (CT) imaging is available in severe HACE, it may reveal nonspecific findings of diffuse cerebral edema, such as the absence of sulci, small ventricles, and a diffuse low-density appearance of the entire cerebrum [Figure 2]. Diffusion-weighted MRI is the

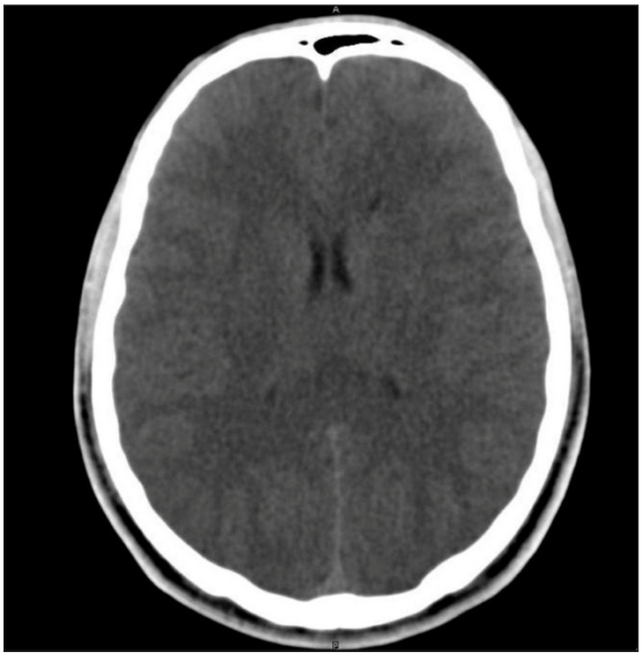

Figure 2: CT Scan in a patient of HACE showing absence of sulci, small ventricles, and a diffuse low-density appearance of the entire cerebrum. HACE: High-altitude cerebral edema. CT: Computed tomography

Table 7: Guidelines for the management of high altitude cerebral edema (HACE) in the resource limited or peripheral setting

- **Do not worsen the hypoxia**
  - No physical exertion/further gain in altitude
- **Correct the hypoxia**
  - a) Immediate descent to lower altitude
    - i) Actual descent to lower altitude
    - ii) Simulated descent using recompression chambers till actual descent possible
  - b) Supplemental oxygen via facemask at 2–4 L/min
- **Pharmacotherapy**
  - a) Dexamethasone 8 mg initially orally/IM/IV followed by 4 mg every 6 hours.
  - b) Tablet Acetazolamide 250 mg 12-hourly if descent to lower altitude is delayed
  - c) Injection Mannitol/Glycerol to reduce intracranial pressure

IM: Intramuscular, IV: Intravenous

most reliable diagnostic modality available. T2-weighted MRI reveals reversible white matter edema, especially in the splenium of the corpus callosum and the centrum semiovale, without involvement of the gray matter.

- **Treatment in the resource poor or peripheral setting**: HACE is a medical emergency requiring immediate descent to a lower altitude. Symptoms are typically seen to resolve with a descent of 300–1000 m (1000–3300 ft). Where actual descent is not possible, simulated descent using recompression chambers is lifesaving. Portable recompression chambers can generate pressures up to 130 mmHg, simulating a descent of about 6000 feet. Supplemental oxygen sufficient to raise the arterial oxygen saturation (SaO_2) to >90% should be administered where descent to lower altitudes is not possible. Oral or parenteral Dexamethasone (8 mg stat followed by 4 mg 6-hourly) and tablet Acetazolamide (250 mg 12-hourly) should be started if available and continued till symptoms resolve [Table 7].[5]
- **Institutionalized care**: Therapeutic measures at a hospital include supplemental oxygen, decongestive or measures to lower intracranial pressures, hyperbaric therapy (if available), and other supportive measures for care of a comatose patient. Oxygen should be given by a face mask (maintaining SaO2 > 90%), or a recompression chamber may be used to simulate a descent to sea level, if available. Decongestive measures should be simultaneously started, including parenteral steroids (Dexamethasone 8–10 mg IV, IM, or PO, followed by 4 mg every 6 h), intravenous Mannitol, and oral glycerol. Attempting to decrease intracranial pressure by intubation and hyperventilation might be tried in refractory cases. Diuretics have not been studied systematically for the treatment of HACE but are reasonable, especially in a hospital setting with care to avoid hypotension. Furosemide may be given in small doses. Treatment of concomitant HAPE with nifedipine may lower systemic arterial blood pressure and cerebral perfusion pressure. This drug should be used cautiously and with frequent monitoring of the blood pressure.
- **Complications:** HACE can be fatal if not managed as a medical emergency.
- **Prognosis and prevention:** HACE is a life-threatening condition. The mortality may be as high as 25% even with prompt institution of therapy. Prevention of HACE is achieved by the same means as for AMS.
- **Employability restrictions:** A patient who develops HACE is unfit for re- employment to HA as she/he is at a high risk of development of a potentially life threatening condition on exposure to HA.

HIGH ALTITUDE PULMONARY EDEMA (HAPE)

- **Definition and epidemiology**: HAPE is a noncardiogenic pulmonary edema characterized by pulmonary hypertension, leading to extravasation of fluid from the intravascular compartment in the lungs of healthy individuals with no underlying cardiac or pulmonary disease. HAPE usually occurs on the second or third day of arrival at HA and rarely after the fourth day. The incidence varies from 0.125 to 15%, being higher with faster rates of ascent to greater altitudes.
- **Etiopathogenesis**: Elevated PAP due to hypoxic pulmonary vasoconstriction is critical in the pathogenesis of HAPE. The nonhomogeneous pulmonary vasoconstriction results in areas of hyper-perfusion, leading to a stress failure of the pulmonary endothelium and extravasation of protein-rich fluid into the pulmonary interstitium and alveoli. Exposure of the basement membrane to the protein-rich edema fluid results in secondary inflammation, activation of coagulation, and generation of microthrombi in the lungs. Preexisting inflammation, for example, preexisting viral infection, may make the endothelium more prone to disruption. Vigorous physical exertion in unacclimatized individuals and exposure to low environmental temperatures may precipitate or aggravate HAPE by raising the PAP. An exaggerated rise of pulmonary artery pressure in response to alveolar hypoxia, increased sympathetic activity, lower endogenous nitric oxide production, and lower rates of alveolar fluid clearance are other factors that may predispose certain individuals to HAPE.[1]

- **Clinical features**: Dry cough and reduced physical performance for the given altitude in an individual, usually within 3–5 days of arrival at HA, suggest HAPE. Rarely, HAPE may occur in an "acclimatized" individual after weeks to months of stay at HA. However, a precipitating factor, for example, unusually severe exertion or gain in altitude, is invariably present. Other common symptoms on presentation are dyspnea, chest discomfort, and fatigue or weakness. Pink, frothy sputum and respiratory distress occur later in the illness. Orthopnea and hemoptysis are uncommon. Patients usually show resting tachycardia and tachypnoea that become pronounced as the illness progresses. Crackles and wheeze are usually present in more than one lung field.
- **Diagnosis**: HAPE is diagnosed clinically as the presence of any two of the symptoms of cough, chest discomfort, dyspnea, and fatigue and any two signs of crackles or wheeze on auscultation of the chest, central cyanosis, tachycardia, and tachypnea [Table 8],[5] usually within 3–5 days of arrival at HA. Investigations may reveal the following:
  (a) ***ECG:*** sinus tachycardia, right ventricular strain, right axis deviation, right bundle branch block (RBBB) and P wave abnormalities
  (b) ***X-ray chest:*** Radiographic findings are variable but usually reveal characteristic patchy infiltrates and lack of cardiomegaly or Kerley B lines. Involvement is usually bilateral, but if unilateral, infiltrates are common in the right middle lung field. The pulmonary arteries are usually dilated. Resolution of lung opacities occurs quickly with treatment and lags behind, only briefly, the signs of clinical improvement [Figure 3].

  Note: Occurrence of symptoms after 3–5 days of arrival at HA is unusual, and alternative diagnoses such as pneumonia, cardiogenic pulmonary edema, pulmonary embolism, and spontaneous pneumothorax should be considered [Table 9].
- **Severity classification**. HAPE is classified into mild, moderate, serious, and severe based on clinical symptoms, magnitude of tachycardia and tachypnea, and findings on Chest radiograph [Table 10].[6]
- **Treatment in resource-limited setting or periphery**: Descent to a lower altitude is the first treatment priority for patients of HAPE.[7] A descent of at least 1000 m (3300 ft) or till an altitude where symptoms resolve is ideal. In case actual descent is not possible, simulated descent using portable recompression chambers and supplemental oxygen should be administered [Table 11].[5] Nifedipine in a dose oof 30 mg sustained release (SR) every 12 hours or 20 mg (SR) every 8 hours should be started in case the above treatment modalities are not possible or if there is no resolution or worsening of symptoms.
- **Institutionalized care**: Supplemental oxygen is the mainstay of therapy. Oxygen is provided by a facemask at

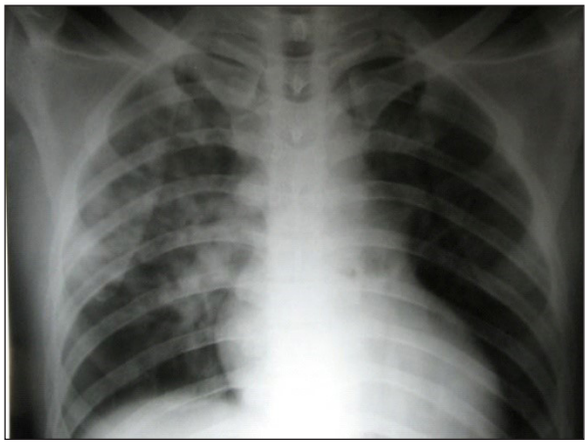

Figure 3: Chest X-ray in a patient of HAPE showing a normal cardiac shadow, characteristic patchy irregular infiltrates in the right middle lung fields with sparing of the apices and areas above the diaphragm. HAPE: High altitude pulmonary edema.

Table 8: Clinical criteria for diagnosing High Altitude Pulmonary Edema

• History of recent gain in altitude along with any two of the following symptoms: a) Cough b) Dyspnea at rest c) Chest discomfort d) Weakness/fatigue
AND
• Any two of the following signs: a) Crackles/wheeze in at least one lung field b) Central cyanosis c) Tachycardia d) Tachypnea

Table 9: Differential diagnosis of HAPE

• Bronchial asthma
• Acute bronchitis
• Pneumonia
• Congestive cardiac failure
• Pulmonary embolism
• Myocardial infarction
• Hyperventilation syndrome
• Pneumothorax

HAPE: High altitude pulmonary edema

Table 10: Classification of HAPE based on severity

Grade	Symptoms	Heart rate (beats/min)	Respiratory rate (breaths/min)	Chest X-ray
Mild	Dyspnea on moderate exertion Able to perform light activity	<110	<20	Minor opacities involving < ¼ of one lung field
Moderate	Dyspnea at rest Weakness, fatigue on slight effort, cannot perform light activity Headache with cough	110–120	20–30	Opacities involving at least ½ of one lung field
Serious	Severe dyspnea, Loose recurrent productive cough, Wheezy, difficult respiration, Obvious cyanosis, Weakness headache, nausea at rest	121–140	31–40	Opacities involving at least ½ of each lung field or unilateral exudates involving all of one lung field
Severe	Clouded consciousness, stupor, or coma Unable to stand or walk, severe cyanosis, bubbling rales Copious bloody sputum Severe respiratory distress	>140	>40	Bilateral opacities involving > ½ of each lung field

HAPE: High altitude pulmonary edema

Table 11: Guidelines for management of HAPE in resource limited setting

- Do not worsen the hypoxia
  a) No physical exertion
- Correct the hypoxia
  a) Descend to lower altitude*
     - Actual descent where possible
     - Simulated descent using recompression chamber
  b) Supplemental oxygen via face mask @ 2–4 L/min (if available)
- Pharmacotherapy to lower pulmonary artery pressure#
  a) Nifedipine 30 mg SR 12-hourly/20 mg SR 8-hourly.

*All cases of HAPE must be evacuated to hospitals at lower altitudes.
#If evacuation to a lower altitude is not immediately possible or the patient shows worsening of symptoms, nifedipine should be administered as an adjunct to simulated descent and oxygen therapy while monitoring the patient's blood pressure. The drug should not be administered if there is a suspicion of acute myocardial infarction or congestive cardiac failure. HAPE: High altitude pulmonary edema.

a rate sufficient to maintain SaO_2 > 90%, until symptoms improve and tachycardia subsides. Elevated PAP usually reduces with the correction of hypoxemia. continuous positive airway pressure (CPAP) can be considered as an adjunct to supplemental oxygen, and nifedipine can be added if the patient fails to respond to oxygen therapy alone. There is no role for the use of diuretics, Acetazolamide, and beta-agonists in the treatment of HAPE. Supportive measures like warmth, rest, and adequate hydration should be ensured.

- **Complications**: HAPE can be fatal if not recognized and treated promptly. Up to 14% of patients with HAPE may show features consistent with HACE, although hypoxic encephalopathy may have the same features.
- **Prognosis and prevention**: HAPE is eminently preventable and has a mortality of <1% if diagnosed and managed promptly. The mainstay of prevention is a staged or gradual ascent to HA. Drug prophylaxis for the prevention of HAPE should only be considered for individuals with a prior history of HAPE. Nifedipine in a dose of 30 mg (SR) 12-hourly or 20 mg (SR) 8-hourly is the recommended drug for HAPE prevention.

SUB-ACUTE AND CHRONIC HA ILLNESSES

A) High altitude pulmonary hypertension (HAPH)

- **Definition and epidemiology**: HAPH is a clinical syndrome that occurs in permanent residents of altitudes > 2500 m (8000 ft) and is characterized by a raised systolic PAP >50 mmHg or a raised mean PAP > 30 mmHg, right ventricular hypertrophy, cardiac failure, moderate hypoxemia, and absence of excessive erythrocytosis [Table 12]. HAPH may also occur transiently in acclimatized lowlanders staying at HA and has been reported in lowlanders staying longer than 5–6 months at altitudes > 5000 m (16,000 ft) or following stay at EA for 6 months. The infrequent occurrence in most lowlanders may be due to their return to sea level once every 3–6 months while working at HA.

- **Etiopathogenesis**: HAPH is believed to be the result of exaggerated and persistent hypoxic pulmonary vasoconstriction and remodeling of the pulmonary vasculature with muscularization of pulmonary arterioles leading to a chronically raised PAP.
- **Clinical features**: Patients of HAPH are permanent residents or long-term sojourners at HA who present with dyspnea, cough, cyanosis, sleep disturbance, irritability, and features of right heart failure.
- **Diagnosis**: A diagnosis of HAPH is considered in an individual presenting with the symptoms described above. The essential criteria to establish the diagnosis is raised pulmonary artery pressure (systolic PAP > 50 mmHg or mean PAP > 30 mmHg) measured at the altitude of residence and hemoglobin < 21 g/dL in males and < 19 g/dL in females [Table 12]. It is recommended that other causes of pulmonary hypertension, chronic obstructive pulmonary disease, interstitial lung disease, and other cardiovascular diseases associated with raised PAP should be ruled out before establishing the diagnosis of HAPH.
- **Treatment**: Descent to lower altitude is the best therapy. For native highlanders for whom this may not be possible due to economic and social issues, the raised PAP can be reduced using calcium channel blockers (Nifedipine 20–30 mg 12-hourly), inhaled nitric oxide (NO) (15 ppm with 50% O_2 or 40 ppm for 15 min), phosphodiesterase inhibitors, and prostaglandins.
- **Complications and prognosis**: Prompt descent to lower altitudes improves symptoms, and the PAP returns to normal in 12–16 weeks. Untreated, the condition results in worsening of right heart failure with patients developing severe shortness of breath.
- **Prevention**: In view of a report on the occurrence of HAPH in a large number of soldiers posted for approximately 6 months at altitudes between 5800 and 6200 m (18,000–19,500 ft) and the large inter-individual variability in the response to hypoxia, it is recommended that lowlanders should not be stationed at EA for more than 3 months in an approximate 2-year duration.

Table 12: Diagnostic criteria and investigation findings in high altitude pulmonary hypertension (HAPH). A diagnosis of HAPH is established in an individual presenting with symptoms suggestive of HAPH who is found to satisfy both of the essential criteria given below.

- **Essential criteria**
  - a) Raised pulmonary artery pressure
    - Mean pulmonary artery pressure > 30 mm Hg and/or
    - Systolic pulmonary artery pressure > 50 mm Hg
  - b) Hemoglobin
    - Males < 21 g/dL
    - Females < 19 g/dL
- **Other findings**
  - a) Chest X ray
    - Cardiomegaly – enlargement of right atrium and right ventricle
    - Prominent central and peripheral pulmonary arteries
  - b) ECG
    - Right axis deviation
    - Marked right ventricular hypertrophy
  - c) Echocardiography
    - Signs of right ventricular hypertrophy/failure

B) Chronic mountain sickness (CMS) or Monge's disease

- **Definition and epidemiology:** First described by Carlos Monge in 1925, the consensus statement of the VI World Congress on mountain medicine 2004 defines CMS as a clinical syndrome that occurs in HA natives or long-term residents at altitudes above 2500 m, characterized by excessive erythrocytosis, severe hypoxemia, and in some cases moderate to severe pulmonary arterial hypertension, which may result in cor pulmonale, leading to congestive cardiac failure. Elevation of PAP and subsequent congestive heart failure are not mandatory features of CMS. The reported incidence of CMS in Tibetans is 0.91%.
- **Etiopathogenesis:** CMS was attributed to a loss of acclimatization in already acclimatized individuals; however, a low hypoxic ventilatory response is no longer considered an important etiological factor. A likely possibility is markedly raised erythropoietin (EPO) levels. The raised hematocrit due to elevated EPO raises blood viscosity, worsens tissue hypoxia, and results in further elevation of EPO levels and leads to the genesis of a vicious cycle. Factors such as relative hypoventilation, sleep apnea, all hypopneas, overweight, and postmenopausal state are believed to be the important risk factors for developing CMS.
- **Clinical features and diagnosis:** The clinical features of CMS are shown in Table 13. CMS is diagnosed clinically in patients living at altitudes greater than 2500 m, with normal lung function, and without chronic pulmonary or other medical conditions that worsen the hypoxemia. In patients with preexisting conditions that worsen hypoxia, the occurrence of features of CMS should lead to a diagnosis of secondary CMS.
- **Treatment:** Descent to lower altitudes is the treatment of choice. Other modalities of treatment have variable results [Table 14].

Table 13: Clinical symptoms and signs of chronic mountain sickness

- **Symptoms**
  - a) Headache
  - b) Breathlessness
  - c) Dizziness
  - d) Palpitations
  - e) Sleep disturbance
  - f) Fatigue
  - g) Localized cyanosis
  - h) Burning of palms and sole of feet
  - i) Dilatation of veins
  - j) Muscle and joint pains
  - k) Anorexia
  - l) Lack of mental concentration
  - m) Alterations in memory
- **Clinical/Investigative findings**
  - a) Excessive erythrocytosis
    - Hemoglobin
      - (aa) > 19 g/dL in females
      - (ab) > 21 g/dL in males
  - b) Raised pulmonary arterial pressure (not mandatory)
  - c) Features of heart failure (not mandatory)
  - d) X-ray chest
    - Prominent pulmonary artery
  - e) ECG
    - Right ventricular hypertrophy
    - Right atrial enlargement
  - f) Proteinuria

ECG: Electrocardiogram

Table 14: Guidelines for management of chronic mountain sickness (CMS)

- Migration to lower altitudes is the treatment of choice
- Other modalities of treatment with variable results
  - a) Phlebotomy to reduce hematocrit
  - b) Oxygen supplementation and respiratory training
  - c) Calcium channel blockers to reduce pulmonary artery pressure
  - d) Inhaled nitric oxide (40 ppm) or nitric oxide 15 ppm with 50% oxygen to lower pulmonary artery pressure
  - e) Medroxyprogesterone 20–60 mg/day for 10 weeks to stimulate ventilation
  - f) Tablet Acetazolamide 250 mg/day for 3 weeks

- **Complications and prognosis:** CMS may result in cor pulmonale and congestive cardiac failure. Migration to lower altitude corrects the hypoxemia, and hematocrit returns to normal in 2–3 weeks. Right ventricular hypertrophy and elevated PAP if present normalize in about 2 years.

THROMBOSIS AT HIGH ALTITUDE

Both venous and arterial thrombotic events have been reported to have greater prevalence among lowlanders at HA and extreme HA.

- **Venous thrombosis:** Isolated venous thrombosis (VT) at high altitudes has been frequently reported in the literature with various case reports of cerebral venous thrombosis (CVT), pulmonary thromboembolism (PTE), mesenteric vein thrombosis, and deep vein thrombosis (DVT) in apparently healthy individuals at HA. In the last one decade or so, a few case series based on the experience of the Indian Army in Ladakh have highlighted the issue of increased incidence of venous thrombosis at HA. An increase in the risk of venous thrombosis varying from 24.5 to 30 times higher in sojourners at HA compared to the plains has been suggested. A number of cases of thrombosis continue to be diagnosed regularly among troops at HA. Interestingly, a large number of these patients are young (<40 years) healthy individuals and thrombosis occurs within days to months after arrival at HA, at altitudes ranging from 3300–6000 m (11,000–20,000 ft), at unusual sites (cerebral, mesenteric, etc.), and in varied ethnic groups.
- **Mechanism and pathogenesis:** Physical and environmental factors may cause a prothrombotic milieu at HA. Dehydration consequent to low ambient humidity, especially when an individual exerts and loses water by hyperventilation is a possible reason. Thirst mechanisms are known to be obtunded by ambient cold. The effect of increased procoagulant activity due to hypoxia and altitude is very significant. Immobility due to reduced daily activity, especially when bad weather supervenes and tight poorly fitting clothing and accessories, may further contribute to sluggish venous flow. Contrary to popular belief, anemia is a more important cause of thrombosis and not polycythemia. Thus, altitude coupled with environmental factors may precipitate a situation ideal for venous clot formation. This risk is compounded in patients predisposed to thrombosis by inherited thrombophilia such as Factor V Leiden mutation, protein C, protein S, and antithrombin deficiency. Platelet number and activation patterns may have a role to play as may

endothelial dysfunction at HA. However, the contribution of these mechanisms, if existent at HA, has not been convincingly demonstrated yet.

- **Diagnosis and management:** A high index of suspicion of thrombotic ailments is warranted to make an early diagnosis. The occurrence of HAPE/HACE in unusual settings, for example, late in the course of a stay at a given altitude, must arouse suspicion of PTE/CVT. Initiation of oxygen therapy and evacuation to lower altitudes are the two most important therapeutic steps at HA/EA. The patient must be evacuated to a secondary or tertiary care center at the earliest possible for further management. In the secondary or tertiary care center, the diagnosis must be confirmed by appropriate imaging modalities (Doppler for lower limb and abdominal veins, magnetic resonance venography (MRV) or contrast enhanced computed tomography (CECT) for cortical veins, and CT angiography for pulmonary vessels), and specific therapy instituted. All patients need to be started on anticoagulation. Heparin (low molecular weight or unfractionated heparin) may be started initially, followed by oral administration after an overlap of at least 5 days to keep a therapeutic INR of 2.5–3.0. Anticoagulation must be continued for at least 3 months for distal (calf vein) thrombosis and 6 months for proximal vein (popliteo-femoro-iliac or inferior vena cava (IVC) thrombosis. Long-term anticoagulation must be administered for thrombotic episodes such as PTE, CVT, and thrombosis at other unusual sites. Cases of pulmonary embolism may require thrombolysis depending on the presence of hemodynamic compromise and right ventricular dysfunction on echocardiography.
- **Arterial thrombosis:** Arterial thrombosis is a recognized peril of high-altitude travel. Dehydration, hemoconcentration, cold, and prothrombotic milieu have been elucidated as etiologies for vascular thrombosis in high altitude, but evidence thus far is limited and also conflicting. Arterial thrombosis in high altitude has been reported in relation to cardiac, brain, mesenteric, and limb ischemia.

In patients with stable ischemic heart disease (IHD) at high altitude, signs of myocardial ischemia occur at similar or slightly reduced cardiac work, and left ventricular contractility is unaffected despite a possible reduction in coronary blood flow, suggesting that myocardial oxygenation is sufficient at least after a few days of acclimatization. Data at extreme altitude is, however lacking.[4]

Studies have shown that the incidence of cerebrovascular complications in young patients (<45 yr) is at least 10–12 times higher in high altitude. The risk of thrombotic events persisted for quite some time even after the individual left the HA area. Hence, it is advisory to follow the individuals up even after they have left HAA. Since there is a lack of sufficiently powered trials, the exact duration of follow-up cannot be dictated presently, but there is a definite need for a well-designed study to evaluate the mentioned queries.

HIGH ALTITUDE–ASSOCIATED SYSTEMIC HYPERTENSION (HASH)

Hypertension at high altitude

A number of soldiers, during fitness medical examinations after ascent to HA, are found to have blood pressure (BP) values in the hypertensive range, that is, >140/90 mmHg. The reasons for this may be

(a) Increase in blood pressure upon ascent to HA and
(b) Diagnosis of pre existing hypertension during medical examination at HA.

An increase in BP consequent to the stress of HA sojourn, such as hypobaric hypoxia, cold, and apprehension, may lead to BP values in the hypertensive range, especially in those with BP values in the prehypertensive range at near sea level. The elevation in BP seen at HA may be due to increased sympathetic discharge and fluid retention in the initial weeks at HA reported by some workers. The sympathetic discharge is believed to settle by 3 months of stay at HA. Few studies have examined BP over a 3-month period at HA, but emerging evidence from the ongoing longitudinal studies suggests a decrease in BP by 3 months of stay after an initial increase in the first 3–6 weeks' stay. Data on the subsequent variations in BP is lacking.

- In the absence of data on the amount and time course of BP elevation at HA, a management protocol is suggested [Figure 4] for subjects found to have hypertension during medical examination.
- The effect of long-term (months to years) stay at HA on systemic BP has not been studied to date. Keeping in mind the likely effect of HA on endothelial function, the possibility exists that systemic hypertension may develop or be accelerated by HA exposure. Long-term longitudinal studies need to be conducted before this issue is set to rest.

COLD INJURIES

- **Local cold injury:** This includes chilblains, trench foot, and frostbite and usually affects peripheral structures such as fingers, toes, tip of nose, and ear lobes. The reason for this is the peripheral vasoconstriction that occurs on

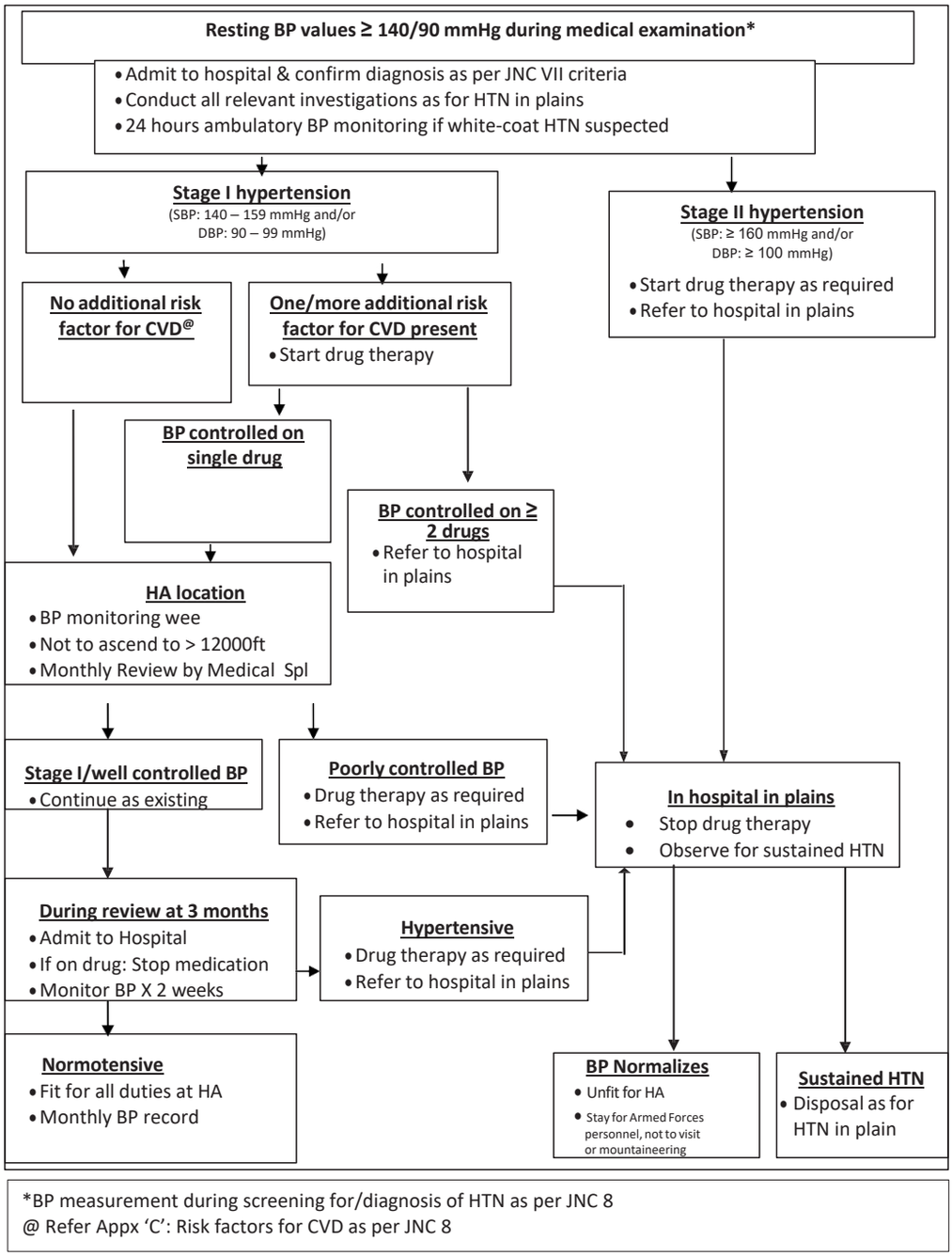

Figure 4: Management protocol for subjects found to be hypertensive at HA. BP: Blood pressure, JNC: Joint national committee, HTN: Hypertension, CVD: Cardiovascular disease, HA: High altitude.

exposure to cold. Predisposing factors to local cold injuries are the wearing of tight clothing, contact with cold objects, smoking, immobility, old age, prolonged exposure to cold and moisture, chronic illness, fatigue, and past history of cold injury. Alcohol, by causing vasodilatation and by direct central effect on hypothalamus, can aggravate heat loss and thereby predispose to frostbite. Cold injuries are frequently associated with generalized hypothermia.

- **Chilblains:** Also known as pernio, occur after prolonged exposure to non freezing temperatures and damp conditions. It is seen in susceptible individuals and consists of an aggravated or uncharacteristic response to

cold exposure. The importance of chilblains lies in the fact that they are common, and so can affect the battle preparedness of soldiers. Patients with chilblains are prone to frostbite.

(a) ***Pathophysiology:*** Prolonged exposure to cold results in constriction of the skin's blood vessels, resulting in hypoxia. Edema in the dermis may also be present. Chilblain can occur with or without freezing of the tissue.[7]

(b) ***Clinical presentation:*** The hands and feet are most commonly affected, but the chilblain of the thighs has also been reported. The affected part is red and there is intense irritation. Desquamation will be present, but tissue loss is rare. The lesions usually resolve spontaneously in 1–3 weeks, but they may recur in some individuals.

(c) ***Treatment:*** Management consists of reassurance, keeping the part dry and warm, immersion in warm water followed by drying, and application of Vaseline and symptomatic treatment. Oral Nifedipine in a dose of 20–60 mg/day may be used to reduce the pain and speed up the resolution of the lesions.

- **Trench foot:** Immersion foot or trench foot is observed in soldiers whose feet have been wet, but not freezing, for prolonged periods. It may occur at ambient temperatures near or slightly above freezing and is usually associated with dependency and immobilization of the lower extremities with constriction of the limb by shoes and clothing.

  (a) ***Clinical presentation:*** Immediate symptoms include numbness and tingling pain with itching, progressing to leg cramps and complete numbness. Initially, the skin is red; later, it becomes progressively pale and mottled and then gray and blue. The soles of the feet are wrinkled and very tender to palpation. The progression of this cold injury has three stages.

  i. Stage 1: Prehyperemic phase, lasting for a few hours to a few days, in which the limb is cold, slightly swollen, discolored, and possibly numb. Major peripheral pulses are barely palpable.

  ii. Stage 2: The hyperemic phase lasts 2–6 weeks. It is characterized by bounding, pulsatile circulation in a red, swollen foot.

  iii. Stage 3: Post-hyperemic phase lasts for weeks or months. The limb may be warm, with increased sensitivity to cold. The injury often produces superficial, moist, liquefaction gangrene quite dissimilar to the dry, mummification gangrene that occurs with severe frostbite.

  (b) ***Treatment:*** Management of this injury entails careful washing and air-drying of the feet, gentle rewarming, bed rest, and slight elevation of the extremity. Improvement occurs within 24–48 hours, while the injury completely resolves in 1–2 weeks.

- **Frostbite:** This is the most serious of local cold injuries and is usually seen at temperatures below freezing point. The pathophysiological process of frostbite may be divided into four phases: *prefreeze, freeze–thaw, vascular stasis,* and *late ischemic.* Overlap is usually present between the phases. In the early prefreeze phase, vasoconstriction and ischemia occur with neuronal cooling and ischemia leading to pain and paresthesia. Subsequently, there is freezing of intracellular or extracellular fluid with the formation of ice crystals, leading to the rise in osmotic pressure, intracellular dehydration, electrolyte imbalances, protein and lipid derangement, cell membrane injury, and cell death. A reversal of this process probably occurs during the thawing of frozen tissues. After tissue thawing, vasodilation and leakage from capillaries occur, causing tissue edema. Alternating freeze thaw cycles potentiate vascular injury lead to ischemic death of tissues. The vasoconstriction and stasis seen in frostbite are associated with the release of prostaglandins that have been implicated in progressive dermal ischemia. Both prostaglandin F2 and thromboxane A2 cause platelet aggregation and vasoconstriction. Therapy with antiprostaglandin agents and thromboxane inhibitors has been shown to increase tissue survival. Frostbite develops as a function of the body's protective mechanisms to maintain core temperature. Warm blood is shunted from cold peripheral tissues to the core by vasoconstriction of arterioles of the extremities and face, especially the nose and ears. Hypothermia may be seen along with frostbite. Frostbite progresses from distal to proximal and from superficial to deep. The severity of frostbite is proportional to the duration of exposure to cold.[8]

  (a) ***Clinical features:*** The onset is usually insidious, with pain and numbness followed by loss of sensation of the affected part. Initially, as the tissue is freezing, the patient experiences discomfort or pain. This progresses to numbness and loss of sensation. Upon examination, the frozen tissue is white and anesthetic, owing to intense vasoconstriction. Tissues that remain frozen can appear mottled, violaceous, pale yellow, or waxy. Favorable signs include warmth, normal color, and some sensation. It has been demonstrated repeatedly that a person who previously suffered frostbite is more prone to develop this cold injury in the same body part than an individual with no history of such a cold injury.

  (b) ***Classification of frostbite:*** In very early stages, there is the freezing of the most superficial layers of epidermis, producing a blanched wheal, which is called frostnip.

Frostnip, the mildest form of cold injury to the skin, is a precursor to frostbite. It can also occur from skin contact with cold surfaces (e.g., metal, equipment, liquid). Mild frostbite involves freezing of the skin and adjacent subcutaneous tissues; extracellular water freezes first, followed by cell freezing. Severe frostbite is the freezing of the tissues below the skin and the adjacent tissues, which can include muscle, tendon, and bone. Traditionally, frostbite has been classified into four degrees of severity, as follows:

i. In first-degree frostbite, hyperemia and edema are evident.
ii. Second-degree frostbite is characterized by hyperemia and edema, with large, clear blisters that may extend to the entire length of the limb, digit, or facial feature.
iii. Third-degree frostbite is characterized by hyperemia, edema, and vesicles filled with hemorrhagic fluid that are usually smaller than those of second-degree frostbite and do not extend to the tip of the involved digit.
iv. Fourth-degree frostbite, the most severe type, involves complete necrosis with gangrene and loss of the affected part.

A simpler and clinically more relevant classification divides frostbite injury into two types: superficial or deep.

(a) ***Superficial frostbite:*** (First and second degree frostbite): Involve the skin and subcutaneous tissues. The skin is cold, waxy white, and non-blanching. The frozen part is anesthetic, but becomes painful and flushed with thawing. Edema develops and clear bullae filled with serous fluid appear within the first 24 hours.
(b) ***Deep frostbite:*** (Third- and fourth-degree frostbite): Involves the muscle, tendons, neurovascular structures, and bone, in addition to the skin and subcutaneous tissues. The frozen part is hard, wood like, and anesthetic. It appears ashen-gray, cyanotic, or mottled and may remain unchanged even after rewarming. Edema develops, but bullae may be absent or delayed. Bullae, if present, are filled with hemorrhagic fluid.
(c) ***Treatment in peripheral medical facilities or prehospital care:*** The patient must be removed from the cold environment. At level of the most peripheral medical facility, general warmth should be provided by hot fluids, sleeping bags, and extra blankets and associated hypothermia, if present, should be dealt with. The patient should be reassured, given mild analgesics, dry dressing applied to affected parts, tetanus toxoid given, and ibuprofen should be started in a dose of 12 mg/kg per day in two divided doses (minimum to inhibit harmful prostaglandins) to a maximum of 2400 mg/day in four divided doses. Aspirin has been proposed as an alternative for anti-inflammatory and platelet inhibition effects and may be given if ibuprofen is not available. Vasodilators such as Pentoxifyline, Nifedipine, and Phenoxybenzamine have been used as primary or adjunctive therapies in the treatment of frostbite. Pentoxifylline, if available, should be given in a dose of 400 mg thrice daily. The patient should be transferred to the nearest hospital at the earliest. Treatment should not be attempted in the field if a hospital is available within a short distance or if a risk exists that the extremity will be refrozen during transportation. Once the rewarming process has begun, weight-bearing on the affected part is almost certain to result in additional injury. Rubbing the frostbitten part with snow or exercising it in an attempt to hasten rewarming is absolutely contraindicated. Contrary to popular belief, walking some distance on frostbitten feet can result in aggravation of damage. Consequently, this should be avoided.
(d) ***Treatment in a hospital setup:*** Normal body temperature should be restored before treating the local injury. The preferred initial treatment for frostbite is rapid rewarming in a water bath at a temperature of 39–42°C (102.2–107.6°F). Strict aseptic technique (e.g., mask, powder-free gloves) should be used by all personnel during the warming procedure and during subsequent wound treatments. The rewarming bath should be large enough so that the frostbitten part does not rapidly reduce the temperature of the water. The temperature of the bath should be monitored carefully as the bath cools. Additional hot water may be added to the bath only after the extremity is removed from it. After the addition of hot water, the bath should be stirred, and the temperature retested before the extremity is reintroduced into the bath. Rewarming should be continued until the frostbitten tissue has a flushed appearance, demonstrating that circulation is reestablished. This rewarming procedure usually lasts 30–45 minutes. Since rewarming is painful, narcotics are often required. After rewarming, the skin should be washed gently and then carefully dried.
(e) Once rewarming has begun, it is imperative that the affected tissue not be allowed to refreeze, as this may result in tissue necrosis. The use of heparin, low molecular weight dextran, and oral anticoagulants have shown no beneficial effects, and their use is not advocated. The benefit of prophylactic antibiotics continues to be debated, and their use is reserved for specific infectious complications. A therapeutic approach should be devised to prevent the progressive dermal ischemia of frostbite. Systemic ibuprofen may be used to reduce dermal ischemia. The goal of thrombolytic therapy in frostbite

injury is to address microvascular thrombosis. For deep frostbite injury with potential significant morbidity, use of intravenous or intra-arterial tissue plasminogen activator (tPA) in the dose of 0.15 mg/kg bolus followed by 0.15 mg/kg/hour infusion over 6 hours (to a maximum of 100 mg) and heparin in a dose of 500 mg/hour for 3–5 days within 24 hours of thawing may salvage some or all tissue at risk in Class 4 frostbites without any trauma or bleeding. For those with Class 3 frostbite trauma or those beyond the window period of up to 72 hours, Iloprost (prostacyclin analog) is indicated. The tissue plasminogen activator is continued till there is evidence of tissue reperfusion or for a maximum of 48 hours. Common indications for use of thrombolytic therapy are purple discoloration of the affected part, absent capillary refill, or the presence of hemorrhagic blisters. The clear blisters are debrided immediately, and antiseptic cream is applied directly to the debrided wound. In contrast, the hemorrhagic blisters are left intact. When the hemorrhagic blisters rupture, these should be debrided. Topical aloe vera cream or gel should be applied to the thawed tissue prior to applying dressings. Aloe vera cream or gel can be reapplied at each dressing change, or every 6 hours. If nonsteroidal anti-inflammatory drugs (NSAIDs) have not been initiated in the periphery, ibuprofen should be administered at a dose of 12 mg/kg divided twice daily, unless contraindicated (e.g., history of allergy, peptic ulcer disease) until the frostbite wound is healed or surgical management is undertaken (typically 4–6 weeks). The affected part should be protected from trauma and infection, and it should be elevated above the patient's heart to minimize edema. A protective cradle should cover frostbitten lower extremities to prevent trauma. An environmental temperature of 21–26°C (69.8–78.8°F) in the hospital room is usually comfortable for the patient. Patients with first- or second-degree frostbite of the feet should continue bed rest until the edema has receded and the vesicles and bullae have dried, which usually takes 2 weeks. Patients with more severe frostbite should remain in bed until wound repair is complete. Avoidance of joint stiffness and wound contraction is an essential goal of the rehabilitation program.

(f) As a general rule, amputation and surgical debridement should be delayed for 60–90 days unless severe infection with sepsis develops. The natural history of most injuries is one of gradual demarcation of the injured area, followed by dry gangrene or mummification of the area, with later sloughing of necrotic tissue, resulting in a viable but shortened extremity beneath the eschar. Emergency surgery is occasionally required for patients with a frostbitten extremity. Open amputations are indicated in patients with persistent infection with sepsis that is refractory to debridement and antibiotics. Compartment syndrome may be encountered in a frostbitten extremity, which mandates fasciotomy.

(g) ***Prevention:*** Prevention is the most important strategy in the management of frostbite and is aimed at ensuring adequate perfusion of tissues and prevention from cold [Table 15].

Table 15: Prevention of frostbite

- **Maintaining adequate tissue perfusion**
  - Maintain core body temperature & hydration (4–6 L/day)
  - Ensure adequate nutrition
  - Do not wear constrictive clothing or footwear
  - Minimize effects of known disease and drugs that may decrease perfusion (e.g., peripheral arterial occlusive disease and smoking)
  - Cover all skin to avoid vasoconstriction
  - Exercise sufficient to cause limb vasodilatation without causing fatigue
- **Protection from cold**
  - Avoid environmental conditions with high risk of frostbite (ambient temp < −15°C)
  - Protect skin from moisture, wind and cold
  - Prevent perspiration and wet extremities
  - Wear layers of clothing/gloves/headgear appropriate to ambient conditions
  - Snow/ice is often colder than ambient temperatures; footgear must be accordingly planned
  - Minimize exposure to cold
  - Behavioral modifications appropriate to cold (e.g., avoid alcohol in extreme cold)
  - Use chemical hand/foot warmers
- **General measures**
  - Recognize frostnip and/or early frostbite and take adequate preventive measures
  - Report symptoms early

HYPOTHERMIA

- Body temperature regulation depends on a balance of heat generation and loss. In the extreme cold conditions seen in the winters at HA and round the year in EA, body heat loss in an inadequately dressed individual could rapidly lead to hypothermia. Since clothing is mostly of is of appropriate quality, hypothermia rarely if ever, occurs today. However, we should be alert to the possibility at all times, especially in survivors of avalanche accidents, blizzards, and falls into lakes or rivers and crevices in ice. Injured or ill persons have an increased risk of cooling,

and unusually rapid cooling should arouse suspicion of underlying injury or illness. A reduction of core body temperature below 35°C is known as hypothermia.

- The occurrence of hypothermia in an otherwise healthy person is known as primary hypothermia and is the result of greater heat loss than production. This is more likely when the metabolic energy substrate stores are depleted. Secondary hypothermia may occur in ill persons with a variety of underlying ailments, even in warm environments due to impaired thermoregulation and/or increased heat loss. CVA, central nervous system (CNS) injury, subarachnoid hemorrhage, acidosis, fatigue, hypoglycemia, and certain toxins may impair thermoregulation; burns, cold infusions, hyperdynamic circulation states, infections, multisystem trauma, and shock may increase heat loss, predisposing to hypothermia.
- **Diagnosis:** A diagnosis of hypothermia should be considered in the setting of a history of cold exposure or a disease that predisposes to hypothermia, for example, head injury and the finding of a cold body or trunk in a patient. The core body temperature measuring a value of <35°C confirms the diagnosis of hypothermia. A rectal thermometer inserted to a depth of 15 cm/esophageal probe in the lower third is required to record the core body temperature in hypothermic patients. Traditionally, hypothermia has been classified as mild, moderate, severe, and profound. However, in a peripheral setting, where core body temperature cannot be measured, the Swiss Staging system that depends on clinical signs is preferable, especially since it aids decision-making on the management and transportation of the patient. Five stages of hypothermia are recognized based on the level of consciousness, shivering, and presence of vital signs [Table 15]. Absence of vital signs, an incompressible chest, and stomach muscles that cannot be kneaded (whole body frozen solid) are features of death due to irreversible hypothermia. Rigor mortis and fixed dilated pupils may be present in patients of reversible hypothermia.
- **Clinical features:** Consciousness, breathing, and circulation are initially intact in all types of hypothermia but are impaired as the body cools further. The body responds initially to cold by shivering and an increase in voluntary movement. At core temperatures <28°C (82°F), some patients may engage in paradoxical undressing. At core temperatures <32°C, atrial fibrillation is common but benign in the absence of other features of cardiac instability. Systolic BP <90 mmHg, ventricular arrhythmias, and core temperature <28°C suggest or cause cardiac instability. The risk of cardiac arrest also increases below 32°C and is significantly greater below 28°C. The patient may be disoriented, confused, or drowsy and slip into a coma with greater hypothermia. On physical examination, there is pallor, the skin is ice cold, and the respiration, heart rate, and blood pressure may be increased early in hypothermia but later decrease and may be difficult to measure. This may lead the clinician to believe that the patient is dead. However, severely hypothermic patients with cardiac asystole can be resuscitated successfully even after a few hours of cardiac arrest. The immediate danger to life is from ventricular fibrillation, which is precipitated by any muscular activity, and the patient must be handled with minimal manipulation. Terminally, pulmonary edema supervenes.
- **Management:** A suggested scheme for out-of-hospital management of hypothermia is as shown in Figure 5.[9]
- Effective and continuous cardiopulmonary resuscitation (CPR) is the mainstay of therapy for patients of stage IV hypertension. Survival up to 390 minutes after CPR has been documented in cases of HT IV. Airway management and CPR must be initiated, and the patient must be transported without delay to a hospital. CPR must be continued till the body is rewarmed to 32°C and cardiac stability is achieved. Indications for termination of CPR include:
  (a) Obvious features of death, such as decapitation, whole body frozen solid, and drowning (in water or snow)
  (b) Absence of vital signs with body temperature >32°C and/or serum potassium level >12 mmol/L.
  Patients with a history or features suggestive of cardiac arrest before cooling have a poorer outcome on resuscitation. Organ failure is common 24 hours after admission, and pulmonary edema is the commonest cause of death.
- **Rewarming techniques:** A warm environment, warm clothing, and ingestion of hot, sweet drinks where possible, are required for all patients of HT. Rewarming techniques include:
  (a) Active external and
  (b) Invasive rewarming
  The latter may be minimally invasive (warm parenteral fluids) or include methods such as peritoneal lavage, thoracic lavage, hemodialysis, veno-venous or veno-arterio extracorporeal membrane oxygenation (ECMO), and cardiopulmonary bypass (CPB). Invasive rewarming techniques have attendant risks, such as bleeding, and are suggested only for cases with cardiac instability or HT IV (other than IV fluids, which may be administered in HT II and III with cardiac stability). Where ECMO and CPB are not available, thoracic lavage may be preferred. Active external rewarming employs the use of chemical packs, electric blankets, and forced-air blankets. The risk of ventricular fibrillation and cardiac arrest is ever present when rewarming a case of hypothermia, and the

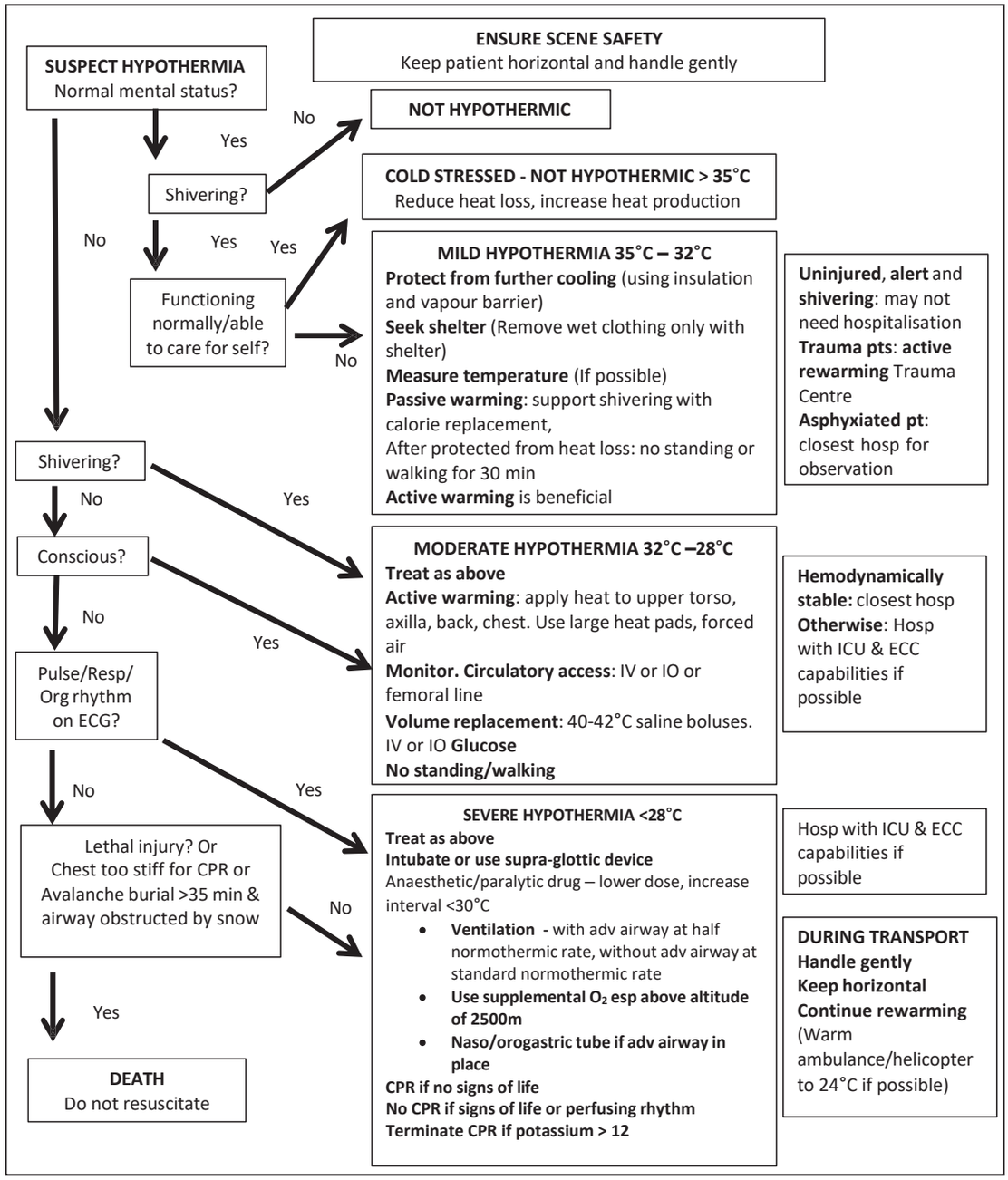

Figure 5: Suggested algorithm for the management of hypothermia in peripheral setting (based on WMS consensus guidelines 2014 as updated). CPR: Cardiopulmonary resuscitation, ECC: Emergency cardiovascular care, WMS: Wilderness medical society, IV: Intravenous, IO: Intraosseous, ICU: Intensive care unit, ECG: Electrocardiogram.

Medical Officer (MO) or physicians should be alert of this possibility. Cardiac resuscitation should be available when rewarming.

CONCLUSION

High-altitude illnesses are a major detriment to living and working in high altitudes for lowlanders. The features of AMS include headache, loss of appetite, sleep disturbance, nausea, fatigue, and dizziness, which begin shortly after rapid ascent to high altitude. The biggest issue in this case is that due to the ease of availability of air travel, rapid ascent has become a rule rather than an exception, which has exponentially increased this condition in the recent past. Hypoxia in HA can lead to impaired mental performance,

weight loss, and reduced capacity for exercise. Certain factors, such as elevation from where a person comes to HA, maximum altitude reached, sleeping altitude (it is best to work high and sleep low), rate of ascent, latitude, intensity of exercise, pre-acclimatization, prior high-altitude experience, and genetics impact an individual's propensity for AMS. The symptoms are relieved by rest and withholding further ascent till symptoms are resolved. In severe cases, descent to a lower altitude is always curative. AMS may progress to HACE. HAPE can intervene without AMS. These two conditions, unlike AMS, are medical emergencies and need descent, supplemental oxygen, and in the case of HACE, the use of oral steroids. Nifedipine, and more recently phosphodiesterase-5 inhibitors, may be effective in the management of HAPE. Descent should never be alone. Portable hyperbaric chambers must be considered if descent is not possible. A high index of suspicion is needed to diagnose these acute life-threatening disorders at high altitudes. Awareness of subacute and chronic high-altitude illnesses as well as miscellaneous disorders of high altitudes, including cold injuries as well as other conditions aggravated by high altitude among medical professionals would go a long way in their prevention, early detection, and treatment.

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Task Force Report

NAMS task force report on mental stress

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EXECUTIVE SUMMARY

Stress is a state of worry or mental tension caused by a difficult situation. Stress affects both the mind and the body. The effect of the stressor on physical and mental health can be either positive or negative, depending on factors such as severity, controllability, duration, and resource availability for managing stress. Mental stress has emerged as a critical health issue in our country, which has significant implications for individual well-being and societal productivity.

Current situation in the country

There have been no nationally representative study to find the prevalence of psychological stress in the general population in our country. However, there are multiple studies that have assessed the prevalence of mental illness in India. Despite various initiatives to improve the mental health like national mental health program (NMHP), tele-mental health, etc., the budget allocations for mental health do not match the growing demand, highlighting a significant gap in resource distribution.

Key issues and gaps

- Stigma associated with mental health disorders
- Low mental health literacy and public awareness
- Shortage of mental health professionals
- Lack of focus on prevention, lack of holistic approaches, digital divide
- Lack of adequate provisions to manage workplace stress
- Low budget allocation

Recommendations to address gaps:

- Increased funding and resource allotment, especially in underserved regions.
- Development of trained workforce
- Improving mental health literacy through strengthening awareness and reducing stigma
- Integrating mental health services into broader healthcare system in our country

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- Development of culturally sensitive and evidence based interventions
- Strengthening policies for mental health
- Encouraging research activities in the area of mental health
- Utilisation of frontline workers to support the persons affected by mental stress
- Collaboration with NGOs and other social services organisations working for mental health welfare
- Monitoring and evaluation to ensure sustainability

Way forward

The implementation plan should include a comprehensive, multi-stakeholder approach involving policy makers, healthcare professionals, community leaders, NGOs, educational institutions, etc. Key activities include enhancing public awareness, building workforce capacity, integrating mental health policies into primary care, enhancing telehealth services, creating accessible pathways to care, and monitoring and evaluation to ensure sustainability.

INTRODUCTION

The World Health Organization has defined stress as "A state of worry or mental tension caused by a difficult situation".[1] The "difficult situation" or the stressor can range from normal day-to-day stressors like missing a bus, or it can be a challenging situation like a job interview, conflict with friends or family, or an event that affects a large number of people at a time like natural disasters, disease outbreaks, and major economic crises.

Stress affects both the mind and the body. The effect of the stressor on the physical and mental health of an individual can be either positive or negative depending on the interplay of multiple factors—the severity of the stressor, the controllability of the stressor by the person experiencing the stressor, duration of stressors, and the availability of resources to manage the stressors. The resources here include psychological resources (coping skills, personality traits, attitude, values, etc.), social and financial resources, as well as physical health-related factors, that one can use in responding to the stressor.

While the term "stress" connoting difficulty or challenge made an appearance in the literature as early as the 14th century, it was during World War II that a heightened curiosity emerged surrounding emotional breakdowns triggered by the pressures of combat. It was found that numerous circumstances in everyday life—such as the process of maturing, marriage, or experiencing illness—could evoke effects akin to those seen in combat situations. This resulted in a growing inclination to view stress as a significant contributor to human dysfunction and distress.[2] However, further studies have expanded the concept further to include not only distress but also eustress (Figure 1).

Eustress is a type of stress where homeostasis is mildly challenged by moderate levels of positive stressors that may lead to mild stress response. Sustress is a type of stress where homeostasis is either not challenged or inadequately challenged, eventually affecting the homeostasis negatively and worsening health. Distress is a type of stress where homeostasis is strongly challenged and worsens health.[3]

Since the concept of stress is broad and it is the distress that leads to more negative effects or damage to an individual, it was mutually decided by the members of the task force that the current article will focus only on the "Distress." Hence, in this article, hereafter, the term "stress" refers to "distress" unless specified otherwise.

Models of stress

Stimulus-based models

Stimulus-based models interpret stress as a stimulus, a life event that evokes physiological and psychological responses, which may increase an individual's vulnerability to developing health issues and dysfunction at various levels. Using this conceptual framework, Holmes and Rahe developed a Stress scale that lists 43 life events, both positive and negative, that can be considered stressful.[4]

Response-based models

The response-based model developed by Selye conceptualized stress as a "response".[5] Selye proposed the "General Adaptation Syndrome," which suggests that stress triggers a physiological response involving three stages: alarm, resistance, and exhaustion. During the alarm stage, the body reacts with the fight-or-flight response, preparing to confront the stressor. If the stress persists, the body enters the resistance stage, attempting to cope with the ongoing challenge. However, if the stress becomes chronic and overwhelming, the body enters the exhaustion stage, leading to a breakdown of physiological systems and increased vulnerability to illnesses.

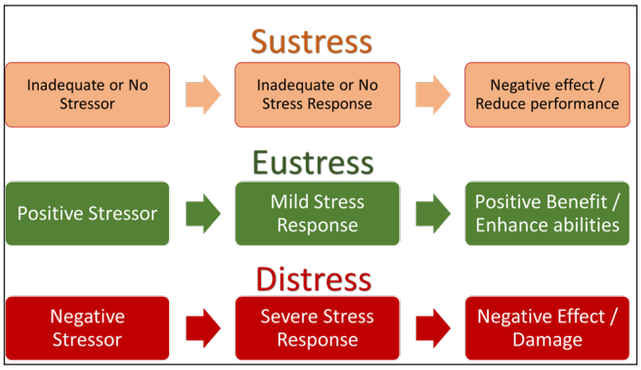

Figure 1: Types of stress.

Transactional model

Another prominent model of stress is the "Transactional Model," proposed by Richard Lazarus and Susan Folkman in the 1980s. This model emphasizes the dynamic nature of stress, suggesting that it emerges from the transactional process between an individual and their environment. Stress is perceived through an individual's assessment of a situation's potential harm and their ability to cope with it. This appraisal leads to either adaptive or maladaptive responses, influencing the overall impact of stress on well-being.[6]

While Lazarus acknowledged specific environmental conditions as stressors, he also highlighted the variations in individuals and groups in perceiving and responding to these stressors due to differences in sensitivity and vulnerability of the cognitive processes that arise between a stimulus and the corresponding response.

Allostatic load model

In recent years, the "Allostatic Load Model" has gained traction considering the cumulative physiological toll of chronic stress. This model focuses on the body's attempts to maintain stability through physiological adaptations, which can become maladaptive when stressors are prolonged or intense. Over time, this can result in "allostatic load," where the wear and tear on bodily systems contribute to various health problems. This model underscores the importance of early intervention and stress management to prevent long-term health consequences.[7]

Importance of stress

Stress is a universal phenomenon. The global prevalence of stress among the general population during the COVID-19 pandemic has been observed to be around 36.5%, and that of psychological distress is around 50.0%.[8] The studies available before the pandemic have shown that the prevalence of psychological distress in the general population varied from 5 to 27%, depending on the screening tool and the methodology used. The prevalence in certain special populations such as migrants, workers facing stressful work situations, and elderly who have faced neglect or abuse is even higher.[9]

The stressors can occur from various sources, such as environmental stressors, physical pain, circadian disruptions, and substance consumption. Also, stressors can differ significantly in their strength, ranging from mild to severe, and in terms of their duration or timing, spanning acute, chronic, or intermittent periods. It is also essential to acknowledge that not only do stressors come in a wide range, but an individual's response to a stressor can also vary significantly based on various factors such as sociodemographic factors, personality factors, the presence of social support, and prevailing social norms.

Stress has been identified as a factor that can heighten the likelihood of various physical illnesses, and it may also worsen preexisting physical conditions. Similarly, stress can elevate the risk of mental illnesses, particularly depression, anxiety, and substance use disorders. Moreover, it has the potential to intensify the severity of preexisting mental health conditions, contributing to a decline in the overall quality of life and an increased risk of morbidity and mortality.

Given that mental stress is a widespread phenomenon affecting individuals across diverse backgrounds, it becomes imperative to comprehend the current situation of mental stress in our country. This article aims to provide an overview of the existing mental stress scenario, delineate the consequences of mental stress, highlight gaps in current policies and programs, and propose recommendations for enhancing the current situation.

BACKGROUND

Medical professionals can play an important role in identifying and managing mental stress in the general population, which in turn can help in the prevention of mental illness and mental health promotion. The National Academy of Medical Sciences (NAMS), India, along with the Armed Forces Medical Services (AFMS) have constituted a Joint Task Force on Mental Stress to develop a white paper that can be submitted to the Government of India to develop guidelines and to improve the interventions addressing the problems of Mental Stress in Indian population. In pursuance of the meeting of NAMS held on August 08, 2023, and the constitution of a Task Force on Mental Stress to develop a white paper to be submitted to the Government of India for improving the health intervention activities in the area of Mental Stress, the objectives of the task force were laid out.

This white paper document discusses the extent of mental stress-related problems in India, offering a roadmap for

policymakers to address these more effectively with the help of evidence-based interventions.

TERMS OF REFERENCE (TORS) FOR THE TASK FORCE

The main objectives of the Task Force were as follows:

- To identify the current status of mental stress
- Identify the deficiencies which need to be addressed.
- To recommend measures for the management of mental stress

METHODOLOGY

The task force reviewed the current reports and data on mental stress in India. It then developed a consensus on the key observations and recommendations by considering the healthcare services and the varied social-cultural-economic contexts across the Indian landscape. The initial working draft was circulated among the task force members, and comments were sought. The working draft was modified based on their suggestions. Subsequently, online meetings were held in which the experts deliberated on the various aspects of the document. Further modifications were made to the document based on the inputs received from experts.

OBSERVATION AND CRITICAL REVIEW

Current situation in the country

Since the concept of mental stress has varied across the literature, the scales used to screen for mental stress, and the methodology used in the studies have also varied. As a result, the prevalence of psychological stress or distress in the general population has also varied across studies from 5 to 27%.[9] In India, there has been no nationally representative study to find the prevalence of psychological stress in the general population, even though there are many studies that have tried to assess the prevalence of mental illness in the country.

In India, the total disease burden due to mental disorders has almost doubled since 1990.[10] The National Mental Health Survey (NMHS) conducted in 2016 across 12 states found that the weighted prevalence for any mental illness in the lifetime was 13.7% and that for current mental illness was 10.6%. Apart from substance use disorders, mood disorders, and neurotic or stress-related disorders were found to be the most common mental disorders [Table 1].[11] The prevalence of mental health disorders according to global burden of disease study has been mentioned in Annexure.

Most studies in India that have tried to assess the prevalence of mental stress or psychological distress have focused on specific populations, such as adolescents and the elderly. There have been very few studies that have focused on the general population.

Table 1: Prevalence of mental disorders as per national mental health survey 2016

Mental illness	Prevalence (NMHS, 2016)
Mental and behavioral problems due to psychoactive substance use	22.4%
Schizophrenia and other psychotic disorders	Lifetime prevalence - 1.4%;
	Current prevalence - 0.4%
Mood disorders	Lifetime prevalence - 5.6%
	Current prevalence - 2.8%
Neurotic and stress-related disorders	Lifetime prevalence - 3.7%
	Current prevalence - 3.5%

NMHS: National Mental Health Survey

Some of the studies conducted in the general population have been listed below:

- A cross-sectional, community-based study conducted among 943 participants in a rural community among the adult population in India found the prevalence of psychological distress to be around 42.4 per thousand, around 0.04%. Being illiterate and being separated or divorced was found to be associated with psychological distress.[12]
- A meta-analysis of 21 cross-sectional studies during the COVID-19 pandemic in India found the overall prevalence of psychological distress among the general population was around 33%. There was significant heterogeneity across studies, with prevalence ranging from 2.4 to 84% depending on the scales and the methodology used.[13]
- A cross-sectional study to assess the psychological distress among healthcare workers in India during the COVID-19 pandemic found the prevalence to be around 52.9%, with the risk being significantly associated with longer hours of work, income, screening of patients, or contact tracing. Also, high emotional exhaustion and depersonalization were found to be associated with higher psychological distress.[14]

Studies on the prevalence of psychological distress in other countries

As the majority of studies on psychological distress among the general population are from countries outside India, the current study also reviewed these studies to understand the

prevalence and various factors associated with psychological distress.

- The prevalence of psychological distress has varied across studies and countries from 5 to 27% in the general population, depending on the tools and the methodology used. However, the prevalence among certain populations, such as migrants and workers facing stressful work situations, can be higher.[9]
- A study that analyzed data from 202,922 participants of the Behavioral Risk Factor Surveillance system in the USA found the prevalence of serious psychological distress to be around 2.1% in the total population.[15] Multiple studies that analyzed the data from the 2007 Behavioral Risk Factor Surveillance Survey, a nationwide survey conducted in the USA, found that psychological distress (Assessed using the Kessler 6 Questionnaire) was associated with abnormal body mass index (BMI, either underweight or obese),[16] urban residence,[17] and smoking status (current and former smokers).[18]
- Another study from Canada which analyzed data from 11,058 participants from the first 12 years of the National Population Health Survey found that nearly 11% of participants experienced at least one episode of psychological stress over 12 years.[19]
- In a longitudinal study involving over 400 adults and their children in the USA, it was observed that the occurrence of negative life events and the adoption of avoidance coping strategies were correlated with an increased likelihood of experiencing psychological distress. Similarly, in children, a higher risk of psychological distress was linked to parental emotional and physical distress. At the same time, an easygoing disposition, family support, and self-confidence were associated with a lower risk of psychological distress.[20]
- A study conducted in Pakistan on 1000 adults aged between 18 and 75 years found the prevalence of psychological distress to be around 41% in women and 19% in men (Scale used: Self-reporting questionnaire [SRQ]). The study also found that lower educational status, lower income, and recent hospitalization (in the past 12 months) were associated with higher rates of psychological distress.[21]

Factors affecting mental stress

A large number of factors have been proposed to moderate stress. A stressor can act as a catalyst, presenting a challenge or predicament that compels an individual into action. Whether a situation is perceived as stress-inducing or not hinges on several factors and individual variations. Stressors can be categorized into two types: major life stressors and daily hassles. The former type is associated with alterations or disruptions related to key aspects of people's lives, for example, shifting to a new city for a job. On the other hand, the latter involve minor, day-to-day vexations or frustrations, such as waiting in line or dealing with challenging individuals. Despite their seemingly small nature, daily provocations can also result in considerable stress, and the cumulative effect of numerous such issues can be as impactful as significant life changes.[22]

Another category of stressors that are of importance are those that are chronic. Wheaton *et al.,*[23] (1997) has given seven types of events or situations that may be understood as chronic stressors:

(a) Threat of regular physical abuse or staying in high-crime areas
(b) Expectations that cannot be met with current resources
(c) Structural constraints, such as lack of higher education facilities near home
(d) Discrimination in the job
(e) Instability in life arrangements, conflicts of responsibilities across roles, for example, in the case of working women
(f) Uncertainty
(g) Ongoing conflicts in personal, social, environmental, or political scenarios.[23]

It is well-known that there is individual variability in a person's response to stressful situations. While some individuals manage even the most extreme situations, some may get distressed even with minimal demands. Hence, the role of individual factors is paramount in determining whether a person will develop psychological stress. At the same time, there are certain situations or stressors like disasters, war, and so on, which can cause psychological distress in many individuals. The ability of an individual to come out of these stressful situations will depend on not only the individual factors but also the availability of social support and other resources such as shelter, clothes, food, and security. Hence, mental stress can occur either due to the nature of the stressor or, due to individual vulnerability or a combination of both. Hence, while some individuals tend to show stressor responses associated with active coping, others tend to show stressor responses associated with aversive vigilance (Llabre, 1998).[24]

While several factors can increase or decrease psychological stress, we have enlisted some of the most important and major factors associated with psychological stress based on the literature.

Demographic factors associated with higher risk of mental stress

- Age: Extremes of age
- Gender: Female gender
- Education status: Lower education
- Marital status: Unmarried or Single status
- Residence: Urban locality
- Economic Status: Lower income
- Work: Unemployment

Physical health-related factors associated with higher risk of mental stress

- Presence of physical disability
- Recent hospitalization
- Chronic physical illness
- Abnormal BMI (Not being physically fit)
- Less exercise
- History of physical illness

Social factors associated with a higher risk of mental stress

- Uncertainty about the current situation (e.g., refugees)
- Uncertainty about future (e.g., refugees)
- Minority status (e.g., ethnic minority, sexual minority, etc.)
- Poor social support
- Societal norms – Can act as both protective and risk factors at times

Environmental factors

- Daily life situations
  For example, being late for work, missing the bus to work, and so on can increase the risk
- Positive uplifts in daily life
  For example, getting appreciated at work and so on can decrease the risk
- Major life events:
  For example, marriage, divorce, birth of a child, death of a loved one, and so on, can increase or decrease the risk
- Exposure to trauma or adverse life experiences can increase the risk
  - Exposure to childhood sexual abuse
  - Exposure to bullying or rejection in the form of being ignored, cursed, or assaulted
  - Exposure to parental emotional distress or parental physical distress
  - Exposure to physical abuse, including intimate violence
  - Exposure to substance use by a family member
  - Being a caregiver of a person with a mental illness
  - Being a caregiver to a person exposed to disaster
- Acculturation stress
  - Migrating to a new cultural environment, language barriers, and so on can increase the risk
- Workplace factors:
  - Risk factors at workplace:
    - Dissatisfaction with job
    - Family–work conflict
    - Long working hours
    - Nontraditional gender roles at work
    - Loneliness
  - Protective factors at the workplace:
    - Having active participation in the job
    - Ability to maintain work and family roles successfully
    - Perceived control in the job
- Higher academic stress can increase the risk for students

Psychological factors

- Temperament:
  - Negative affectivity increases the risk
  - Easy-going temperament lowers the risk
- Lower psychological flexibility increases the risk
- Personality factors:
  - Risk factors:
    - Higher neuroticism
    - Higher conscientiousness
  - Protective factors:
    - Openness to experience
    - Extraversion
    - Agreeableness
- Coping skills:
  - Risk factors:
    - Emotion-focused coping
    - Avoidance or escape coping
  - Protective factors:
    - Problem-focused coping
- Gratitude, optimism, and self-compassion have lower risk
- The presence of mental illness symptoms has a higher risk
- History of mental illness has a higher risk

Consequences of Mental Stress

Some amount of stress is necessary to propel an individual to act or deal with the situation. The Yerkes–Dodson law, proposed in 1908, elucidated that the performance increased with stress or arousal only to some extent, beyond which it started declining. It further stressed that insufficient

stress would lead to disinterest or boredom and decreased performance [Figure 2].

However, extreme or prolonged stress can have physiological, psychological, and social ramifications. A systematic review comprising 47 studies revealed that elevated stress reactivity in both the situationally accessible memory (SAM) system and the hypothalamic-pituitary-adrenal (HPA) axis was predictive of a heightened risk of cardiovascular diseases. Conversely, blunted stress reactivity was associated with an increased likelihood of future obesity, depression, anxiety, higher illness frequency, pains or aches, diminished cognitive ability, poor self-reported health, and disability.[25]

Physiological effects: The hypothalamus is affected in the same manner by our internal anger, as well as our guilt and resentment toward other people and ourselves. But, we trap this tension inside where its consequences compound rather than letting it go. Research indicates that nearly every bodily system can be impacted by chronic stress. When chronic stress is not relieved, it hampers the immune system, leading to illnesses. Fortunately, in typical situations, 3 minutes after the cessation of a threatening scenario and the elimination of real or perceived danger, the fight-or-flight response diminishes. Consequently, the body relaxes and reverts to its usual state. During this period, several physiological functions such as heart rate, blood pressure, breathing, muscle tension, digestion, metabolism, and the immune system normalize. If stress persists beyond the initial fight-or-flight reaction, the body's response progresses to a second stage.

Effect on physical health: Psychological distress is well known to lead to an increase in the risk of physical illness, as well as worsen the course of physical illness.

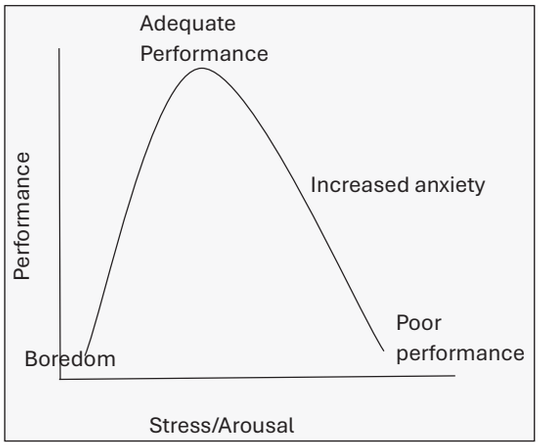

Figure 2: Yerkes–Dodson law.

Stress and immune system: The harmful effects of chronic stress lead to dysfunction of the HPA axis, which in turn leads to impaired immune system, reduction in activity of the T-lymphocytes and natural killer (NK) cells, and predisposition to malignancies.

Stress and cardiovascular system: Stress, both acute and chronic, has a deleterious effect on the cardiovascular system, as it causes chronic activation of the autonomic nervous system, leading to vasoconstriction, atherogenesis, increase in blood pressure, and so on. A systematic review of 24 prospective studies found that psychological distress was associated with a significantly increased risk of recurrent cardiac events in patients with coronary artery disease.[26]

Stress and Gastrointestinal (GI) system: Stress affects not only appetite but also the absorption process, intestinal permeability, mucus and stomach acid secretion, function of ion channels, and GI inflammation. Stress can also alter the functional physiology of the intestine. Many inflammatory diseases, such as Crohn's disease and other ulcerative-based diseases of the GI tract, are associated with stress. Irritable bowel syndrome (IBS) is considered a functional disorder related to stress.

Diabetes: Higher levels of chronic psychological stress and, more importantly, a decreased stress-coping ability measured as a sense of coherence (SOC)[27] were associated with a greater risk of type 2 diabetes (T2DM) among Indians. A dysregulated HPA axis[28] driven primarily by arginine–vasopressin (AVP)[29] was observed to be the possible link in this association. A significant association of psychological stress with oxidative stress and inflammatory markers in the context of T2DM was also documented.[30] All these findings were novel and hitherto unreported in Indians.

Mortality: An individual participant pooled analysis of 10 prospective cohort studies among 68,222 individuals found a higher risk of all-cause mortality, deaths due to cardiovascular diseases and external causes.[31]

Effects on mental health: Stressful living circumstances increase the risk of mental illnesses, including depression and anxiety. Psychological stress has been associated with an increased risk of psychiatric disorders, especially depression, anxiety disorders, and substance use disorders. Apart from psychiatric disorders, psychological distress is also associated with an increased risk of sleep disorders, dementia, memory disturbances, eating problems, and so on.

Memory disturbances: Chronic stress leads to impairment of the HPA axis, leading to changes in the hippocampus that

consist of a high density of cortisol receptors. This leads to impairment in memory and learning.

Depression: Depression is one of the most common mental health issues, with a prevalence rate of 5%.[32] The relationship between stress and depression has long been studied. Initially believed to be unidirectional, recent studies on the stress–diathesis model indicated a bidirectional relationship. Recently, the focus has been shifted to the awareness that stressors during early developmental years, such as loss of parent(s) and bullying, as well as enduring or chronic stress, such as marital or occupational circumstances, are strong indicators of depression.[33,34] A recent key pursuit has been the investigation of accumulated stress (measured through allostatic load) and its influence on depression and other psychological issues. Biological components such as increased cortisol levels and dysregulation in the HPA axis have been implicated in both stress as well as depression.[35] In comparison to age- and gender-matched controls, a study of 13,006 Danish patients with initial psychiatric admissions diagnosed with depression showed higher instances of recent divorces, unemployment, and relative suicides. A serious medical diagnosis is often considered a severe life stressor and is frequently linked with elevated rates of depression. For instance, a review indicated that approximately 24% of individuals diagnosed with cancer experienced major depression.[36] Future research should enhance the specific factors influencing the relationship between stress and depression by employing reliable and consistent methodologies.

Anxiety and stress-related disorders: Anxiety serves as the physiological and psychological indicator that the body's stress response has been activated. Unmitigated stress has been shown to precipitate the development of anxiety disorders as well as stress-related disorders such as acute stress disorder (ASD) and post-traumatic stress disorders (PTSD). Roughly 4.05% of the worldwide population, corresponding to around 301 million individuals, suffers from any anxiety disorder.[37] According to the NMHS conducted in India, the prevalence of any anxiety disorder was found to be 3.6%, and that of PTSD was found to be about 0.2%.[11] The prevalence of ASD is estimated between 5 and 20% following a traumatic or stressful event. Stress-induced changes in brain regions, such as shrinkage in hippocampal volume have been implicated in ASD as well as PTSD.

Sleep disorders: Sleep disorders have been reported in 25–30% globally.[38] The relationship between stress and sleep problems is a commonplace phenomenon. Recent research has shed light on the presence of a sleep-specific aspect of stress reactivity, and the phenomenon has been termed "Sleep reactivity." Sleep reactivity has been understood as the individual variation in sleep disturbances in response to exposure to stress. Sleep disorders have been implicated in various physical and mental health issues, including cardiovascular diseases and depression. A recent meta-analysis indicated a moderate association between sleep quality, insomnia, and stress in undergraduate students.[39] On the other hand, sleep disorders also affect one's capacity to tolerate stress as well as stress reactions.

Eating habits: Eating has frequently been associated with stress. Studies examining the relationship between stress and eating habits have predominantly evaluated stress by several methods, such as tallying life events, evaluating ongoing stress factors, or concentrating on daily hassles. It has been reported that high cortisol levels are associated with increased consumption of calories. Moreover, when stressed, people decrease their consumption of healthy foods. Evidence also points toward an association between stress and eating disorders, especially binge eating disorder. Research has been conducted primarily on the adult population to understand the relationship between stress and eating habits. Only a few studies have been conducted on young children and adolescents, which found a positive correlation. Potential mechanisms that explain the association between stress and eating habits include mood, negative automatic thoughts, coping, and hormonal changes.[40]

Substance use and substance use disorders: Stress has been implicated in initiation as well as maintenance of substance use disorders. However, most studies were cross-sectional and did not allow us to infer cause-effect relationships. Longitudinal studies have reported that other factors such as poor family support, poor coping styles, stressful life events, migration, and gender also mediated the relationship between the two.[41]

Studies have found that populations that live in highly stressful environments tend to smoke heavily and experience higher mortality from lung cancers and cardiopulmonary diseases (COPD). Chronic, stressful conditions have also been linked to higher consumption of alcohol. Alcohol may also be used as self-medication for stress-related disorders. The correlation between acute and chronic stress and the desire to use addictive drugs is well documented in the literature. Many of the major theories of addiction have identified stress as an important cause of addiction processes. These range from psychological models of addiction that view drug use and abuse as a coping strategy to deal with stress and reduce tension to self-medicate and decrease withdrawal-related distress.

Numerous population-based and clinical investigations have found strong evidence for the link between psychosocial adversity, negative affect, chronic distress, and predisposition

to addiction. Negative life experiences, including parent death, parental conflict and divorce, limited parental support, physical and emotional abuse and neglect, social isolation, and deviant affiliations, have all been linked to an increased likelihood of drug dependence. Additionally, there is overwhelming evidence linking childhood maltreatment, misuse of drugs, and abuse of sexual and physical abuse. After taking into consideration a variety of control factors, including race or ethnicity, gender, socioeconomic level, past drug misuse, the incidence of mental illnesses, family history of substance use, behavioral and conduct issues, and lifetime exposure to stressors, researchers have recently looked at the effect of cumulative adversity on addiction vulnerability. Even after considering control variables, the results showed that the total number of stressful episodes was a dose-dependent significant predictor of alcohol and drug dependency. Addiction susceptibility was strongly and independently impacted by both proximal and distal events. Even though there are many effective behavioral and pharmaceutical therapies for the treatment of addiction, recurrence rates of addiction are still very high. Exposure to stress can reinstate drug-seeking behavior in animals and increase relapse susceptibility in addicted individuals.

Stress and psychosomatic disorders: Many studies have indicated the strong link between stressful life events and IBS. In general, psychosocial factors are followed by the onset or exacerbation of GI symptoms (Lee OY, 2006).[42] IBS is a functional disorder with an etiology that has been linked to both psychological stress and infection. It is characterized by an overactivation of the HPA axis and a proinflammatory cytokine increase. (Dinan TG et al., 2006).[43] Acute mental stress has a significant effect on the coronary artery blood flow that may be significant in patients with preexisting coronary disease.

Mental stress induces arterial endothelial dysfunction, with impaired vasodilatation and paradoxical vasoconstriction.

Special Populations

Stress can be triggered in children and adolescents when they experience something new or unexpected. While work-related stress is common among adults, most children and adolescents experience stress when they cannot cope with threatening, difficult, or painful situations. It is important to remember that children are like "sponges"; absorbing what is going on around them, noticing the stress of their parents, and reacting to that emotional state.

Children do not always experience stress the way adults do. Specifically, the younger children do not always understand what is truly happening because of their age and level of development. To them, a new or different situation feels different, uncomfortable, unpredictable, and even scary. Also, they may not always have the emotional intelligence or vocabulary to express themselves. On the other hand, older children and adolescents experiencing stress may refrain from discussing their worries with peers, parents, and teachers as they perceive that acceptance of stress is a sign of psychological vulnerability, which usually is not consonant with their evolving autonomy and self-esteem.

For young children, tensions at home, such as domestic abuse, separation of parents, or the death of a loved one, are common causes of stress. School is another common reason; making new friends or taking exams can make children feel overwhelmed. As children grow older, their sources of stress can increase as they experience bigger life changes, such as new groups of friends, more schoolwork, and greater access to social media and news around the world. Many teens are stressed by social issues such as climate change and discrimination.

The common causes of stress in children and adolescents include the following:

- Negative thoughts or feelings about themselves
- Changes in their bodies, like the beginning of puberty
- The demands of school, like exams and more homework, as they get older
- Problems with friends at school and socializing
- Changes like moving homes, changing schools, or separation of parents
- Chronic illness, financial problems in the family, or the death of a loved one
- Unsafe environments at home or in the neighborhood

Specific factors contributing to mental stress in children

Family: Both children and adolescents reported severe illness, sickness, and death of a family member as significant stressors. However, children are more likely to identify such events as significant problems than adolescents. Interpersonal conflicts between parents and separation or divorce are other major contributory factors for stress in the younger population. Sibling rivalry, arising partly due to perceived differential treatment by parents, may not be limited to childhood and can be present in adolescents too, and can cause stress. The family dynamics involving the structural and systemic aspects, the roles and responsibilities, and expectations and accommodation put an additional burden on the developmental trajectory of an adolescent. Stressors

arising from parent-child interactions are reported with increased frequency among adolescents.[44] The most common sources of parent-adolescent conflicts include issues related to adolescents' autonomy and academic performance.

Peer group: The most commonly reported stress in peer group interaction is the phenomenon of peer rejection.[44] For children and adolescents, peer rejection may occur through exclusion by a peer group or bullying. As approval of peers is intertwined with the concept of self-image, especially among adolescents, such rejections may act as an anchor for negative thoughts about self. For adolescents, peer rejection can also occur in the context of romantic relationships.[45] Stressors associated with navigating relationships, particularly at the beginning and ending phases, are also reported by adolescents.[46]

School: School serves as an evaluative playground in both the cognitive domain and the socio-emotional field. Childhood encompasses transitions related to school, including first experiences with attending school away from parental and familial figures and salient transitions to middle and high school. The school itself can become a stressful place for the youth in case of barriers to smooth transitions, often manifesting as avoidance of school. School refusal behavior is a common problem across all ages, and even though the function precipitating and maintaining may be varied, it causes significant distress to the child-parent dyad.

Academics: Academic stressors commonly affect children and adolescents.[47] In Indian settings, where the parameters of success are measured in terms of grades or marks, a child is always under constant performance stress to meet the expectations of self and significant others, including parents and teachers. Adolescents report academic stressors related to challenging coursework, which may not agree with their interests and aptitudes.

Various studies carried out after the year 2000 revealed that the prevalence of stress among Indian adolescents varied between 13% and 45%.[48] A study on high school students[49] revealed that nearly two-thirds (63.5%) of the Indian students reported of stress due to academic pressure.

In a cross-sectional survey of 632 Bachelor of Medicine and Bachelor of Surgery (MBBS) students during the COVID-19 lockdown, 6.48% and 0.92% experienced severe and extreme levels of anxiety, respectively. Females were more vulnerable as compared to males, and the maximum level of anxiety was found in MBBS first-year students, that is, late teens.[50] Another study conducted on 612 MBBS students from Karnataka reported that the most frequent stressors included the vast academic curriculum, high parental expectations, adjusting to the new environment, moving away from home and staying in the hostel, and adjusting to new roommates. Eating was observed to be the most commonly employed coping mechanism.[51]

A cross-sectional study of 52 college students in New Delhi found high levels of academic stress but low levels of social and psychological stress. No association between stress and age was found. Stressors usually include a new environment, lack of structure in curriculum, high need for achievement, balancing newly found freedom and studies, peer pressures, and intimate relationships.[52]

Gender: There is a long history of valuing boys above girls, and therefore, female gender experiences overt and/or covert discrimination. Further, girls are prone to be at higher risk for specific stressful life experiences like sexual harassment and sexual abuse. Girls have been valued based on their physical appearance, and they continue to report greater stressors and pressures associated with meeting societal expectations for female beauty. Girls place greater stock in interpersonal relationships and are more emotionally intimate in relationships than boys. As a result, they are also more likely to experience more interpersonal burdens and stressors experienced by others in their social networks.[53] Although both boys and girls have the same level of worry regarding academics and economics, girls are much more vulnerable to increased stress when it comes to issues related to future events, classmates, and personal health. Adolescent girls are found to perceive negative interpersonal events as more stressful than boys. Studies further revealed that adolescent girls experience more stress than boys.[54] Women with multiple roles to play may have an increased level of stress. A study examined the relationship between perceived stress and psychological health among working women versus housewives in Jammu Kashmir (n = 150). A significant difference was seen in both groups in terms of perceived stress, which was found to be higher in the former, probably due to multiple role demands. A negative association was seen between perceived stress and psychological well-being in both groups.[55]

There is also evidence that in certain contexts, some forms of stress may be more commonly experienced by boys. A study conducted by Carlson and Grant[56] on stressors affecting low-income urban adolescents found that boys in their study sample, especially those who were in gangs, reported more stress than girls, including exposure to violence and sexual stressors.[57] Alarmingly, there has been an increase in the number of deaths due to suicide in males, and the common stressors or risk factors are young age (18–29 years), unemployment, being a daily wage earner, low education (between 9 and 12), which could be leading to few job opportunities or financial and family issues.[57]

Bias and discrimination: Children and adolescents who differ from the majority based on ethnicity, socioeconomic status, sexual orientation, or disability status are more likely to experience stressors related to prejudice and discrimination. Similarly, discrimination based on language differences has been documented.[58] Further, children whose primary language differs from the dominant may also experience academic and social stressors related to language.

Acculturation: International studies report that children and adolescents whose families have immigrated from other countries may experience various acculturation stressors.[59] The stressors may range from stressful interactions with parents who may not wish to acculturate as quickly (or at all) to their children to experiencing heightened tension between peer and cultural groups. Since India is a country of cultural diversity, the construct of such stressors related to cultural differences arising due to regional differences can be extrapolated within the national boundaries as there is a rapid movement of people from one state to another in search of better employment opportunities.

Poverty: When poverty is experienced regularly, it has a significant impact on a variety of outcomes in children and adolescents. It affects both proximal and distal stressor variables. At the family level, it is linked to an increased risk of marital conflicts, separation, divorce, and negative parent-child interactions. Furthermore, children and adolescents living in urban areas with persistent poverty are more likely to be victims of community violence and crime. Similarly, children who live in poverty are more likely to have limited resources at school, poor school functioning, and/or problematic school and peer climates.[60]

Psychosocial adversity: Apart from poverty, some of the other factors responsible for psychosocial adversity include exposure to physical and sexual abuse, neglect, physical illness, and natural disasters. Also, cyberbullying, dating violence, intimate partner violence, and drug abuse can result in an environment of stress for older adolescents. Such stressors may be less common but are more severe and are associated with higher levels of psychopathology.

Over the past two centuries, there has been a consistent upward trend in human life expectancy, which has contributed to the worldwide phenomenon of population aging.[61] This natural process of growing older is accompanied by several challenges, including various forms of loss, such as financial security, psychosocial connections, and personal identity, as well as diminishing health, independence, and cognitive functioning. Moreover, loss of spouse or friends, caregiving responsibilities, retirement, an "empty nest" and elderly abuse can further exacerbate the issues.

While it is widely acknowledged that stress influences the aging process, there is no unanimous agreement on the specific dynamics of this relationship or the mechanisms at play. The interaction between stress and aging is contingent upon various factors like the type of stress, its duration, and intensity. Over the years, studies have tried to answer questions related to whether age affects resilience to deal with stress, whether stress accelerates aging, and regarding individual differences in coping.[62]

Research has explored the impact of persistent stress on the mental well-being of older individuals through various studies involving different populations. These populations include individuals dealing with chronic medical conditions, those who have experienced the loss of a spouse, and caregivers tending to family members with dementia.

Risk factors specific to the geriatric population:

Elderly abuse: A cross-sectional study conducted among 9589 older adults aged 60 years and above in India across seven states, namely Himachal Pradesh, Punjab, Odisha, Tamil Nadu, Kerala and Maharashtra, found the prevalence of psychological distress to be around 40.6%. The study also found that elderly abuse was found to be associated with a higher risk of psychological distress.[63]

Financial dependence: A cross-sectional study in Dharan, Nepal reported that the majority of elderly people experienced some kind of stress, with 9% reporting severe stress. Increased stress was associated with advanced age, lower educational levels, and high financial dependence.[64] Similar findings have been reported in studies conducted in India.[65] Studies have also shown evidence of a connection between long-term financial stress and health in the elderly; more specifically, studies showed evidence that perceived long-term financial pressures throughout a person's life were strongly correlated with certain health-related outcomes in later life, such as self-rated health status, depressive symptoms, and functional impairment.

Social and familial support: In another study from India on elderly living in old-age homes, it was found that as high as 30% of individuals reported severe stress, highlighting the lack of social and familial support for the high indices of stress in this population.[66] These investigations have helped establish connections between stress, coping mechanisms, and the development of mental health disorders in older adults.[67]

Functional limitations: A study conducted in Australia among 626 Australians aged 60 years and above found that older age, higher functional limitations, lower social support,

and more time spent sleeping were found to be associated with a higher risk of psychological distress.[68]

Consequences of mental stress specific to elderly: Chronic stress is associated with inflammation, which has been implicated in various mental and neurological issues in the elderly, such as insomnia, late-life depression, anxiety, and dementia, specifically Alzheimer's. According to the World Health Organization (WHO), more than 20% of people above 60 years of age suffer from a mental or neurological disorder, accounting for 17.4% of Years Lived with Disability (YLD).[69] The most common mental illness seen in the elderly is depression, followed by anxiety disorders, substance use, and death due to suicide.

Various indicators of stress in the geriatric population are evident in the form of sleep disturbances, mood instability and irritability, changes in appetite, somatic complaints, withdrawal from others or clingy behavior, and difficulty making decisions.

Despite high rates of physical and psychological ramifications of stress in the elderly, this area has been consistently neglected, especially in low- and middle-income countries.

Working population: The WHO defines workplace stress as the response individuals may have when confronted with job demands and pressures that do not align with their knowledge and abilities, posing a challenge to their coping abilities. It can stem from inadequate work organization (such as the design of jobs and work systems and their management), suboptimal work design (e.g., a lack of control over work processes), ineffective management, unsatisfactory working conditions, and insufficient support from colleagues and supervisors.

The workplace encompasses several elements that converge to shape the overall employee experience. These elements encompass physical aspects such as office infrastructure, layout, and ergonomic considerations, as well as cultural components, including communication norms, organizational support, trust levels, decentralization practices, employee engagement, and the established policies and procedures governing work processes. Furthermore, technological dimensions, including digitalization and the tools facilitating work activities, play a pivotal role in this comprehensive work environment.[70]

The presence of robust social support from colleagues and supervisors can alleviate the adverse effects of stress and enhance the overall well-being of employees. Additionally, research has demonstrated that fostering a positive social support network bolsters job satisfaction diminishes employees' intentions to leave their positions, and promotes retention within the organization. A conducive work environment plays a pivotal role in elevating employee happiness, engagement, and productivity. Conversely, an unfavorable work environment can result in disengagement, diminished loyalty, and increased turnover rates among employees.[71]

The survey by the 7th Fold (2020) with 509 working people across metro cities and diverse sectors from India revealed that 36% of the employees suffered from one or the other type of mental health issues. The situation of mental health has been exacerbated due to the COVID-19 pandemic, making it a more serious concern. India ranks first among 18 nations in terms of stress, as per a survey conducted by Deloitte during the second wave of the epidemic. According to a recent PwC survey on employee financial wellness for 2021, 63% of workers have been under financial stress since the start of the COVID-19 epidemic. These studies suggest that workplace mental health requires immediate attention.

Employee well-being and organizational success are paramount concerns in human resource management. In today's dynamic work landscape, addressing work-related stress, bolstering job satisfaction, and mitigating job insecurity have taken center stage.

The prevalence of work-related stress has made it an integral part of the modern workplace. Concurrently, the Indian workforce has experienced heightened levels of job insecurity. Various studies from India involving engineers and blue-collar workers have found that high job stress and levels of job satisfaction are negatively correlated, and the differences were stable across gender.[72]

Stress is common among mental health professionals and subsequent treatment-seeking is quite low, which affects not only their well-being but also their ability to provide services to others. A cross-sectional study conducted on mental health professionals working in a tertiary care neuropsychiatric center (n = 101) observed low work-life balance, higher perceived stress, higher levels of psychological distress, higher secondary trauma, and high levels of burnout. Increasing age, belonging to a department, staying with family, and better monthly income were found to be protective factors.[73]

Specific factors leading to stress among workers:

Discrimination at the workplace: According to a cross-sectional study, conducted in 2016, in 35 nations including India, almost two-third of employees Brouwers *et al*.[74] (2016)

who had experienced depression faced discrimination at work or while seeking new positions.

Sexual harassment and bullying: Another work-related stress that can occur in any business is sexual harassment and bullying. Both sexes may be impacted, although women and people at the bottom of the social order are frequently more vulnerable.

Family–Work balance: A study conducted on 34,468 Finnish people currently engaged in active work found that loneliness, job dissatisfaction, and family–work conflict were associated with a high risk of psychological distress, while having children being actively involved in work, successfully combining family and work roles, and presence of social support were associated with lower risk of psychological distress.[75] A cross-sectional study of 217 teachers working in Kerala was conducted to understand the relationship between workplace factors and employee indifference and burnout. Results indicated a negative relationship between workplace factors and employee indifference, which increased with burnout.[76]

Consequences of stress at the workplace: A variety of physical ailments, including hypertension, diabetes, and cardiovascular disorders, among others, can be exacerbated by poor mental health at work. According to recent research, employee productivity is influenced by their mental health and is correlated with their effectiveness. Consequently, it is critical to give priority to the employees' mental health.

Other special populations:

Caregivers of individuals with mental illness: A cross-sectional study conducted among two groups of individuals (240 each) living with and without a person with mental illness, respectively, found the prevalence of psychological distress to be around 50% in those living with a mentally ill compared to those not living with a mentally ill.[77] Very few Indian studies exist on the stress of parents with children having neurodevelopmental disorders despite it being consistently shown that this group reported higher stress as compared to other parents with typically developing children. One hundred thirty parents from Northern India of preschool children diagnosed with autistic spectrum disorders were assessed for their stress levels. It was found that parental stress was strongly associated with poor attention span and behavioral issues in the children.[78]

Females: A prospective cohort of 1500 females found neuroticism traits or antisocial behavior in adolescence and a history of psychiatric or physical illness. Divorce among parents has been found to have an increased risk of psychological distress among females in midlife.[79]

Refugees/migrants: A cross-sectional study conducted among 75 migratory construction workers in India found the prevalence of psychological distress to be around 64.0%, with females having more distress compared to males.[80]

A study conducted among 2639 adult refugees in Germany found that females of older age, those at risk of deportation, those in refugee housing facilities, and those not in private housing had a greater risk of psychological distress.[81] Another study conducted among 1062 Russian-born immigrants to Israel found that compared to males, females had higher psychological distress. Factors such as family problems, inappropriate climate conditions, anxiety about the future, uncertainty in the current situation, and poor health were associated with this higher risk among females compared to males.[82]

Survivors of trauma/disaster: The average person experiences several traumatic incidents during their lifetime, particularly in developing nations like our own. Following life-threatening traumatic events, both acute stress response and PTSD are frequent. According to many studies,[83] traumas and disasters are linked to PTSD, as well as concomitant depression, other anxiety disorders, cognitive impairment, and drug addiction. A study conducted among 527 trauma survivors found that the severity of PTSD symptoms was associated with younger age, ethnic minority status, unemployment, low income, unmarried status, and type of trauma, with assaultive trauma showing higher risk.[84]

Current Infrastructure, facilities, technologies, policies, programs, and so on in the country in the context of the problem/health issue

Current infrastructure and facilities

The government and other organizations have been providing community mental health services since the NMHP was established in 1981. The major aim of the NMHP is to deliver basic psychological health care at the grassroots level, as well as to ensure that services are available and accessible to the most vulnerable and underprivileged people. In India, government spending on mental health accounts for only 0.06% of the total health expenditure, which accounts for barely 4% of the national gross national product (GNP). In India, only 43 mental hospitals with 1.469/100,000 beds, 0.047/100,000 psychologists, and 0.301/100,000 psychiatrists exist. Qualified personnel are scarce. The availability of mental health nurses and social workers is 0.166/100,000 and 0.033/100,000, respectively. Mental health infrastructure is mostly restricted to huge, semi-permanent facilities which serve a small number of people. We are still in the early stages of completely allowing patients, families, and communities to

fulfill the three goals of mental health, promotion, prevention, and treatment. The objectives of the District Mental Health Program (DMHP) as envisaged in the 12th 5-year plan were: To reduce mental illness-related distress, disability, and premature mortality, as well as to improve rehabilitation from a mental condition by assuring that psychiatric care is available and accessible to all, specifically the most marginalized and poor members of society. Other objectives were as follows: reduce stigmas, encourage community engagement, increase accessibility to preventative care for at-risk groups, safeguard persons with mental illness (PWMI) rights, and integrate mental health services with other programs such as rural and child health, motivate and empower employees, build administration, regulations, and accountability procedures to strengthen mental health service delivery infrastructure, develop awareness and information, and develop leadership, organizational, and accountability mechanisms. These goals are now being pursued through extending community services and improving community-based programs (satellite clinics, school counseling, workplace stress management, and suicide prevention), organizing community awareness camps with the assistance of local groups, increasing national involvement (through collaboration with conscience and caretaker organizations), forming public-private partnerships with designated financial cooperation, establishing a special 24-hour hotline number (e.g., to notify the public about urgent mental health services), assisting national and state mental health agencies in obtaining public funding, and so on. Hence, the concept of mental distress alleviation is being dealt with by not only psychiatrists but also a team of mental health professionals, including psychiatry social workers, mental health nurses, occupational therapists, psychologists, primary care physicians, Accredited Social Health Activists (ASHAs) workers, and volunteers from the community.

Application of technology in the alleviation of stress and mental health intervention: Technology creates opportunities for extending mental health services to remote areas. The use of technology in the field of mental health has given impetus at multiple levels.[85] Information and communication technologies have yielded positive results in mitigating stress. Innovative technology-based interventions have helped to reach out to various age groups and to reduce stigma.[86]

Digital mental health interventions and technology interface: Digital mental health interventions (DMHI) have been categorized as "e-Health" through telemedicine or internet-based interventions and "m-Health" through mobile digital interventions such as smartphones or virtual and augmented reality applications.[87,88]

a. Internet-based Interventions (IBIs) can be effective in promoting healthy behaviors
b. Smartphone Apps: Efficacy was examined by the meta-analysis conducted by Linardon *et al*.[89] (2019). It was noted that apps can be low-intensity, cost-effective, and easily accessible interventions for those unable to receive standard psychological treatment.
c. Virtual and Augmented Reality: Virtual reality is defined as "a collection of technologies that allow people to interact efficiently with 3D computerized databases in real-time using their natural senses and skills".[90] It has been helpful for relaxation as well as for the treatment of social phobia, etc.
d. Artificial Intelligence–based technologies (e.g., machine learning, deep learning) may bring phenomenal changes in understanding and preventing the occurrence of stress-related psychological disorders.[91]

With respect to mental health concerns and stress-related disorders, availability and access of trained human resources remain a challenge.[92] Stigma of seeking help, availability of trained human resources, and geographic and economic challenges are some of the issues that supplement and advocate the implementation of DMHI.[93] Systematic review and meta-analysis of DMHI to quantify the effectiveness of the interventions of DMHI revealed that they may be helpful if delivered under supervision and with active support.[94] Some of the challenges are adaptations of the psychological interventions into digital formats.

The DMHI (e.g., Internet-based interventions, smartphone apps, mixed realities – virtual and augmented reality) provides an opportunity to improve accessibility to intervention in stress-related disorders. Systematic reviews and meta-analyses found that DMHI is effective in mild mental disorders; however, in-person professional consultation is associated with greater effectiveness and lower dropout than fully automatized or self-administered interventions.[95]

Tele-mental health: Tele-mental health involves technologies such as video-conferencing to deliver mental health services and education and to connect individuals and communities for healing and health. Tele-mental health is effective and increases access to care.[96] Future directions suggest the need for more research on service models, specific disorders, the issues relevant to culture and language, and cost. Technology adoption for combating stress during the pandemic has opened many options for interventions. Information dissemination and mental health interventions attained momentum during this period. It involved the dissemination of authentic information through reliable resources of government-

aided platforms. Technology-based solutions, information management, and the use of technologies[97] were widely tried to alleviate distress. The stress mitigation initiatives through telework and online educational interventions are the key factors of an entirely new era of technology-based interventions in mental health. The primary advantage of these interventions is connectivity to remote locations where mental health interventions are not available for mitigating stress.

Tele-MANAS: The current National Tele-Mental Health Program (Tele Mental Health Assistance and Networking Across States [T-MANAS]) has been envisioned as the digital arm of DMHP as a further extension of the mental healthcare service in the country.

The Government of India introduced of the National Tele-Mental Health Program (T-MANAS) during the Union Budget 2022–23. The program was officially launched in October 2022. T-MANAS is a two-tier system comprising state T-MANAS cells, including trained counselors as first-line service providers at Tier 1 and mental health professionals at DMHP at Tier 2 to provide secondary-level specialist care. Referral services are also available for in-person consultations or audiovisual consultations through e-Sanjeevani, which is the national telemedicine initiative under the Ministry of Health and Family Welfare (MoHFW). The inclusion of tele-mental health services as a part of the mental healthcare deliverables is an expansion of digital mental health in the country.[98] Following are the objectives of Tele-MANAS:

a. To enhance health service capacity to deliver accessible and timely mental healthcare through a tele-mental health network support system.
b. To ensure a continuum of services in the community, including tele-mental health counseling.
c. To facilitate timely referral for specialist care and follow-up as appropriate.
d. To enhance mental healthcare capacity and networking at primary healthcare or health and wellness centers/district/state/apex institution levels.

The Ministry of Social Justice and Empowerment launched a helpline to offer mental health rehabilitation services with the objective of early screening, first aid, psychological support, distress management, promoting positive behaviors, and so on. The helpline is available in 13 languages and has 660 clinical or rehabilitation psychologists and 668 psychiatrists as volunteers. It is being coordinated by the National Institute for the Empowerment of Persons with Multiple Disabilities (NIEPMD), Chennai (Tamil Nadu) and the National Institute. It aims to cater to people in distress, people impacted by pandemic-induced psychological issues, and Mental Health Emergencies.

Mental well-being Apps: There are many apps available commercially but lack scientific validity. Under the mental health augmentation strategies, Sleep App, Mindfulness App, and Relaxation Apps are available. There is a strong need to regulate the practice of referring these apps for practice purposes. Content and standardization need to be regulated for the approval of the use of Apps in the mental health field for mitigating stress. In the pursuit of enhancement of positive mental health, scientific and evidence-based information is required to be curated for well-being apps. Mental Health and Normalcy Augmentation System Positive mental health App was developed based on robust scientific evidence in collaboration with National Institute of Mental Health and Neuro-Sciences, AFMC, and Centre for Development of Advanced Computing Bengaluru, under the Prime Minister Science and Technology Advisory Committee, Office of Principal Scientific Advisor to Government of India. The App focuses on the promotion of positive mental health.

Current Programs

Over the years, Government of India have launched various mental health programs to promote mental health and prevent mental illnesses [Figure 3].

a. **National Mental Health Program**
   The Government of India launched the NMHP in 1982, with the following objectives. As shown in Figure 4, NMHP has delineated various objectives to create an environment of awareness. It helped in promoting community participation in the mental health services and providing minimum healthcare available for all.

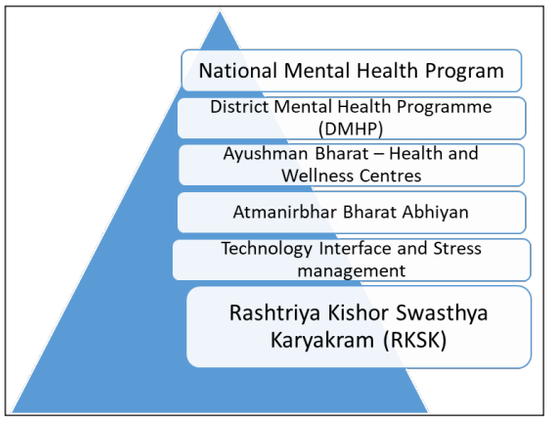

Figure 3: Initiatives by government of India.

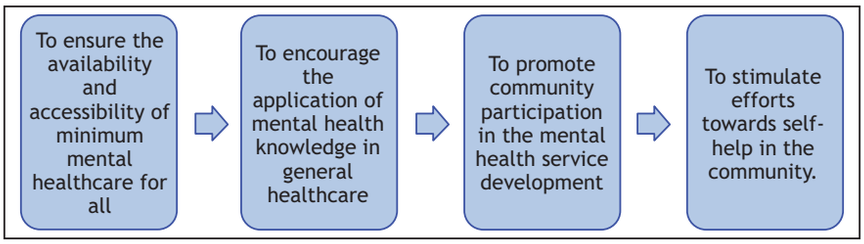

Figure 4: Objectives of National Mental Health Program (NMHP).

b. **District Mental Health Program (DMHP)**
The DMHP is a government scheme launched in 1996 to provide mental health services at the district level and integrate mental health services into primary healthcare. The DMHP was initiated under NMHP in 1996 (during the IX 5-year plan). Modeled after the "Bellary Model," DMHP encompasses the following components:
(1) Early detection and treatment
(2) Training: Providing short-term training to general physicians for the diagnosis and treatment of common mental illnesses and utilizing a limited range of drugs under specialist guidance. Health workers are also trained to identify individuals with mental illnesses.
(3) IEC (Information, Education, and Communication): Creating public awareness
(4) Monitoring: Primarily for straightforward record-keeping purposes
DMHP addressed workplace stress management, life skill training, counseling in schools and colleges, and community awareness prevention and promotion at the district-level healthcare delivery system.

c. **Ayushman Bharat - Health and Wellness Centers (AB-HWC)**
Ayushman Bharat – Health and Wellness Centers (AB-HWC) is a flagship program of the Indian government launched in 2018 intending to provide comprehensive primary healthcare services to all individuals. The program aims to establish 150,000 health and wellness centers across the country by 2022.

d. **Atmanirbhar Bharat Abhiyan:**
The Atmanirbhar Bharat Abhiyan, launched in 2020, is a self-reliance program aimed at promoting economic growth and development in India. The program also focuses on addressing the impact of the COVID-19 pandemic on the mental health of individuals. The schemes have focused on integrating mental health services into the general healthcare system and promoting community-based mental health care. This further was envisaged to help reduce stigma and improve mental health.

e. **Rashtriya Kishor Swasthya Karyakram:**
Rashtriya Kishor Swasthya Karyakram (RKSK) is a national program launched in 2014 to improve the health and well-being of adolescents in India, including their mental health.

Mental health programs in schools in India:

a. The "Mental Health Justice" program by the Mental Health Innovation Network was started to bring mental health services to school spaces. This program aimed to pilot a replicable mental health justice program in schools in Mumbai that included sensitizing stakeholders in schools about mental health issues and building their capacity to support the cause.
b. Yuva Mitra in Goa is a community-based program for youth health promotion, which includes peer-to-peer learning, teachers' training, and awareness programs on youth health subjects like mental and reproductive health. On evaluating its impact, the program piloted in rural and urban areas showed more openness toward seeking help for mental health issues like substance and sexual abuse and suicidal thoughts.
c. SAATHI in Sikkim: "SAATHI" stands for Sikkim Against Addiction Toward Health India. It exerts that mental health issues (especially in a context like Sikkim, India) are intricately linked with substance abuse and thus uses a "peer education" model to advocate against drug use among school students, staff, and parents.

Budget allocation

The optimum level of training of mental health professionals will take decades to reach the ideal number of Mental healthcare professionals training in the country.

Out of the total ₹86,200 allocated last year, the budget for mental health was ₹791 crores, which was 0.92% of the total health budget. This year, it has marginally increased to 1.03% and as per Table 2, it amounts to 919 crores out of 89165 crores allotted for health. In this year's budget, the line item of NMHP under tertiary activities has been used as the Tertiary Care Program. The tertiary components of the NMHP are mandated for strengthening Post Graduate Training Departments of mental health specialties, establishing Centers of Excellence and modernizing state-run mental health hospitals.

Table 2: Mental health-budget: 2023	
Budget head	**In crores**
Total GOI budget for 2022–2023	₹ 45,03,097
Total budget for health (MoHFW)	₹ 89,155
Total budget for social justice and empowerment (Ministry of Social Justice and Empowerment [MoSJE])	₹ 14,072
Direct expenditure for mental health (from MoHFW)	₹ 919
Indirect expenditure for mental health (from MoSJE)	₹ 280
Total budget for mental health	₹ 1,199
https://cmhlp.org/wp-content/uploads/2023/02/Budget-Brief-2023-v3.pdf (Center for the Mental Health Law and Policy). GOI: Government of India, MoHFW: Ministry of health & family welfare	

KEY ISSUES AND GAPS IDENTIFIED IN THE CURRENT SITUATION IN THE COUNTRY IN CONTEXT OF THE PROBLEM OR HEALTH ISSUES

Mental health awareness and stress management have been subjects of concern in India, as in many other countries around the world. While there have been significant advances and modifications, there are still numerous gaps in mental stress intervention. A mental healthcare deficit is defined as a large and persistent absence of necessary resources, amenities, and support for those living with mental health concerns or in mental stress. This weakness can present itself in a variety of ways with major ramifications for individuals as well as the community as a whole. In the context of the problem, there are key issues that require close consideration for impactful mental stress management. These issues are discussed below.

1. **Stigma**

   The stigma attached to mental health concerns has been one of India's greatest obstacles. Many people are reluctant to ask for assistance due to fear of being judged or misunderstood. It is vital to promote awareness about mental health and lessen stigma.

   Stigma encompasses a negative or derogatory belief, perception, or stereotype associated with a specific characteristic, attribute, identity, or group of individuals. This often results in social exclusion, discrimination, and a sense of shame or disgrace for those possessing the stigmatized attribute. Public stigma consists of three main components: stereotypes, prejudice, and discrimination. These negative perceptions contribute to the fear of social distancing in individuals with mental illnesses. Similarly, self-stigma prompts an individual to socially distance themselves. Stigma serves as a hindrance to recovery; epidemiological research indicates that over half of the individuals who could benefit from mental health services do not access them.

   The comprehensive survey, NMHS of India, 2015–16, found that nearly 80% of people with mental health disorders did not seek any form of treatment due to stigma and the fear of social discrimination. Venkatraman *et al.*[99] (2019) assessed the stigma toward mental health issues among higher secondary school teachers in Puducherry, South India, which showed that around 70% had a stigma toward mental health symptoms. Stigma against mental illness is prevalent among not only the general population but also healthcare professionals in India. The stigma among professionals can affect the quality of care offered to individuals experiencing mental health issues. In a tertiary care center (medical college) in North India, nearly three-fourths of the 442 residents considered that they had significant mental stress; however, only about 13% sought help from mental health professionals. The two main barriers reported for not seeking help included the stigma of being labeled as mentally ill (54.6%) and being labeled as weak among their peers (58.1%). A systematic review revealed that less than one out of six medical students with depression sought psychiatric help and demarcated stigma as the most common factor. Further, many of these people adopted social stigma and experienced a loss of self-esteem and self-efficacy. They were also worried about repercussions and of being judged by their supervisors.[100]

   Thus, the paucity of mental health literacy among the Indian population is aggravating stigma, myths, and misconceptions related to mental illness. Hence, stigma gets strengthened due to a lack of proper education methods and improper information dissemination. The stigma associated with mental health is a complex issue influenced by cultural, social, and economic factors, and efforts to combat it often involve public education, awareness campaigns, and destigmatization efforts by both the government and non-governmental organizations.

2. **Lack of public education – "Mental health literacy"**

   People are generally unaware of mental health concerns, including how to identify symptoms or seek help [Figure 5]. This lack of information leads to delayed action and the perpetuation of stigma. Most of us are aware of the necessary professional support available for the treatment of major physical ailments, as well as some of the medical or complementary therapies. This knowledge also underlies substantial support for community resources to deal with these bodily ailments. This is in contrast to mental health issues, where, largely, people are unaware that they are suffering and that help for substantial

Figure 5: Attitude, and knowledge of mental health issues.

improvement is available. Similarly, community resources are not relatively aligned to deal with mental illness.

Mental health literacy is defined as "knowledge and beliefs about mental health issues that aid their recognition, management, or prevention." So, it is limited not only to knowledge but also to an awareness of appropriate actions and behaviors to prevent and manage mental health issues. This term is useful as it targets community awareness, which has been neglected at the cost of the focus on mental health at primary care levels and the training of registered medical practitioners.

This frivolous mental health literacy was highlighted by Ogorchukwu *et al.*[101] (2016), wherein his study showed that the percentage of mental health literacy among adolescents in south India was very low, at 29.04% for depressive symptoms and 1.31% for psychotic symptoms, both of which also have implications for mental stress. The study also showed that informal sources (including family members) were preferred sources for information over formal sources, highlighting widely ingrained stigmatizing attitudes regarding mental health conditions. This is in contrast to the study by Lauber *et al.*[102] (2003) in the Swiss population, which identified 40% with depression and 75% with schizophrenia. This stark difference underscores the urgent need for enhanced mental health literacy. This limit in mental health literacy is not limited to the general public alone but is also seen among health providers. This deprived literacy, caused by a lack of poor community awareness programs, is further deteriorated by the depiction of mental stress and its ramifications in movies and other sources of media, which stands far from legitimacy. Thus, such depictions are a source of misinformation among the general public. These low levels of mental health literacy are critical factors in the low perceived need among the general public for mental health services and also in the modest use of these services. Both of these are significant barriers to treatment. Further, low levels of literacy result in attitudinal barriers such as wanting to handle issues on their own, perceived ineffectiveness, the belief that mental stress would get better on its own, problems are not severe, and, as stated above, stigma.

3. **Cultural factors**

   Cultural norms and expectations can sometimes hinder open discussions about mental health. Traditional beliefs and practices may discourage seeking professional help for mental health issues. Societal norms often promote the idea of enduring challenges without seeking help (cultural endurance). People might consider mental stress a normal part of life and do not recognize the need for preventive measures. The belief in black magic and other superstitions cannot be overemphasized as a reason for the need for psychiatric help.

4. **Access to mental health services**

   For those well-informed individuals actively seeking mental health improvement to alleviate mental stress, their efforts are hindered by limited access to help. The uneven and scattered distribution of mental health services, coupled with a shortage of public health resources and limited manpower, along with inconsistent availability of medications, contribute to the restricted accessibility of mental health services. This, in turn, contributes to the increased prevalence of mental stress in society. The NMHS of India has emphasized the treatment gap and the deficiency of mental health services in various regions of the country. A 2017 survey on mental health in India, published in the Lancet medical journal, revealed a doubling in the diagnosis of psychological disorders from 1990 to 2017.

   A cross-sectional study in a mental health camp conducted in the east-central tribal district of Madhya Pradesh showed that among 113 patients who sought help, the treatment deficit was 85%. Common mental illnesses were far greater than severe mental illnesses, and anxiety disorders were the most common. The diagnosis of the severe mental illnesses came late in the course of the illness.

   a. **Shortage of mental health professionals:**

      There has been a perpetual shortage of mental health professionals, including psychiatrists, psychologists, and counselors, in both rural and urban India. India has 0.75 psychiatrists per 100,000 population, while the desired number is above three psychiatrists per 100,000 individuals. To achieve this goal, 36,000 psychiatrists are required. The number of Psychiatry PG seats per year is approximately only 1234. A crude calculation reveals that more than 30 years will be

required to reach anywhere near the desired ratio. Further, there are only 0.07 psychologists, 0.07 social workers, and 0.12 nurses with mental health training per 100,000 people.[103]

This glaring gap is further compounded by the nominal undergraduate training in mental health, Psychiatry, and Psychology. This is true of medical or paramedical training. This scarce training schedule allotted to the MBBS curriculum and a fortnight of Internship in Psychiatry makes it almost impossible for the graduates at primary health centers (PHC) and other general out patient department (OPD) to identify mental stress or complaints regarding mental stress.

The scarcity of mental health professionals thus constitutes a significant healthcare challenge. It stems from limited training opportunities, a prevailing stigma around mental health, inadequate infrastructure, urban-rural disparities, increasing patient demand, the emigration of skilled professionals, low government investment, and insufficient awareness. This issue is compounded by a lack of, and enrolment in, specialized training programs, with a concentration of these in selected urban areas, leaving rural populations further underserved. This shortage leads to long wait times, limited availability, and increased strain on existing professionals.

b. **Lack of early intervention**

Early intervention is a crucial factor for managing mental stress and can reduce the progression of mental disorders. However, due to the reasons discussed earlier, such as the unavailability of expert care and minimal training of medical staff at primary care centers, poor identification of mental stress and its complications leads to delays in intervention at all levels. This, in turn, prolongs the suffering and deteriorates the quality of life of an individual. The ramifications of this are an increased prevalence of mental stress, reduced productivity at societal levels, and a silent economic burden and deterioration.

c. **Affordability**

Even when they are offered, mental health services are frequently out of reach for a huge segment of the population, especially those from lower socioeconomic backgrounds. Public mental health facilities are dispersed unevenly, and thus, the care shifts to private setups, which are out of the pocket for the majority of the population.

A study about out-of-pocket expenditure (OOPE) and poverty impact due to mental illness in India found that among the studied 6500 people with mental illness, 18.1% of the household's monthly consumption expenditure was spent on healthcare for mental illness, and 20.7% of the households were forced to become poor from non poor due to treatment care expenditure on mental illness.[104]

There is conditional insurance coverage, limited psychiatry public services, and almost negligent therapy or counseling services in the country, although all are part of the mental healthcare act (MHCA) 2017 directions within a defined time.

d. **Rural-urban disparities**

While urban areas may have relatively better access to mental health services, rural areas often lack adequate infrastructure and awareness about mental health. The cultural beliefs and practices also make it difficult to implement the same ideas and service themes practiced in urban areas. Various issues discussed above reduce the availability of expert mental healthcare in rural areas. Thus, people living in the most disadvantageous places are also likely to have compromised access to specialized mental health services. The disparity also continues among migrants from rural areas, as demonstrated by the poor mental health found in this population.

e. **Fragmented care**

Mental healthcare is often fragmented, with individuals receiving treatment from various providers who may not communicate effectively with each other. Further, there is often a lack of coordination between primary care providers, mental health professionals, and other stakeholders in the mental healthcare system. Thus, the concerns and requirements from the grassroots levels dissipate before they reach any executive ear. This results in a lack of coordination and continuity of care. Delayed identification of mental distress, ineffective treatment, and repeated relapses are all consequences of a lack of continuity in care at different levels.

f. **Emergency mental health services:**

The emergency mental healthcare services were tested in the COVID-19 times. There is a need for improved crisis intervention and emergency mental health services to prevent suicides and address acute psychotic episodes effectively. Even day-to-day mental stress can cause acute behavioral change or be an indication of urgent psychiatric intervention. These are also important for crisis intervention and disaster management issues. Timely psychiatric interventions are known to prevent the development of an acute stress reaction and PTSD later. However, the knowledge, awareness, and promptness to visit these centers are lacking. The lack of such facilities and awareness of such facilities increase the prevalence of mental stress.

Suicide attempts are a serious mental health emergency, and the suicide rate among Indian girls and women are twice the global rate. It is the cause of most deaths in the 15–39 age group compared with other causes of death.[105] The absence of a national suicide prevention strategy is a concerning lacuna and will be discussed in the next section. The Mental Healthcare Act of 2017 decriminalized suicide, and various actions the Government has already taken in the social and health fields. The establishment of toll-free helplines for domestic abuse and psychosocial assistance during the COVID-19 epidemic implicitly addresses suicide prevention.

5. **Lack of focus on prevention**

In recent years, discussions around mental health have gained significant attention, shedding light on the pervasive impact of mental stress on individuals and societies. While strides have been made in acknowledging and addressing mental health issues, a critical aspect that often remains in the shadows is the lack of focus on preventing mental stress from escalating into more severe conditions. Factors such as work pressures, societal expectations, financial burdens, and personal challenges contribute to an environment ripe for the onset of mental stress. Ignoring the early signs and failing to address mental stress can potentially lead to conditions such as anxiety disorders, depression, and even suicidal tendencies.

Prevention strategies have long remained a lost battlefield for mental health promotion for the simple reason of a lack of training in this area. The prevention strategies need to arise from the primary healthcare settings for any program to be successful. However, the lack of awareness of psychiatric issues among medical and paramedical students is a roadblock for such measures. Even the curriculum for PG in Preventive Medicine is not explicit about mental healthcare measures. Thus, this remains an elusive area for both of these sections of health workers, who are otherwise geared toward preventive measures.

The Consequences of neglect:

a. **Individual suffering**: The most immediate consequence is the continued suffering of individuals. Many bear the burden of stress silently, unaware of the strategies that can help them cope effectively. This not only deteriorates their quality of life but can also impact their physical health.
b. **Overburdened healthcare system**: By not addressing stress at an early stage, individuals are more likely to require intensive medical and psychological interventions when their conditions worsen. This strains healthcare resources and limits their availability for those in critical need.
c. **Economic impact**: Mental stress affects work productivity and absenteeism, ultimately impacting economic productivity. Failing to prevent mental stress contributes to a vicious cycle where individuals' mental health issues exacerbate their financial worries and vice versa.
d. **Social and family dynamics**: Unmanaged mental stress can strain relationships, disrupt family dynamics, and isolate individuals from their social networks. The consequences ripple through communities, affecting the overall social fabric.

6. **Lack of holistic approaches**

Mental health is influenced by various factors, including genetics, environment, lifestyle, and social support. Focusing solely on one aspect can result in incomplete treatment.

a. **Lack of integration**: Mental health services are often not well-integrated into the primary healthcare system. This leads to mental health concerns being neglected or not addressed promptly. The treatment gap for all mental health problems is as high as 91% in some states. As compared to other physical illnesses or issues, only one-half to one-fifth of the population with mental health issues receive medical attention.
b. **Combination approaches**: Mental health is complex, and individuals often experience a combination of issues. Finding effective ways to address multiple factors simultaneously, such as stress, anxiety, and depression, is an ongoing challenge.
c. **Integration with physical health:** Mental health is often treated separately from physical health despite the strong connection between the two. Integrated care models are essential to address the holistic well-being of individuals.
d. **Overemphasis on medication:** While medications can be helpful, there is sometimes an overemphasis on pharmacological treatments at the expense of psychotherapy and other nonpharmacological interventions.
e. **Personalization:** While there are numerous stress-management techniques available, there is a lack of personalized approaches that consider an individual's unique stressors, triggers, and coping mechanisms. Tailoring interventions to an individual's specific needs could improve the effectiveness of stress management strategies.

7. **Integration of technology**

While technology has made some inroads into mental health and stress management, there is still room for

innovation. Developing user-friendly and evidence-based digital tools and apps can help individuals manage stress in a more engaging and accessible manner. The digital divide in India can limit access to these resources, especially for marginalized communities. These issues are discussed in detail in the next section.

8. **Workplace stress**:
   Many workplaces in India do not have adequate provisions for managing stress and promoting mental well-being among employees. Long working hours, excessive workload, and a lack of work-life balance contribute to stress-related issues.
   According to a comprehensive study conducted by Deloitte, a management consulting firm, almost half (47%) of the professionals surveyed consider work-related stress to be the most significant factor affecting their mental health, followed by financial challenges. The report estimated that mental health problems cost Indian employers approximately $14 billion annually due to lower productivity, absenteeism, and attrition.
9. **Educational stress**
   The education system in India places significant pressure on students to excel academically. This pressure can lead to high levels of stress and anxiety among students, and there is a need for more comprehensive support mechanisms in schools and colleges. Some of the key issues causing mental stress in the educational sphere are as follows.
   a. **Competitive environment**: The pursuit of limited seats in prestigious institutions and the emphasis on securing high grades create a competitive atmosphere, leading to stress.
   b. **Parental and peer pressure**: Peer pressure to perform well and parental pressure to secure top grades can significantly impact a student's mental well-being.
   c. **Lack of mental health support**: Mental health education and support services are not uniformly available in schools and colleges. Many students lack the resources to cope with stress effectively.
   d. **Lifestyle factors**: Long hours of studying, sleep deprivation, and neglect of physical health can contribute to stress-related issues.
   e. **Examinations**: Board examinations are considered crucial milestones, and the significance attached to these exams contributes to stress among students. Competitive entrance exams for medical, engineering, and other professional courses are notorious for their difficulty and the pressure they place. These have also caused the mushrooming of coaching institutes and have had tragedies for families beyond repair.
   f. **Rote learning and memorization**: The education system's emphasis on rote learning and memorization rather than critical thinking and practical application can lead to monotonous and high-pressure study routines.
   g. **Lack of holistic education**: The focus on academic achievement often overshadows the importance of holistic education, including extracurricular activities, sports, and personality development.

   These highlight that school-based interventions are largely lacking. Knowledge is the basis of help-seeking behavior, and how we look at things changes with awareness.
10. **Evidence-based practices:**
    While many stress management techniques are available, all of them do not have strong scientific evidence to support their efficacy. It is important to continue refining and expanding the pool of evidence-based practices. There is a pooling of resources via the internet and social media, which are vehemently advertised for stress management. Many of these have a poor scientific or medical basis or evidence and, contrary to popular belief, serve to deteriorate mental health. The lack of control by the government on these platforms is a significant lacuna that needs to be addressed urgently.
    a. **Research and data**: Comprehensive data on the prevalence of mental health issues and their specific impacts in different regions of India is often lacking. This hampers the development of targeted interventions and policies.
    b. **Measurement and assessment:** Objective and standardized methods for assessing stress levels are still being developed. Accurate assessment is essential for understanding the effectiveness of interventions and providing personalized recommendations.
11. **Government support and lack of funding**:
    While there have been some efforts by the government to address mental health issues, more sustained and comprehensive policies and funding are needed to create a robust mental health support system. This is being dealt with in the next section.
12. **Long-term maintenance**
    Many stress management techniques offer short-term relief, but sustaining positive effects over the long term remains a challenge. Developing strategies that help individuals maintain their stress reduction efforts is crucial.

Recommendations made to bridge the critical gaps and deficiencies in this aspect

Bridging the critical gaps in mental health services in India requires a comprehensive and multifaceted approach that addresses various challenges.

1. **Increased funding and resource allocation**

   The first step to improvement is having money for it. Most of the above issues require the allocation of funds by the government. Presently, mental health gets a meagre share of the budget, compared to the disability-adjusted life years (DALYs) and YLDs it is relatively responsible for. The effects of mental health disorders are not as overtly visible as those of physical disorders. Perhaps this reduces the urgency for it in the minds of decision-makers. Also, awareness of this silent epidemic, which is making its way, is poor at all levels.

   The allocation of a higher proportion of the healthcare budget to mental health services to address resource shortages and enhance the quality of care is of paramount importance. The funds are required for enhancing the medical services, training of PHC and community health center (CHC) staff, procurement of ample amounts of medications, increasing community awareness, school mental health literacy, deaddiction campaigns, research, and so on. The list is too long, as most of these areas are poorly addressed. For the financial year 2023–24, BE for mental health is just above 1% of the BE of the MoHFW. The government has increased its budget for T-MANAS, showing its commitment to digital mental health programs. However, elsewhere, there is a substantial lack of funds.

   The mental health atlas by WHO also reiterates the above allocation and points out that most of the allotted budget is used for in-patient treatment, leaving even lower financial aid for community psychiatry, literacy, and so on.

2. **Workforce development**

   The second step after the allocation of funds is to have trained manpower to address the issues. Thus, the government should aim to train and increase the number of mental health professionals, including psychiatrists, psychologists, counselors, and psychiatric nurses, to ensure adequate coverage. As stated above, the national averages for the above are far below the international standards, which causes an increased prevalence of mental health issues and is an economic burden. At the current pace of training, we are not looking at less than three decades to fill our cup.

   Thus, the way forward is to train the existing medical workforce until we can upgrade our infrastructure.

   a. **Increase psychiatry training at the graduate level:** Since the training in Psychiatry at MBBS and equivalent levels is poor, the Medical Officers manning the health centers are unaware of how to recognize and manage basic mental health issues. Thus, Psychiatry should be taught as a full, separate subject in MBBS, in the final professional examination, and simultaneously, the Internship in Psychiatry should be increased from 2 to 4 weeks. This amount of exposure in both theoretical and practical training is vital for improved knowledge and skill development. This training will also assist the specialist doctors in recognizing mental health issues in their clinics, as these issues, although having a very high prevalence in almost all chronic illnesses, go undetected. Thus, mental health components should be included in the training of primary care physicians and other healthcare professionals.

   b. **Increase training programs and capacity:** Medical and paramedical staff already employed can undergo short capsules of training in mental health with a refresher training every 5 years. This will ensure the staff is sensitized to mental stress recognition and management. These capsules can be run by the district hospitals or medical colleges.

   c. **Increase trained psychologists:** Increasing the seats for Psychology training helps fill the gap. Further, training of medical and nursing undergraduates should include Psychology as a subject, which would increase the mental health workforce.

   d. **Provide supervision and mentorship:** Establish mentorship programs for new mental health professionals, allowing them to learn from experienced practitioners. Regular supervision can help professionals improve their skills and ensure high-quality care. These can be arranged between CHC and tertiary care centers, such as medical colleges.

   e. **Incentives and scholarships:** Offer scholarships, grants, and financial incentives to attract individuals to mental health professions. Create initiatives to support mental health professionals working in underserved areas or with vulnerable populations.

   f. **Enhance tele-health training:** This is particularly useful for covering remote areas with geographical difficulties and has the advantage of real-time assistance.

   g. Develop a cadre of mental health professionals trained to work within the primary care system.

3. **Awareness and stigma reduction**

   Improving mental health literacy. Reducing stigma against mental health in India requires a multifaceted approach that involves raising awareness, education, advocacy, and fostering open conversations about mental health.

   a. **Public awareness campaigns:** Launch nationwide campaigns that provide accurate information about mental health, debunk myths, and challenge stereotypes. Various media platforms, including TV, radio, social media, and print, to reach a wide audience are required. The success of Polio immunization and

TB or HIV awareness are evidence of the power of awareness and reducing stigma, respectively.

b. **Education in schools and colleges:** Integrate mental health education into school curricula to promote understanding and empathy from a young age. Conduct workshops and seminars in colleges to address stigma and promote mental health literacy. School-based awareness programs have been shown to reduce suicide attempts and suicidal ideation. The universal school program affects both the recognition of mental disorders, prejudice, and knowledge about where to seek help and, consequently on the mental health literacy of adolescents. One such program that needs to be mentioned is the Young Mental Health First Aid Program, conducted in Australia, to help young adults learn the skills required to recognize early signs of mental illness in adolescents and provide help as and when required.
c. **Promote positive portrayals in media**: Media has the most powerful effect on changing attitudes and images. The portrayal on the screen is almost the truth for the public at large. Thus, it is recommended to collaborate with media outlets to portray mental health issues sensitively and accurately. There should be strict laws against the incorrect or deceptive portrayal of mental health issues in the media. Highlight stories of recovery and resilience to inspire hope and reduce fear.

The Schizophrenia Research Foundation (SCARF) in Chennai, India, has been sponsoring a film festival called "Frame of Mind," which includes various films depicting mental illness and an international competition for short films on mental health and stigma. This approach has been a big success, with three editions published so far. Similar celebrations have subsequently taken place in places such as Kolkata. Many nongovernmental organizations (NGOs) employ short videos to raise awareness about their work or cause, although the effectiveness of such initiatives has not been studied.

a. **Celebrities and influencers:** The psychology of advertisements teaches us that the source of information to the public influences how well that information is accepted. Engage celebrities and influencers to share their own experiences with mental health challenges, thereby normalizing the conversation. Encourage influential figures to use their platforms to spread awareness and advocate for mental health.
b. **Support groups and peer networks:** Create safe spaces where individuals can share their experiences and find support from others who have faced similar challenges. Peer support networks can play critical roles in reducing isolation and combating stigma.
c. **Training for healthcare professionals**: Provide training for healthcare professionals to deliver culturally sensitive and stigma-free care to individuals with mental health issues. Equip healthcare providers with communication skills to address mental health concerns without judgment.
d. **Engage religious and community leaders:** Collaborate with religious leaders and community figures to promote understanding of mental health and challenge harmful beliefs. Religious institutions can be influential in spreading positive messages about mental well-being.
e. **Legal and policy measures:** MHCA 2017 has been beneficial to people with mental health disorders and is right-based. However, for people who are suffering from mental stress and are not diagnosed with any mental disorder, another set of policies and advocates might be required. This includes a smooth path for obtaining help when required without being marginalized due to the prevailing stigma.
f. **Mental health days and events**: Organize events like World Mental Health Day to draw attention to mental health issues and foster open discussions. Use these occasions to launch awareness campaigns and educational initiatives. These can also be used by the government to launch schemes to facilitate help for mental stress.
g. **Corporate initiatives**: Encourage workplaces to prioritize employee well-being and promote mental health awareness. Provide resources for employees to seek help and create a supportive environment.
h. **Open conversations**: Encourage individuals to openly share their experiences with mental health, which helps break down walls of stigma. Engage in conversations with family, friends, and colleagues to normalize discussions about mental well-being.
i. **Empowerment and advocacy:** Empower individuals with lived experience to become mental health advocates, sharing their stories to inspire change. Support advocacy organizations that work to reduce stigma and improve mental health services.

It has to be remembered that changing deeply ingrained societal attitudes takes time and consistent effort. By implementing these steps and fostering a culture of understanding and empathy, India can make significant progress in reducing the stigma against mental health and creating a more supportive environment for individuals facing mental health challenges.

4. **Integration of mental health services**

It is crucial to integrate mental health services seamlessly into the broader healthcare system in India to ensure that

individuals receive well-rounded care encompassing both their physical and mental well-being. The integration of mental health services into primary care settings facilitates early detection, timely intervention, and an all-encompassing approach to healthcare. Achieving this goal necessitates collaborative efforts among mental health professionals, general physicians, and community health workers, fostering a coordinated response to address mental health needs.

a. **Policy and legislative support**: Develop policies and guidelines that mandate the integration of mental health services into primary care. Ensure that existing mental health legislation, such as the Mental Healthcare Act, supports integration efforts.
b. **Health workforce training**: As stated above.
c. **Screening and assessment:** Integrate mental health screening tools into routine primary care assessments to identify individuals at risk of mental health problems. Further research is required to develop culturally sensitive assessment protocols considering local beliefs and practices. This will ensure a valid and reliable assessment and increase its sensitivity.
d. **Referral pathways:** Establish clear referral pathways between primary care and specialized mental health services for complex cases. This ensures a continued level of care, starting from the primary level, and instills confidence in the staff at the primary level and trust in the clientele. Develop mechanisms for prompt and seamless communication between different levels of care.
e. **Collaborative care model:** Implement a collaborative care model where mental health specialists work closely with primary care providers to deliver integrated care. Facilitate regular case discussions and joint treatment planning.
f. **Telemedicine and technology:** Utilize telemedicine platforms to connect primary care providers with mental health specialists for consultation and guidance. Develop mobile applications for mental health education, self-assessment, and support.
g. **Community-based initiatives:** Establish mental health clinics or centers within CHCs to provide accessible mental health services. Train community health workers to deliver basic mental health support and education.
h. **Health information systems:** Develop electronic health records that include mental health assessments and treatment plans, this will ensure continuity of care, and this could be further elaborated to implement data-sharing mechanisms between primary care and mental health services.
i. **Establish cross-sectoral partnerships** (Legislative, Executive branches of Government, Medical infrastructure, NGOs, etc.) to address social determinants of mental health. This will collectively focus their expertise and resources on this issue. This will help the various parties bridge the gaps existing in their solo operations.

Integration of mental health services in India requires a concerted effort involving policymakers, healthcare providers, mental health professionals, and communities. By building a strong foundation of policies, training, and support mechanisms, India can enhance access to mental healthcare and improve the overall well-being of its population.

a. **Telemedicine and technology**: Expand telemedicine initiatives to increase access to mental health services, especially in remote and underserved areas. Develop mental health apps and digital platforms for psycho-education, self-help, and remote counseling. The technology will be discussed in detail in the next section.

5. **Culturally-adapted interventions**

It is important to develop evidence-based interventions that are culturally sensitive and contextually relevant to the diverse population in India. Involve community leaders and local organizations in designing and implementing mental health programs. The adaptation of policies and programs to the local culture of the target population will go a long way in terms of acceptance, implementation, and benefits. India is a culture-driven nation, and congruency with culture should be the foremost criterion of any policy. Similarly, campaign programs that include *Nukkad Natak*, puppet shows, and talks by local teachers or leaders are far more acceptable than a lecture behind the dais. Similarly, art therapies, such as dance, theater, and folklore, apart from providing entertainment, have been in India for decades and are one of the means of imparting health education in rural India.

Many screening schedules are not culture-sensitive and thus do not give correct information to the health workers. More research into these areas is required to formulate scales sensitive to our diverse culture.

6. **Strengthening policies**

Revise mental health policies to align with international standards and emphasize prevention, early intervention, and community-based care. This is dealt in detail in the next section.

7. **Support for families and caregivers**:

Offer counseling and support services for families and caregivers of individuals with mental health conditions to empower them to provide effective care and reduce stigma.

8. **Research and data collection**
   Invest in research to generate local evidence on effective interventions, prevalence rates, and factors affecting mental health. Establish a comprehensive mental health database to track trends, evaluate interventions, and inform policy decisions. Research to assess the effectiveness of integrated mental health services and identify areas for improvement.
9. **NGO collaboration**
   This will assist in the reach of mental health services and community-based support programs. Foster partnerships between the government, NGOs, and private sector to leverage resources and expertise for mental health initiatives
10. **Front-line workers to support the individuals affected by mental stress**
    The recommendations stated above require consistent efforts, which are expected to take time. Although the above is essential for quality care, as a stop-gap measure, a short training course in mental health needs to be initiated for all health workers at PHC and CHC levels. Workshops for sensitizing these first-line health workers can be easily done at tertiary care centers by psychiatrists and psychologists, which will enable them for early detection of mental stress or mental health issues. This will further increase the level of mental healthcare in the area and in turn, increase mental health awareness. The extent of services that can be provided and the population that can be handled by such centers depend on the available manpower and will act as a learning benchmark as this process comes into effect.
11. **Monitoring and evaluation**
    To improve anything, the best way is to measure it continuously. So, regular monitoring and evaluation of the implemented programs, policies, and procedures needs to be done. This should be followed by informed adjustments and improvements. This continuous effort will ensure that the procedures in place are functional, improving, and being updated to meet the required needs. The reports and returns need to be stringent in concept and format and should be evaluated strictly.

Key issues/gaps identified in the current infrastructure, facilities, technologies, policies, and programs in the country in the context of the problem/health issue

The government of India implemented the NMHP, which helps in mitigating mental stress to some extent. However, several focused areas need further improvement in the execution and implementation. Currently, there is a huge gap in this domain as identified below.

Huge treatment gap for all mental disorders

There is a huge treatment gap for all mental disorders due to various reasons such as a deficit in the number of trained human resources, the need for standardized delivery of care, need to address the specific needs of special populations like women, pediatric, and geriatric population; and as well as due to lack of awareness related to mental illness among general public.

Less availability of mental health professionals

According to the Indian Psychiatric Society, there are around 9,000 psychiatrists currently practicing in India. Every year, about 700 more psychiatrists graduate from various medical institutions across the country. However, the number of psychiatrists available in India is quite low, with only 0.75 psychiatrists per 100,000 people, which is much less than the recommended minimum of three psychiatrists for every 100,000 inhabitants. Clinical psychologists are also very less in number.[103] There is a significant deficit in the availability of human resources trained in mental health who can cater to mental stress. Hence, there is a need for training in the mental health field at different tiers as discussed below.

Need for training at different tiers of healthcare services

Mental Health Awareness Training (MHAT) is important to cater to community-level interventions and prepare individuals to identify early signs of distress before the breakdown occurs. Identification of stressors and skills to handle these stressors can be achieved through training. Training can be imparted to provide support at the community level by primary-level care providers and equip them to cope with levels of stressors involving adjustments and coping during stressful periods. This can be achieved by a three-tier level approach as given below in Figure 6. Further trained human resources can be generated by introducing these skills at education levels, both graduate level of Psychiatry and Clinical Psychology.

The current mental health budget has been mentioned in Table 2.

Mental health awareness strategic approach

Enhancing mental health awareness in the country will lead to its promulgation, creating its demand. Additionally, as awareness expands in a democratic society, there will be an emergence of advocacy efforts, the utilization of political will, increased funding, and the development of cross-synergies. Srivastava *et al*.,[106] (2016) envisaged that a significant portion of the contributions to awareness shall flow from the various platforms shown in Figure 7.

Adapted from: (Srivastava *et al.,* 2016).[106]

Figure 6: Training at different tiers of healthcare services.

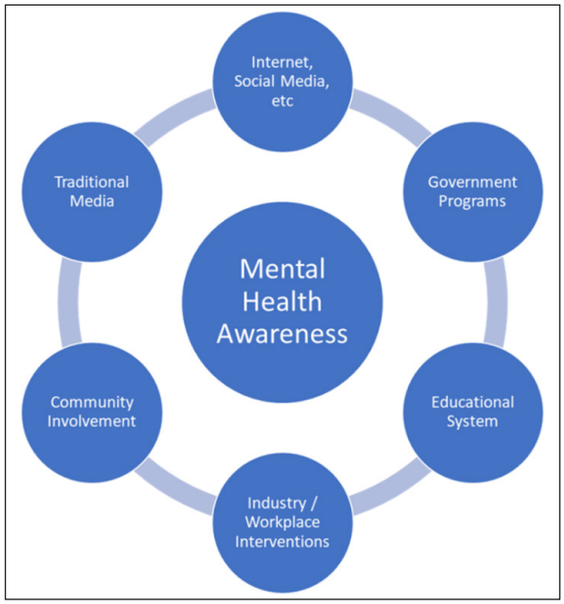

Figure 7: Platforms for creating mental health awareness.

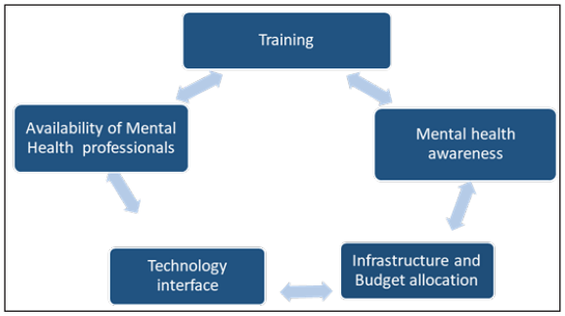

Figure 8: Strategies to mitigate mental stress.

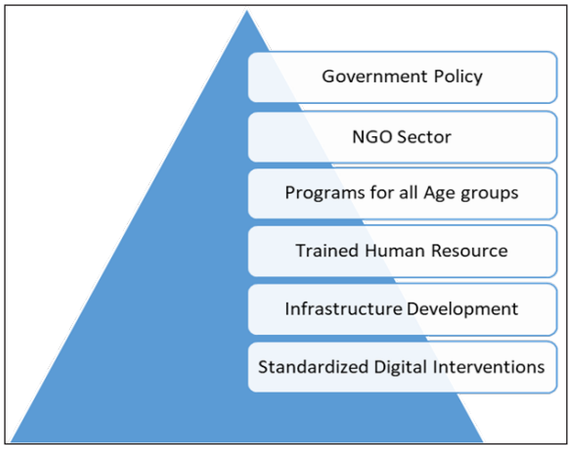

Figure 9: Recommendations to address critical gaps in mental health services in India.

Need to incorporate technological advances to increase reach

There is a need to incorporate Government initiatives of the Digital India Mission as an add-on arm to mental health initiatives.

Very low budget allocation and lack of adequate infrastructure

There is a pressing need to rationalize the budget allocation for mental health programs, as it is less than 1% of the current total budget, which hinders the expansion of services for mental health promotion as well as the development of services that can cater to the huge prevalence of mental stress among the general population. Also, there is a need to allocate adequate budget for research in the field of mental health.

These are five important components essentially required to mitigate stress as depicted in Figure 8.

RECOMMENDATIONS MADE TO BRIDGE THE CRITICAL GAPS AND DEFICIENCIES IN THIS ASPECT

Addressing the critical gaps in mental health services in India requires a concerted effort from governments, healthcare organizations, NGOs, mental health professionals, communities, and individuals as shown in Figure 9. By adopting a comprehensive and collaborative approach, it is possible to create a more accessible, effective, and stigma-free mental health support system for all citizens. The failure to focus on reducing mental stress creates a cycle of suffering that affects people, families, communities, and society as a whole. Recognizing the significance of preventive measures and adopting comprehensive techniques is vital to prevent mental stress from escalating into more severe problems. We can create a healthier and more psychologically robust society by developing resilience, raising awareness, and encouraging early intervention. The mental stress should be handled not only when it reaches crisis proportions but also while it is still manageable; this is the genuine way to a psychologically better future.

Infrastructure development

Recommendations for current financial inputs in the country in the context of the problem/health issue

Currently, no specific budget has been allotted for the prevention or management of stress and related issues. Some financial support is allocated for mental health issues; however, it is imperative to shift our focus toward a more comprehensive approach, which would include:

- Prioritizing budget allocation for evidence-based prevention instead of solely concentrating on treatment.
- Increasing government investment in public services to ensure sustainability and accessibility of services in the government sector.
- Recognizing the importance of telemedicine in modern healthcare and establishing a budget for stress management through telemedicine. This can significantly enhance access to care.
- Encouraging the nongovernment sector to provide mental healthcare by incentivizing them.
- A dedicated budget for manpower development can help in training primary care professionals, lay counselors, nurses, and other healthcare professionals.
- Separate funds should be kept for research to find and implement prevention and management strategies that are efficacious as well as cost-effective.
- Increased resource and funding allocation: Increase the percentage of the healthcare budget designated for mental health treatments.
- Use the funds for enhancing healthcare, educating the public, acquiring medicine, raising community awareness, promoting mental health literacy in schools, deaddiction programs, and research.

WAY FORWARD

To effectively tackle the challenges posed by stress, our way forward should encompass both preventive and therapeutic dimensions. It is very important to adopt strategies that are proven and implementable. A multifaceted approach may be the most effective way to address the issue, ensuring that we cater to the unique needs of different regions and communities.

Suggested policy activities and advocacy for policymakers

- Sensitive public healthcare approach, which is person-centered, culturally sensitive, collaborative, and transdisciplinary. It should be able to adequately address bio-psycho-social determinants, especially for vulnerable groups, and promote community engagement.
- Policy convergence to align all government departments, NGOs, integration of stress mitigation and public mental health policies with primary care, establishing implementation units at national, state, and district levels, and mobilizing existing community resources.
- Implementation strategy for program development, building human resources, setting up service delivery standards, and aligning those to the needs of the community.
- Sensitizing important stakeholders such as community leaders, teachers, employers, and parents for early identification of stress and its manifestations.
- Formulation of telepsychiatry and telepsychotherapy guidelines.
- Implement a collaborative care paradigm with primary care professionals and mental health professionals.

Recommendations for health/medical professionals

- Develop effective pathways to care by training lay counselors, ASHA workers, community leaders, and so on, screening vulnerable populations, and developing systems for triaging, referrals, service contracts, and delivery of services.
- Have a basic understanding of stress, its manifestations, and identification of common mental disorders.
- Greater utilization of basic counseling skills to deal with issues at the primary care level and knowing when and where to make a referral.
- Undertaking offline or online courses imparted by government agencies such as Project Extension for Community Healthcare Outcomes (ECHO) for the training of medical professionals and lay counselors.
- Integrate psychosocial rehabilitation along with treatment of mental health issues.
- Launch public awareness initiatives around the country to dispel myths and factual information.
- Bring mental health education into the classroom and run awareness campaigns at schools, colleges, and universities

Suggestions to create awareness among the public, NGOs, and community stakeholders

- Community awareness and engagement through IEC activities to de-stigmatize impact of stress, build capacity for information dissemination, sensitization, experiential learning, and peer support.
- Provide support for vulnerable groups - prioritize children, adolescent, and youth development. Empowerment of women, elderly care, and outreach to vulnerable groups.
- Initiate workplace interventions to tackle stress at the workplace.

- Sensitizing teachers in educational institutes to carry out stress prevention activities, engage in life-skill training, identify early signs of stress in students, and understand where to make referrals.

Any other

- Inputs would include:
  - Increased number and dispersion of mental health personnel
  - Training of all medical and nursing personnel and community health workers in assessing and addressing stress
  - Streamlining of access to care and referral processes
  - Coordination of stress mitigation policies across all departments or arms of government
  - Increased use of force multipliers through technology, for example, websites, apps, and so on.
- Workforce Development in dealing with stress management:
  - Psychiatric nurses, psychologists, counselors, and psychiatrists should all receive more training in this area.
  - Improve graduate-level psychiatry education for family practitioners and other medical specialists.
  - Provide rewards, scholarships, and financial aid to draw people to jobs in mental health.
  - Create telehealth training for reaching remote places.
  - Create peer networks and support systems.
  - Teach medical staff or other concerned trainers to deliver treatment without judgment.
- Outcomes would be assessed by:
  - Screening for stress in the community to track trends in schools or colleges; PHCs, workplace (formal/informal sector), and community through surveys.
  - Measures of change of awareness in the community
  - Tracking of NGO and community support group activities
- Impact would be measured by:
  - Improved or increased identification of stress and consequences
  - Shortened pathway to care
  - Reductions in delay of treatment, cost of treatment, and outcome.
  - Reduction in mental health gap
  - Increased care-seeking in the community or population
  - Reductions in surrogate markers of stress like substance use, suicide, depression, anxiety, and physical illness
  - Reduction in stigma
  - Increased integration of those with stress-related illnesses

The implementation plan requires comprehensive discussions involving both medical professionals and a diverse array of stakeholders. This multi-stakeholder approach should encompass individuals with mental health issues, those with programmatic and administrative expertise, financial specialists, and others. The selection of prioritized strategies should be informed by both empirical evidence and a nuanced understanding of the country's distinctive cultural, social, economic, and political context.

These chosen strategies must be closely tied to quantifiable outcomes assessed within appropriate timeframes. Defining objectives that are specific, measurable, achievable, reliable, and time-bound (SMART objectives) is essential to gauge the effectiveness of these strategies. Such a framework will be instrumental in directing resources effectively and optimizing inputs for the intended outcomes.

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ANNEXURE

Important data statistics related to the issue

Prevalence of mental disorders in India according to the Global Burden of Disease Study 1990–2017

	Both sexes	Males	Females
All mental disorders	14.3% (12.9–15.7)	14.2% (12.8–15.6)	14.4% (13.1–15.8)
Idiopathic developmental intellectual disability	4.5% (3.0–6.0)	4.7% (3.1–6.3)	4.3% (2.9–5.7)
Depressive disorders	3.3% (3.1–3.6)	2.7% (2.5–3.0)	3.9% (3.6–4.3)
Anxiety disorders	3.3% (3.0–3.5)	2.7% (2.4–2.9)	3.9% (3.6–4.3)
Conduct disorder	0.8% (0.6–1.0)	1.0% (0.8–1.3)	0.6% (0.4–0.7)
Bipolar disorder	0.6% (0.5–0.7)	0.6% (0.5–0.7)	0.6% (0.5–0.7)
Attention-deficit hyperactivity disorder	0.4% (0.3–0.5)	0.6% (0.5–0.7)	0.2% (0.2–0.3)
Autism spectrum disorders	0.4% (0.3–0.4)	0.5% (0.5–0.6)	0.2% (0.2–0.2)
Schizophrenia	0.3% (0.2–0.3)	0.3% (0.2–0.3)	0.2% (0.2–0.3)
Eating disorders	0.2% (0.1–0.2)	0.1% (0·9–1.4)	0.3% (0.2–0.3)
Other mental disorders	1.8% (1.5–2.0)	2.1% (1.8–2.4)	1.4% (1.2–1.7)

Source: India State-Level Disease Burden Initiative Mental Disorders Collaborators. The burden of mental disorders across the states of India: The Global Burden of Disease Study 1990–2017. Lancet Psychiatry. 2020;7(2):148–61. https://doi.org/10.1016/S2215-0366(19)30475-4