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Physiological Basis Of Non-Exercise Activity Thermogenesis (Neat): An Integrative Approach

Anagha Balakrishnan[1], Gayathri Holla[2]

[1]Post Graduate Scholar, Dept. of PG Studies in *Kriya Shareera* , Alva's ayurveda medical college , Moodubidire, Karnataka, India.

[2]Associate Professor, Dept. of PG Studies in *Kriya Shareera* , Alva's ayurveda medical college , Moodubidire, Karnataka, India.

ABSTRACT

Background: The energy expenditure in our body is done by mainly four mechanisms. One among these is Non-Exercise Activity Thermogenesis (N.E.A.T.). Energy expenditure for any activity that is not intentional exercise, such as walking, fidgeting and maintaining posture is included in non-exercise activity thermogenesis (N.E.A.T.). Understanding N.E.A.T. is vital for combating sedentary lifestyle, managing obesity and metabolic disorders and enhancing long-term energy balance and weight maintenance. **Objectives:** Compare and integrate the concept of Non-Exercise Activity Thermogenesis into *Ayurveda*. **Materials and Methods:** Literary searches were conducted using classical text in *Ayurveda* and contemporary books, Articles and many other sources. **Conclusion:** N.E.A.T. is regulated mainly by Central Nervous System, Hormones and Skeletal muscles. *Vata dosha* especially *Vyana Vata* is responsible for Non-Exercise Activity Thermogenesis. So likewise *Vata Prakriti* people shows higher NEAT than other *Prakriti* types.

Key words: Non-Exercise Activity Thermogenesis (N.E.A.T.), *Dosha, Agni.*

INTRODUCTION

Daily Total Energy Expenditure (TEE) is the net amount of energy utilized by animals and humans to maintain core physiological functions and locomotion. Four main components of energy balance determine TEE: Basal metabolic rate (BMR), the Thermic effect of food (TEF) also called diet-induced thermogenesis, Exercise activity thermogenesis (E.A.T.) and Non-exercise activity thermogenesis (N.E.A.T.).[1] Energy expended by each component of TEE is given in table no.1.

Table 1: Energy expended by 4 different components of TEE.

Component	Energy Expenditure	Description
Basal metabolic rate (BMR)	60-70%	Energy for resting body functions
Thermic effect of food (TEF)	10%	Energy to digest and process food
Exercise Activity Thermogenesis (E.A.T.)	10 – 20 %	Planned workouts and sports
Non – Exercise Activity Thermogenesis (N.E.A.T.)	20 – 30%	Daily movements, not considered formal exercise

Non-Exercise Activity Thermogenesis (N.E.A.T.)

Non-Exercise Activity Thermogenesis (N.E.A.T.) refers to that portion of daily energy expenditure resulting from spontaneous physical activity that is not specially the result of voluntary exercise. This depends upon the complex interactions of environmental and biological factors, including people's differing occupations, leisure time activities, individual molecular and genetic factors.[2]

N.E.A.T. includes:

- Postural control and transitions
- Walking for daily chores
- Talking, gesturing, and fidgeting
- Leisure time activities like gardening
- Tapping of fingers etc.

Regulation of N.E.A.T.

N.E.A.T. is primarily regulated by the **Central Nervous System, hormones** and **skeletal muscles**.

Hypothalamus is the master regulator. It integrates signals from adipose tissue, gut hormones (ghrelin, PYY), glucose levels to modulate behaviour and metabolism. Key nuclei involved in N.E.A.T. control are Arcuate Nucleus, Paraventricular nucleus and Lateral Hypothalamic Area. Arcuate Nucleus Receives leptin and insulin signals, balances energy intake and expenditure. Paraventricular nucleus which influences muscle tone and posture. Whereas Lateral Hypothalamic Area contain orexin neurons that stimulate wakefulness, locomotion and physical activity.[3]

Neurotransmitters like Dopamine, Serotonin and Norepinephrine regulates N.E.A.T. Dopamine regulates motivation, reward-seeking behavior and motor activity. High dopamine levels lead to more likely to engage in exploratory behaviors, fidgeting and movement. The Dopaminergic resistance leads to reduced responsiveness to reward. While Serotonin Involved in mood regulation, satiety and behavioral inhibition. Low serotonin levels are linked with lethargy, depression and reduced NEAT. Norepinephrine, the Key neurotransmitter of the sympathetic nervous system. It increases heart rate, blood pressure etc. It stimulates readiness for action which promotes movement even at rest (E.g.: restless legs). It released during stress, excitement or alertness. Leptin, Insulin, Cortisol, Thyroid hormones, Ghrelin and Peptide YY plays a great role in regulating NEAT. Leptin targets the Arcuate nucleus (ARC) in the hypothalamus, increases spontaneous physical activity, encourages fidgeting, pacing, posture changes and standing, helps to maintain

high NEAT during periods of energy surplus. In insulin-sensitive individuals, post-meal insulin rise is associated with increased alertness and movement. Insulin resistance results in Blunted insulin signaling in the brain, less stimulation of movement-promoting neurons, reduced NEAT even in a high energy state. Thyroid hormones Regulates Basal metabolic rate (BMR), Oxygen consumption, Heat production, Neuromuscular function and reflexes and increase ATP production by enhancing mitochondrial function. Upregulate expression of uncoupling proteins in brown adipose tissue (BAT), leading to heat generation. Stimulate Postural muscle tone, mental alertness and activity drive, restlessness or increased movement (in hyperthyroidism). Acute Effects of Cortisol results in Increases sympathetic nervous system activity Enhances alertness, heart rate, muscle readiness. Promotes movement and behaviors such as pacing, fidgeting or restlessness. Chronic Effects of Cortisol result in harmful effects such as Central fatigue, demotivation, Muscle wasting, Suppression of thyroid hormone conversion and Reduced dopamine signaling. Ghrelin Secreted mainly by the stomach (especially during pre-meal). Stimulates hunger by acting on the hypothalamus which increases dopaminergic activity, promotes exploratory and food-seeking behavior which may include Pacing before meals, increased alertness and movement and Fidgeting. Peptide YY (PYY) Released from the distal small intestine and colon after food intake. Signals satiety to the brain. Reduces appetite and slows gut motility. This may lead to reduced spontaneous movement following meals. Supports energy conservation in the postprandial period. Contributes to post-meal lethargy.[4]

Skeletal muscles maintain upright posture, Support balance while moving or fidgeting, Prolonged activation, even at low intensity. People with higher muscle tone or better neuromuscular coordination tend to Move more efficiently, exhibit more spontaneous movement, Show greater variability in posture and position.[5]

AYURVEDIC PERSPECTIVE OF NON-EXERCISE ACTIVITY THERMOGENESIS.

Thridosha in NEAT

Vata dosha is responsible for all kinds of movement in the body. It possess Chala Guna. Especially Vyana Vata as it traverse through out the body. Pitta dosha is responsible for metabolism, digestion and thermogenesis.[6]

Deha Prakriti in NEAT

Table 2: The relation between *Dehaprakriti* and NEAT

Prakriti	**NEAT**
Vata Prakriti	High spontaneous movement, low weight gain tendency High NEAT
Pitta Prakriti	Moderate NEAT, high metabolism, may be active but structured
Kapha Prakriti	Low NEAT, sedentary tendencies, sluggishness, prone to weight gain

Table 3: The relation between *Vata Prakriti* and contribution in NEAT

Vata Prakriti	**Physiological Expression**	**NEAT Contribution**
Chala (Mobility)	Frequent spontaneous movement	Fidgeting, standing, walking
Laghu (Lightness)	Lean body mass, low adiposity	Increased Movement efficiency and energy storage
Ruksha (Dryness)	High catabolism	Increased Caloric burn during minor activities
Kshipra (Quickness)	High neuromuscular excitability	Increased reflexive movements
Anavasthitatva (Instability)	Psychological restlessness	High Behavioral NEAT (pacing, tapping)

These alignments suggest that Vata Prakriti may be inherently adapted to elevated NEAT, providing metabolic flexibility and resistance to obesity.

Agni in NEAT

Agni is responsible for all transformation, including calorie combustion. *Jatharagni* and *Dhatvagni* together contribute to Body temperature, Nutrient utilization Spontaneous physical energy.

CLINICAL AND HEALTH RELEVANCE OF NEAT

NEAT in Obesity Resistance

Lean individuals show increased NEAT more than obese individuals during overfeeding. Obesity-resistant people subconsciously burn more calories through micro-movements.[7]

NEAT in Metabolic Health

NEAT promotes regular muscle contractions throughout the day, which enhance glucose uptake into skeletal muscle cells, lower postprandial blood glucose spikes, support better glycemic control in both healthy individuals and those with insulin resistance, reduces triglyceride, LDL levels and increases in HDL.[8]

NEAT in Cardiovascular Function

Regular small movements promote venous return and arterial flow which prevents venous stasis and reduces the risk of conditions like deep vein thrombosis (DVT) in sedentary individuals.

NEAT increases stress on endothelial cells. This stimulates the release of nitric oxide results in Vasodilation, improved blood flow, and reduced arterial stiffness.[9] Prolonged sitting is linked with increased cardiovascular disease (CVD) mortality. Frequent NEAT breaks significantly reduce this risk, even without formal exercise.

HOW TO IMPROVE NON-EXERCISE ACTIVITY THERMOGENESIS

NEAT is Ideal for individuals those who are Struggle to maintain an exercise routine and recovering from injury or illness. There are multiple way to improve NEAT for them.

Table 4: Different ways to improve NEAT in different conditions

Obesity	Engage household work Use stairs Walk Posture change
Sedentary jobs (E.g.: IT professionals)	Frequent micro breaks for movements Stand up or stretch Under desk cycle pedals Foot fidget devices
Paralysis patients	Functional Electric Stimulator (FES) devices[10]
Depression	Pet care Socializing
Parkinsonism	Arm swings, foot tapping Use soft balls Use adaptive aids for walk FES Devices

CONCLUSION

NEAT (Non-Exercise Activity Thermogenesis) refers to all energy expended in daily activities excluding sleep, eating, and structured exercise. Increasing NEAT is linked to lower obesity risk, improved insulin sensitivity, better cardiovascular and metabolic health, reduced inflammation and chronic disease burden. NEAT strategies are more inclusive and sustainable than structured exercise especially for elderly individuals, people with mobility issues and those with low motivation for formal workouts. *Vata dosha* especially *Vyana Vata* responsible for all the NEAT. *Vata prakriti* individual shows high NEAT among all. Understanding NEAT is vital for combating sedentary lifestyles, Managing obesity and metabolic disorders and enhancing long-term energy balance and weight maintenance. Integrating NEAT-promoting behaviors into daily routines offers a sustainable and accessible approach to improving overall health. Thus NEAT serves as a promising, physiologically grounded strategy in preventive and therapeutic medicine.

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