Cognition Development and Cultural Transmission of Menstrual Practices: Structural Equation Model

***Reshithalakshmi R[1], Dr. Rama Prabha R[2] Jeffrin Aldo J[3]**

[1] Research Scholar, Department of Communication, PSG College of Arts & Science, Coimbatore, Tamil Nadu, India.

[2] Assistant Professor, Department of Communication, PSG College of Arts & Science, Coimbatore, Tamil Nadu, India.

[3] Research Scholar, Department of Communication, PSG College of Arts & Science, Coimbatore, Tamil Nadu, India.

Abstract

This study aimed to develop and validate a theoretically grounded model which elucidates cognition development and cultural transmission of menstrual practices among women in Coimbatore, Tamil Nadu, India. Integrating Bronfenbrenner's Ecological Systems Theory and Randall Collins' Interaction Ritual Theory, the model explores how multi-layered environmental factors Micro, Meso, Exo, and Macro systems interact with culturally embedded interaction ritual variables such as Interaction Ritual, Group Solidarity, Emotional Energy, and Sacred Symbols of Emotional Energy. A Quantitative approach was employed; cross-sectional structured quantitative survey was administered to 450 participants across different menstrual life stages across Coimbatore, Tamil Nadu, India. Structural Equation Modeling (SEM) was used to analyze the data, yielding excellent model fit indices that affirm both theoretical consistency and empirical strength. Findings reveal that Meso and Macro systems significantly shape interaction rituals, which creates group solidarity and generate high levels of emotional energy. The model offers an empirically proven, culturally sensitive framework to understand how menstrual practices are learned, preserved, and emotionally transmitted across generations and has significant implications on menstrual health interventions which emphasize the importance of addressing both the emotional and ritualistic experience as well as educational and policy modification.

Keywords: Menstrual cognition, cultural transmission, Bronfenbrenner's Ecological Systems Theory, Randall Collins' Interaction Ritual Theory, structural equation modeling, model fit.

1. Introduction

Menstrual cultural landscape in India is presented by centuries of traditions norms, religious practices and ritualistic systems that still govern the level of experience felt by womankind. The system is highly socio-culturally complicated where menstruation is not simply a biological-based process but includes very strong symbolic, emotionally charged phenomenon. The Menstrual practices in India have been covered by various myths, stigma, norms that are controlling, unspoken taboos, and rituals that are held sacred and passed on through family and community interactions over generations. Depending on the regions, castes, religions and generations these practices differ and nevertheless all end up interacting in agreeably complex multi-layered course of belief, practice and emotion.

The traditional health communication models, concentrating menstruation, have tended to focus on hygiene, product use or a lack of awareness. Even though these rational informational strategies cannot be neglected, they cannot explain why menstrual beliefs persist even after extensive exposure to modern education and public health programs among women and men. These models often fail to recognize emotional and symbolic aspects that give menstrual practices meaning especially in cultures where identity and tradition are closely interconnected. The continuance of menstrual taboos that include isolation, restriction, or absence of access to places of worship, reinforces the need to adjust the linear and behaviorist views.

In the majority of the cultures, menstruation becomes not only a biological experience that goes statistically beyond themselves but also the rite of passage that gets planned and articulated along the means of a path of ritualized experiences and emotionally intense tales and sacred gestures and symbols. Elders, peers, teachers, mass media, and religious figures contribute heavily to the formation of menstrual cognition and behavior through installation of beliefs and practices at various levels of ecology. Such stereotypical exchanges between individuals on various ecological tiers create some collective emotional power and an emotional connection with the group, thereby ensuring the survival of such cultural habits, namely continuous generation, over the generations.

Because of this complex reality, an urgent and coherent theoretical background is necessary which will encompass the comprehension of the development, experience and transmission of menstrual knowledge through generation. This current study addresses that need by proposing and validating a structured model that integrates **Bronfenbrenner's**

Ecological Systems Theory with **Randall Collins' Interaction Ritual Theory**. The model explores how micro, meso, exo, and macro-level environments encourage interaction rituals, which in turn creates group solidarity, generate emotional energy, and sustain sacred symbols tied to menstruation. Through a quantitative approach using empirical validation via Structural Equation Modeling (SEM), this research aims to provide a strong, culturally grounded explanation for the persistence of menstrual practices in transitional societies like Coimbatore, Tamil Nadu, India. The below diagram shows the basic concept behind the model and its constructs.

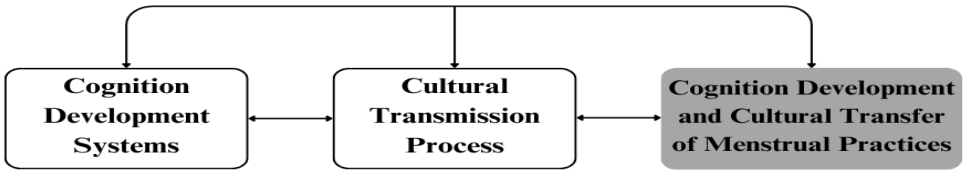

Fig.1 - Basic Concept Underlying the Cognition development and cultural transfer of menstrual practices model

The following tabulation elucidated the model's theoretical core constructs used in this study:

Theoretical Constructs and Definitions

Theory	Core Constructs	Definitions
Ecological Systems Theory **Urie Bronfenbrenner**, a renowned developmental psychologist, developed the **Ecological Systems Theory** to explain how individual's cognition development is	**Microsystem**	Immediate environments with direct interaction, such as family, peers, school, and neighbourhood, that shape individual development through daily face-to-face experiences (Bronfenbrenner, 1979)
	Mesosystem	The interconnections between different microsystems (e.g., home and school), emphasizing the influence of relationships across contexts on an individual's development (Bronfenbrenner, 1979)
	Exosystem	External settings that indirectly influence the individual, like a parent's workplace or media, through their impact on directly connected people (Bronfenbrenner, 1979)

influenced by a complex interplay of environmental systems ranging from immediate family and peer contexts to broader cultural and societal influences.	**Macrosystem**	The overarching cultural, economic, political, and social structures, including ideologies and norms, that shape individual development within a broader societal context (Bronfenbrenner, 1979)
Interaction Ritual Theory **Randall Collins**, an American sociologist known for his contributions to sociological theory, his **Interaction Ritual Theory** offers a dynamic lens to understand how shared symbols, emotional resonance, and ritualistic practices shape human behavior. According to Collins (2004), repeated ritual participation reinforces shared meanings and group identity, allowing values and beliefs to be passed down across generations.	**Interaction Ritual**	Structured social engagements involving **co-presence, mutual focus, shared mood, and rhythmic entrainment** that generate emotional energy and reinforce collective identity (Collins, 2004)
	Group Solidarity	A sense of shared belonging and collective moral commitment that emerges from successful interaction rituals, strengthening identification with group values and traditions (Collins, 2004), (Durkheim, 1995)
	Emotional Energy (EE)	The enthusiasm, confidence, and motivation produced through positive ritual experiences, driving future participation in meaningful social interactions (Collins, 2004)
	Sacred Symbols for EE (SEE)	Symbols, gestures, or objects imbued with emotional significance through collective rituals, serving as emotional anchors that sustain group identity and transmit cultural values across generations (Collins, 2004), (Durkheim, 1995)

Building upon the foundational insights presented in the introduction, the previous researches on the cognitive development and cultural transmission of menstrual practices were critically examined in literature review.

2. Literature Review

2.1 Menstrual Meaning-Making

Menstruation is a biological phenomenon that is however culturally relative, the meanings of menstruation have been created in discourses of purity, shame, transformation, and power, and thus menstruation has become an explicitly symbolic and socially constructed phenomenon. In the sequence of the last few decades, the seriousness with which menstruation has been approached in scholarship has transformed: once classified menstruation as an issue of affecting individual's hygienic practices, has come to be perceived as a central site of identity-shaping and cultural transmission (Buckley, 1988) (Chrisler, 1988).

(Berger, 1966) asserts that people internalize social knowledge in routinized interactions with family members, educational institutions, peer associations and mass media. When the perspective is applied to menstruation practices, it shows that girl children first acquire their initial knowledge not in generalized classrooms, but during peer and parent discussions that are more discrete and emotional in nature (Agrusa, 2019), (House, 2011). The empirical studies undertaken in India, established that mothers, elder sisters and other females in the kinship act as mainly the actors of knowledge, giving answers embedded with cultural myths and taboos(Khanna, 2005).

2.2 A Bronfenbrennerian Perspective on Menstrual Cognition

Menstrual Cognition is acquired less by formal knowledge than by cultural scripting a process in which the beliefs and practices are reinforced through repetitive and emotionally prominent interactions throughout the socio-cultural landscape (Dube&Sharma, 2012), (Poonam, 2022). To completely comprehend how menstrual cognition is developed, one must address the way knowledge is conveyed and the context in which is it transmitted. **Bronfenbrenner's Ecological Systems Theory**, 1979 offered a theoretical framework to inquire on these overlapping settings entailed the following, the microsystem (individual/family), the mesosystem (schools/community), the exosystem (media/policy), and the macrosystem (religion/culture).

At the microsystem level, the familial and peer interaction, family discourse and message feedback, and mother-daughter conversation shape the development of experiential meanings created due to the onset of menarche. This mesosystem between home and school can either support or challenge the dominant cultural discourses; schools, in particular, may either spread menstrual health knowledge and challenge the taboo or simply reinforce the stigma by remaining silent or noticeably embarrassed (Tiwari, 2006). The exosystem (consisting of mass media and local health infrastructures) is less direct, but usually maintains discourses of concealment and purity by advertising or policy discourse (Eva Åkerman, 2024). The macrosystem, which includes religious and ideological constructs, assigns the major meaning of menstruation as either impure, sacred, or polluting(Garg, 2015).

The factors that influence onset of menstruation in Tamil Nadu are not only limited to the conversational interventions i.e. the narratives and advice given but also by the background against which these interventions take place the relationships that arise in the first menstrual period and practices that are involved.(Narayan, 2020), (Rajaraman, 2019).

2.3 Cultural Transmission: A Randal Collin's Interaction Ritual Theory Perspective

The menstrual practices is not only the dissemination of certain pedagogy, but the dissemination itself is performative and ritualized. Using the **Interaction Ritual Theory** (IRT) proposed by **Randall Collins** (2004), the menstrual event could be streamlined into a largely prolonged cultural practice enabled by repetitious emotional interactions that creates and strengthens common moods, bind the solidarity of the group and creates sacred symbolic values. It is symbolic restrictions, menarche ceremonies, and seclusion customs that are one of the classical examples of cultural performance that reaffirms social norms and encapsulates emotional memory at the same time.

According to Collins, IRT, there are four key ingredients of successful interaction rituals, i.e. they require bodily co-presence, focus of attention on a common object or activity, a shared emotional mood, and an outsider boundary. The experience of menarche among adolescent girls in the presence of mothers or elders and the symbolic tasks to be performed by girls, which are associated with fertility or purity theme, complete these conditions as a whole. The emotional energy is the resultant element, which congeals the importance of the ritual thus making it memorable and sustainable (Collins, 2004).

Menstruation in India plays the role of a gendered ritual whereas a female child is transformed into an adult woman. As ethnographic studies in Tamil Nadu show, even

apparently festive events have control, surveillance, and coded moral guidance of the people present in them. It is at such practices where the girl is at the same put on a pedestal, but also educate about the right way to control her body since these teachings are emotionally inscribed and socially enforced.

This emotional support is experienced even at adulthood. It is through symbolically rich interactions, emotional responses of others and repeated body regulation that practices of not entering temples, avoidance of the kitchen or use of separate utensils during the menstruating period are learned and not through direct instruction (Kumar, 2011). These practices are perpetuated not only due to belief in them but also, they are rituals of granting social affiliation, emotional satisfaction, and symbolic importance.

The following literatures have contributed to the development of the following research objectives aimed at exploring how menstrual knowledge, beliefs, and practices evolve across different life stages and social contexts.

3. Objectives

This research aimed to develop and validate a model associating cognition development and the culture of enacting menstrual practices among women Coimbatore, Tamil Nadu through Structural Equation Model.

4. Methodology

A quantitative research design was adopted to statistically validate the proposed theoretical model explaining cognition development and cultural transmission of menstrual practices. The theoretical background and well-developed review of relevant literature led to the creation of a well-structured questionnaire based on the Ecological Systems Theory developed by Bronfenbrenner and the Interaction Ritual Theory proposed by Collins. The instrument included eight latent constructs four ecological system variable, four interaction ritual constructs, which are Interaction Ritual, Group Solidarity, Emotional Energy, and Sacred Symbols of Emotional Energy. All items were implemented in each construct with a certain number of questions depending on the construct that were presented in a 5-point Likert Scale that included a range of response choices on a scale of “Strongly Disagree” to “Strongly Agree”. Stratified sampling was conducted to obtain proportional representation on a sample of 450 respondents, namely; 150 menarche, 150 menstruating women and 150 menopausal women in the Coimbatore district of Tamil Nadu. The study could do so with some help of this

stratified design due to its ability to explore cross-generational differences in menstrual cognition and perpetuation of cultural practices.

The current study used Structural Equation Modeling (SEM) with AMOS 26.0 as it allows analyzing observable as well as latent variables at once, which helps determine the interdependence of sophisticated interrelations. The adequacy of model was tested through few indices of fit, namely, the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), and the Chi-Square to Degrees of Freedom (CMIN/DF). These indices were read based on the criteria presented by (Hu, 1999), therefore assuring an intense evaluation of both theoretical and empirical authenticity.

The resulting final SEM model was, thereafter, tested on the structural integrity, path significance, and overall goodness-of-fit to validate its abilities to take into account the complex processes involved in developing menstrual knowledge, emotionally entrenching it, and culturally passing it across the life stages. Results of structured surveys were extracted by using SEM to investigate hypothesized correlations between ecological and ritual-based variables. The results of this analysis gave factual answers to the larger scope in the contribution of environmental systems and interaction rituals on impacting the cognition development and cultural transmission of menstrual practices in women.

The following section presents these findings and offers an interpretation of their significance within the theoretical framework.

5. Findings and Interpretation

To explain the multi-strata nature of the processes by which knowledge on menstruation is built, emotionally stabilized, and culturally composed about the various life stages, the path diagram model was developed using ecological and ritual variables as its key nodes.

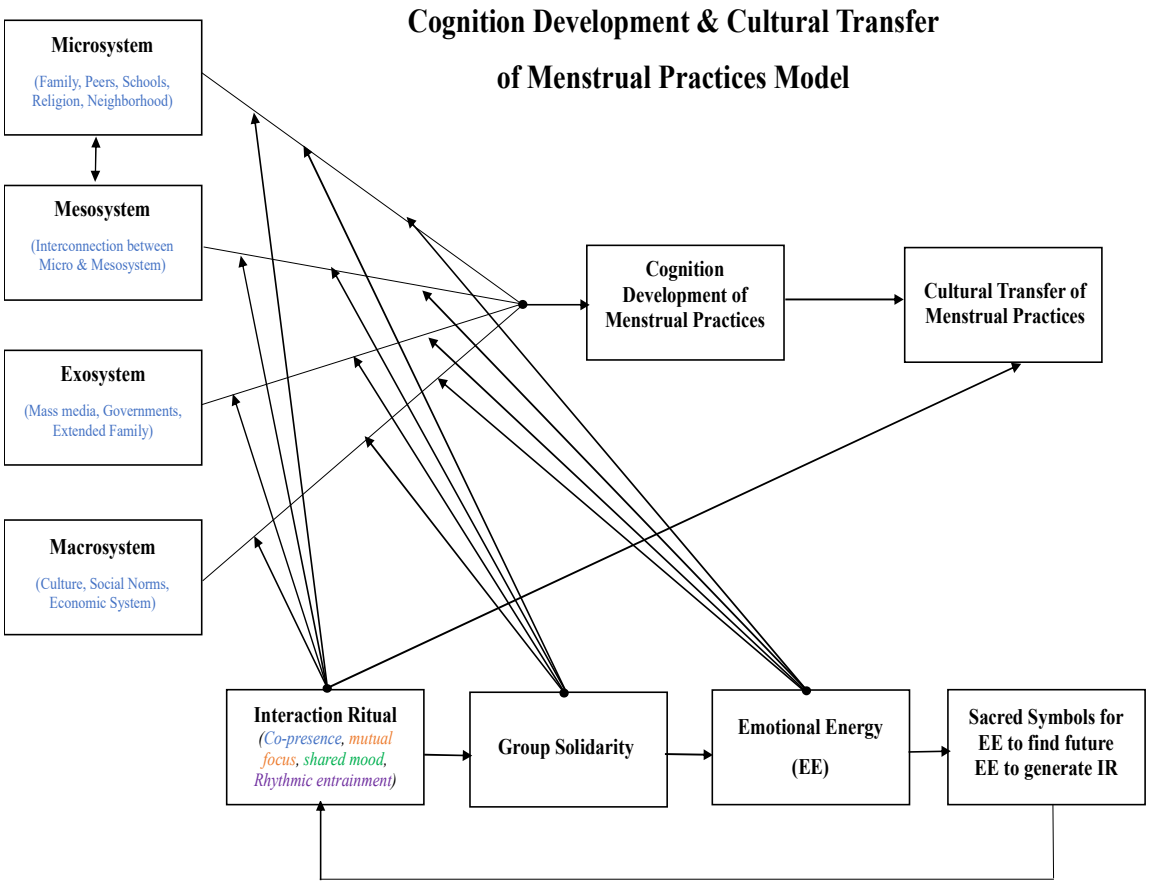

Fig 2- Cognition development and cultural transfer of menstrual practices Model

The model was analyzed using Structural Equation Modeling (SEM) with AMOS 26.0.

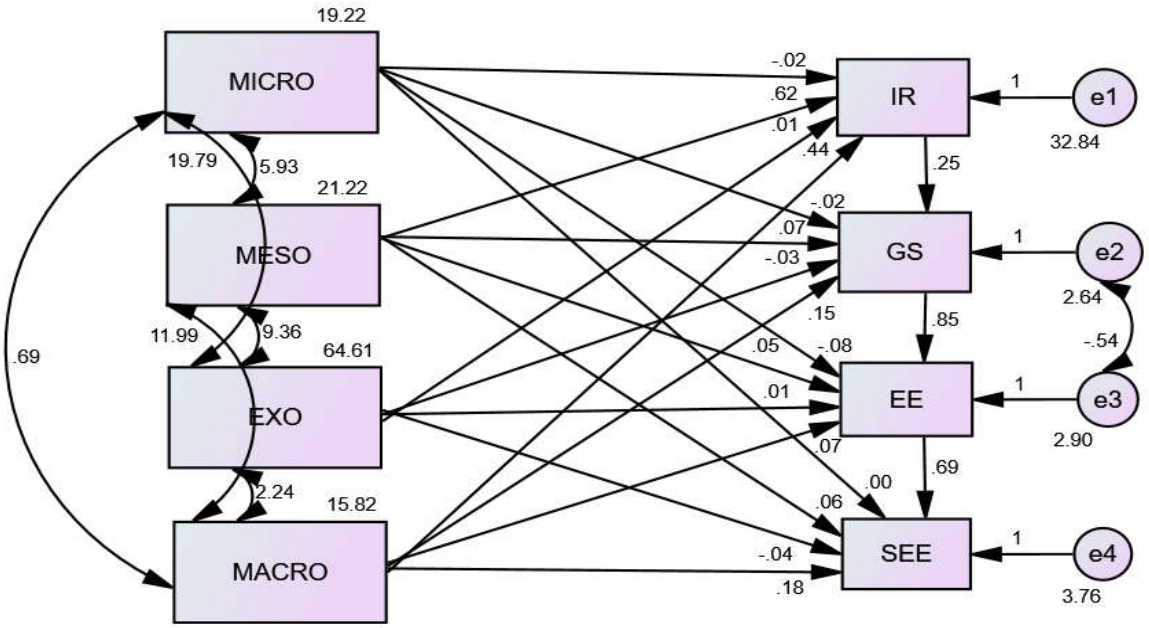

Fig 3: Structural Equation Model of Cognition development and cultural transfer of menstrual practices Model

5.1 Model Fit

Measure	Estimate	Threshold	Interpretation
CMIN	1.298	--	--
DF	2	--	--
CMIN/DF	0.649	Between 1 and 3	Excellent
CFI	1.000	>0.95	Excellent
SRMR	0.004	<0.08	Excellent
RMSEA	0.000	<0.06	Excellent
PClose	0.788	>0.05	Excellent

The results support an excellent model fit, as it appears there is a very strong and coherent correspondence between the theoretically suggested framework and the empirical patterns that appear in the data. Remarkably, the constantly high fit measures (Comparative Fit Index (CFI) of 1.000, Root Mean Square Error of Approximation (RMSEA) of 0.000, and Standardized Root Mean Square Residual (SRMR) of 0.004) confirm not only the structural soundness of the model but also establish that it will measure the process of menstrual cognition and cultural transmission through ecological and interaction ritual variables in a satisfactorily ideal way. The high fit values represented by such strong figures indicate that the above stated latent constructs Micro, Meso, Exo, Macro (ecological systems) and Interaction Ritual, Group Solidarity, Emotional Energy, and Sacred Symbols of Emotional Energy (interaction ritual variables) have a statistically significant and meaningful interaction with each other. Moreover, the error margins are small and the model convergence is high, which demonstrates that the structural equation model is theoretically and practically appropriate, and is a valid explanatory model of the manner in which the menstrual practices are emotionally rendered, ritualized, and socially transmitted in the context of this socio-cultural setting.

5.2 Regression Weights:

			Estimate	S.E.	C.R.	P
Interaction Ritual	<---	Meso Variable	.624	.083	7.478	***

			Estimate	S.E.	C.R.	P
Interaction Ritual	<---	Micro Variable	-.021	.077	-.275	.783
Interaction Ritual	<---	Exo Variable	.006	.041	.139	.890
Interaction Ritual	<---	Macro Variable	.435	.092	4.730	***
Group Solidarity	<---	Macro Variable	.146	.027	5.471	***
Group Solidarity	<---	Micro Variable	-.023	.022	-1.046	.295
Group Solidarity	<---	Meso Variable	.067	.025	2.691	.007
Group Solidarity	<---	Exo Variable	-.032	.012	-2.779	.005
Group Solidarity	<---	Interaction Ritual	.250	.013	18.711	***
Emotional Energy	<---	Micro Variable	-.075	.023	-3.276	.001
Emotional Energy	<---	Meso Variable	.052	.028	1.857	.063
Emotional Energy	<---	Exo Variable	.009	.012	.773	.440
Emotional Energy	<---	Macro Variable	.074	.031	2.388	.017
Emotional Energy	<---	Group Solidarity	.854	.056	15.247	***
Symbols To EE	<---	Micro Variable	.001	.026	.019	.985
Symbols To EE	<---	Meso Variable	.057	.030	1.902	.057
Symbols To EE	<---	Exo Variable	-.044	.014	-3.143	.002
Symbols To EE	<---	Macro Variable	.179	.033	5.398	***
Symbols To EE	<---	Emotional Energy	.688	.039	17.458	***

Regression Weights:

- **Interaction Ritual** has significant relationships with **Meso Variable** ($\beta = 0.624$, $p < 0.001$) and **Macro Variable** ($\beta = 0.435$, $p < 0.001$). The negative relationship with **Micro Variable** ($\beta = -0.021$, $p = 0.783$) and **Exo Variable** ($\beta = 0.006$, $p = 0.890$) are not significant, indicating weaker or no meaningful effects in these areas.
- **Group Solidarity** shows strong positive effects from **Interaction Ritual** ($\beta = 0.250$, $p < 0.001$) and **Macro Variable** ($\beta = 0.146$, $p < 0.001$), while weaker relationships with other variables suggest less influence from **Micro Variable** and **Exo Variable**.
- **Emotional Energy** has a significant positive relationship with **Group Solidarity** ($\beta = 0.854$, $p < 0.001$), and smaller, statistically significant effects from **Macro Variable** (β

= 0.074, p = 0.017). The negative relationship with **Micro Variable** (β = -0.075, p = 0.001) is also significant.

- **Symbols To EE** shows a significant positive relationship with **Macro Variable** (β = 0.179, p < 0.001) and **Emotional Energy** (β = 0.688, p < 0.001), with a negative relationship with **Exo Variable** (β = -0.044, p = 0.002).

Structural Equation Model of Cognition Development and Cultural Transmission of Menstrual Practices is the conceptual and empirical framework of this research. It integrates the ecological systems theory with the emotional systems presented by rituals to explain how menstrual knowledge is constructed, affectively internalized, as well as handed down throughout generations in the Indian cultural context. The model is visually represented in Figure 3 in which direction arrows between four ecological system variables, including Micro, Meso, Exo, and Macro, and four core Interaction Ritual variables, namely, Interaction Ritual (IR), Group Solidarity (GS), Emotional Energy (EE), and Sacred Symbols of Emotional Energy (SEE) are given.

The Meso and the Macro system which are considered as the most determining influences of IR. These observations serve as reminders of the all-important roles that family, peers, cultural norms, and institutional practices serve in ritualizing and social communication of menstruation. Meso → IR path (β = 0.62) implies the strength of the instant social interactions into creation and consolidation of menstrual rituals particularly by mothers, teachers, as well as peers. Respectively, the Macro → IR path (beta = 0.44) proves that cultural ideologies, religious beliefs, and even more general societal norms, provide the background story that provides the framework of these rituals directing their symbolic significance.

Interaction Ritual (IR) manages to become a fundamental mediator in the model directly impacting Group Solidarity (GS) (β = 0.25), which refers to the wholesome sense of belongingness and together political identity that is created during menstrual practice. This solidarity forms part of the emotional basis on which Emotional Energy (EE) is built (β = 0.85) a major motivational factor in influencing compliance towards the cultural expectations and strengthening the behavior of menstruation through an affective commitment rather than rational compliance. EE, in its turn, has significant predictive power of Sacred Symbols of Emotional Energy (SEE) (β = 0.69), which is how long-term ritual involvement translates in the emergence of powerful cultural symbols, such as isolation rooms, menarche rituals,

regulated diets, and barriers to temple entry. The symbols are encoded in emotions and long-lasting thus sustaining the culture of one generation to the other.

Applying the ecological systems theory, the current study focuses on the relationship between ecological variables that comprise menstrual cognition. The results indicate the statistical relationship existing between the meso-level variables and the macro-level variables (r =.654), and between micros-level variables and the meso-level variables (r=.294). In combination, all these associations support the model offered by Bronfenbrenner by concluding that menstrual cognition is defined not by isolated events of learning but due to many-layered exchange of the environment.

The solid lines in Figure 3 are associated with direct paths between variables where the arrows identify that the relationship between variables is statistically significant ($p < .001$). The combined inclusion of Interaction Ritual variables and ecological predictors highlights the many-layered, emotion-filled machinations of menstrual belief and practice manufacturing and rehearsal. This arrangement confirms that cognition surrounding menstruation is hardly an informational enterprise and is strongly subjective, thus influenced by affective reinforcement, rituals, and attribution of symbolic meaning. The model thus gives a complete culturally specific version of transmission of menstrual knowledge. Integrating ecological structures with ritual-emotional dynamics, Figure 3 provides visual and theoretical analysis of the creation and dissemination of menstrual cognition within Indian society by showing that reductionist explanations fail to unravel it, and such cognition is framed in terms of emotion, ritual, and symbolic interaction in communication and behavior of health.

6. Discussion

The Cognition Development and Cultural Transmission of Menstrual Practices model provides a theoretically based model that can be used to explain through which processes menstrual knowledge may be constructed socially, through ritual and through the emotionally intense experiences. Through combining Bronfenbrenner Ecological Systems Theory (1979) and Collins Interaction Ritual Theory (2004), the paper has revealed that menstruation is a social constructed process characterized by emotional energy, symbolism and affiliation to a group.

The results of a Structural Equation Modeling suggest that the most significant effects are produced by Meso ($\beta = 0.624$ $p<.001$) and Macro systems ($\beta = 0.435$ $p<.001$), such as family, peers, schools, and broader culture, that influence menstrual rituals. Such results align

with those of (House, 2011) and (Garg, 2015), and their study contains a discussion of the centrality of interpersonal and cultural messages in menstrual education.

The work of the Interaction Rituals is like a passage of emotions because it does not just transfer behavioral models but a collective emotional state too. Group Solidarity ($\beta = 0.250$, $p < .001$) increases as a result of such rituals and in turn strongly creates Emotional Energy ($\beta = 0.854$, $p < .001$). The model hence confirms the theories of (Collins, 2004) and (summers-effler, 2006) regarding the affective group dynamics.

The empirical findings show that sacred icons, such as turmeric and red saris and taboos of the temples have a significant correlation with Emotional Energy ($\beta = 0.688$, $p < .001$). These figures support the argument by (Durkheim, 1995) that rituals give ordinary things or items a sacred connotation. These results can be cross-referenced with the discussion provided by (Bobel., 2020) and also shed a light on the nowadays changes among younger females that carefully evaluate the traditions passed to them.

As the tradition-keepers, menopausal women, along with menstruating girls, supply each other with instructions and eventually reproduce cultural significations (Hennegan, 2019) and (Schmitt ML, 2017). The girl who receives menarche in turn depends considerably on the teaching of the family, and the same patterns of initial socialization, and internalisation described by (Chrisler J. C, 2014) can be observed here, as well.

The present framework explains cognition development and cultural transmission of menstrual practices as an interactive process influenced by several ecological factors of determination, ritual experience, emotional valuation, and symbolic validation. It opposes simplistic, hygiene-focused narratives by emphasizing the emotional and cultural logics that underpin menstruation existence. The model therefore provides the policy makers and educators with a platform through which to diffuse empirical knowledge at the same time calling the cultural grammars which inserts menstruation with lived meaning.

7. Conclusion

This study provides support that the Cognition Development and Cultural Transmission of Menstrual Practices model forms a theoretically consistent, contextual environment, and evidence-based set of theories in explaining knowledge and behaviour of menstruation phenomenon. By combining ecological, emotional, and symbolic approaches, the model shows that menstruation moves beyond the biological level acquiring the form of a culturally-

mediated experience that is organized by ritual participation, group solidarity, emotional vitality, and sacred symbolism.

This model has a good statistical fit that testifies to its explanatory power. Structural Equation Modeling reveals that cognitive development of menstruation is constructed through social rituals, kept alive by emotional investment, and transferred through the symbolic continuity. These results can be aligned with the theory of interaction rituals, but will also present a new comprehensive explanatory framework designed to fit specifically to the Indian culture. In practice, the model highlights the importance of menstrual health interventions that are more than just information and hygiene but must have affective and cultural connotations. Policy programmes and educational initiatives should make use of ritual and emotional aspects of menstrual life.

8. Scope for Future Research

The current study forms the significant starting point of a number of possible investigation lines:

- **Cross-cultural application:** The model is applicable to different communities that may be religious, ethnic, and regional and present clarity on how menstrual cognition shapes across cultures.
- **Longitudinal study:** The lines of future research can be defined by tracing the paths of menstrual beliefs and emotional responses over the life span of a woman which can bring in the knowledge about behavioral change and cultural continuity over time.
- **Policy integration:** The framework is capable of informing public health action and curricula in schools that merge respect of culture and science so that dignity, autonomy and inclusivity can be promoted.

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