Maternal strategy for coping with confirmation of Zika virus infection during pregnancy: reflection on the neurodevelopment of their children

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Abstract: Zika virus infection in pregnant women results in changes in neuropsychomotor development in affected children, being an important stress factor for these women. This study aimed to evaluate the mothers' coping strategy in this situation and how this was reflected in the neurodevelopment of their children. Cross-sectional study with 46 women and their children. The coping strategy was assessed using the Brief Cope Inventory, applied to mothers, and the children's neuropsychomotor development was assessed at 24 months of age using the Bayley III Scales. The predominant coping strategy most frequently used by mothers was approach (73.9%), with emphasis on the planning component. The use of the avoidant coping was associated with lower scores on the Bayley III scale, with self-blame being the most used component on this scale. Religion was the auxiliary support component most used by mothers. The use of avoidant as the predominant coping strategy by mothers was associated with the worst results in the assessment of child development and reinforces the need to support these women, so that they can deal more directly with the feelings arising from the situations they experience.

➤ **Keywords:** Zika virus. Brief Cope. Neuropsychomotor development disorder. Psychometrics.

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Introduction

The Zika virus epidemic brought a series of challenges to public health, especially for pregnant women who were diagnosed with the disease during pregnancy and who were faced with the possibility of their children being seriously affected by conditions directly linked to their neurodevelopment. Outbreaks of Zika virus infection have always been reported around the world, but in 2015 there was a major epidemic in Brazil. Concomitantly, there was an increase in cases of microcephaly in the northeast of the country, which was associated with Zika virus infection in pregnant women (Souza *et al*., 2016; 2018).

This epidemic spread to other countries, being declared a public health emergency worldwide by the World Health Organization (WHO). The severe manifestations of fetal brain development in pregnant women who were infected caused great concern among pregnant women. Being responsible for the care of a child with a condition that affects their neurodevelopment has significant socio-emotional effects for parents, affecting family dynamics.

In search of giving meaning and reducing the feeling of helplessness, these women begin to look to their beliefs for the necessary support to help them face the situation of insecurity regarding their baby's future. Hope is made possible through a force that has the potential to favor the maintenance of decisions, determination to overcome the disease, in addition to giving meaning to life (Ribeiro; Minayo, 2014; Simas *et al*., 2020). Bishop *et al*. (2015), evaluating individuals with schizophrenia and their family members, using a questionnaire to measure possible resilience factors, found that social support, whether from family or friends and community groups, allowed the sharing of experiences. The knowledge acquired through these exchanges helped patients not to feel isolated, and their families to better adjust to the disease situation. The learning resulting from the exchange of experiences contributes to better acceptance of the situation of a chronic illness. The ability to seek and believe in one's strengths suggests that one becomes more capable of resisting stress and enduring the situation, and adapting to the crisis experienced (Bishop; Greeff, 2015).

In Brazil, Zika virus infection most frequently affected the population of young and socially vulnerable women, mainly in the Northeast region of the country (Nunes *et al*., 2016). Furthermore, support networks for families of children with neurological impairment were overwhelmed, making social, gender and racial

inequality more evident. This factor became an aggravating factor for many of these pregnant women, who, in addition to worrying about the future development of their baby, were apprehensive about their livelihood.

The most recent theories about stress and coping argue that the process between the individual and situations involves constant interactions and adjustments, with the individual being an active agent capable of influencing the impact of a stressor through the use of coping strategies. Thus, the better the individual's strategies, the less vulnerability they will have to stress (Dias *et al*., 2020).

Several factors interfere with a child's development, in addition to direct actions on the brain during intrauterine growth or resulting from insults after birth, which must be considered when evaluating a child's development (Walfisch *et al*., 2013; Appleyard *et al*., 2005). The experiences lived by children in their family or social environment, as well as social inequalities, interact with each other and with the entire process of neurodevelopment during childhood (Bronnfenbrenner *et al*., 2007). However, the family environment and especially the child's closest caregiver, usually the mother, are key factors in inducing the positive stimuli necessary for the child's neurodevelopment process to occur towards a future healthy adult.

As maternal stimulation influences the child's neuropsychomotor development, and the maternal emotional state modulates their stimulating capacity, the hypothesis was raised that the way these women faced the Zika diagnosis during pregnancy would influence the neurodevelopment of their children. Thus, this study aimed to evaluate the coping method used by mothers and verify how much the adopted form influenced the children's neurodevelopmental profile.

Method

A cross-sectional study was carried out on a cohort of children whose mothers were infected by the Zika virus during pregnancy, who were born asymptomatic and were being monitored at the Fernandes Figueira Institute (FFI-Fiocruz) in the project "Exposição vertical ao Zika vírus e suas consequências no neurodesenvolvimento" [Vertical exposure to the Zika virus and its consequences in neurodevelopment]. The study was approved by the institution's Ethics Committee with number CAAE 52675616.0.0000.5269 and was carried out from 2018 to 2019 at the FFI Pediatrics Outpatient Clinic. Mothers and children were included in the study after signing the Informed Consent Form.

Inclusion criteria: children proven exposed to the Zika virus by positive PCR during pregnancy, asymptomatic at birth, and who were monitored from birth until two years of age at the FFI outpatient clinic. Children with microcephaly, congenital Zika syndrome, congenital malformations, and TORCHS group infections were excluded.

In this study, the type of coping used by mothers when they found out they were infected with the Zika virus during pregnancy, with the potential to compromise their children's neurodevelopment, was evaluated. The assessments were carried out when the children turned two years of age.

Assessment of the type of coping

To assess the type of coping, the Brief COPE instrument was used, applied to the children's mothers at the time of the consultation. This instrument is an inventory of multidimensional strategies composed of 28 items, to assess how people respond to stressful situations (Carver, 1997). These 28 items are contained in 14 scales (Pais Ribeiro; Rodrigues, 2004), with information on the following components of the strategies: planning, use of information support or emotional social support, seeking support in religion, positive reframing, self-blame, acceptance, venting, denial of the situation, self-distraction, behavioral disengagement, use of substances (e.g., medication/alcohol) and use of humor.

The Brief COPE instrument was validated for the Portuguese language (Pais Ribeiro; Rodrigues, 2004). The items are added together on each scale, and the score obtained determines the scores that define the coping strategy.

The questionnaires were applied individually, by a single examiner, following standardized instructions, according to the original version of the instrument. Each question receives a score according to the answer given by the mother: 1 = I haven't done it at all; 2 = I have done a little; 3 = I have done more or less; 4 = I have done a lot. These scores are added together, forming a score for each strategy: avoidant or approach, considering the components of each of them, described below.

The components self-distraction, denial, drug use, disengagement behavior, venting and self-blame were used to define the avoidant coping. Use of emotional support, use of information support, positive reframing, planning and acceptance were used to define the approach coping. The use of support from religion and the use of humor as a distraction from problems are not part of the components of approach and avoidant coping. They are evaluated separately.

Neurodevelopmental assessment

To assess neurodevelopment, the Bayley Scales of Child Development 3rd Edition (Bayley III) (Bayley, 2006) were used, applied at the 24-month appointment. This scale evaluates children aged 1 to 42 months, covering the cognitive, language (subdivided into receptive and expressive) and motor (subdivided into fine motor and gross motor) domains. The range of score variation considered appropriate is 85 to 115.

Composite scores for the language, motor and cognitive domains lower than 85 (1 standard deviation) were considered moderate delays, and severe delays were those lower than 70 (2 standard deviations). The scales also provide assessments of the social-emotional and adaptive components, which were not assessed in this study.

The following confounding factors were considered: maternal education and age and breastfeeding during the first two years of life.

Information on maternal race (self-declared), work during pregnancy, high blood pressure and diabetes during pregnancy, family income, type of birth, anthropometric variables at birth (weight, head circumference and length), gestational age and 1st and 5th minute APGAR.

Analysis

Data were stored in Microsoft Access software and analyzed using SPSS Statistics version 2.3 software. A descriptive analysis of the variables of interest was carried out, using frequency tables, means and medians. The results of the Brief COPE Inventory were categorized according to the predominance of the strategy used by women, considering the one with the highest score among the avoidant or approach strategies. One mother presented identical scores for both strategies, being excluded from the analyzes of the association of factors and Bayley scores with the strategies. The frequencies of the predominant strategies used by the remaining 46 women in the study were calculated. The average scores for the language, cognitive and motor domains were calculated, as well as their subscores – receptive and expressive language, and fine and gross motor. The presence of breastfeeding during the first two years of life was categorized into two groups: i) the child was never breastfed; or ii) received some breast milk (exclusive or supplemented with formula) in the first year of life.

Multivariate analyzes were carried out to evaluate factors that would be contributing to the coping strategy used by mothers in this population. The following factors were considered as independent variables: support for religion,

presence of comorbidities during pregnancy (maternal hypertension and diabetes), use of humor as an auxiliary component of coping, use of emotional support to cope with the situation, use of a support network as support for coping, family income in minimum wage (continuous variable) and maternal age (continuous variable). Two models were carried out considering the two predominant coping categories as dependent variables: avoidant and approach.

Results

The initial sample was composed of 47 mothers, with a mean age of 31.1 ± 5.6 years, 30 (63.8%) of whom self-declared as yellow (1), black (9) or mixed race (20), and 17 (36.2%) self-declared white. Vaginal birth occurred in 12 women (25.5%) and by cesarean section in 35 women (74.5%). Hypertension during pregnancy occurred in 12 (26.7%) mothers and diabetes in 4 (8.9%). The average gestational age at birth of these children was 38.1 (SD 2.09) weeks, birth weight was 3,137g (SD 592.2), length 48.7 cm (SD 3) and head circumference 34.4 cm (SD 1.5). The median APGAR score at the 1st minute was 9 (IQR 2) and at the 5th minute 9 (IQR 1). At the date of the interview, the children were on average 26.9 ± 15 months old, 26 (55.3%) were female and 21 (44.7%) were male. Most children (84.4%) were breastfed, either exclusively or supplemented with formula. The average family income was 3 ± 4.9 minimum wages; 10 mothers (21.3%) had completed higher education, 31 (66%) had completed secondary education and 6 (12.8%) had completed primary education. Regarding work during pregnancy, 25 (53.2%) of the women declared having worked and 22 (46.8%) did not work. The predominant coping strategy used by mothers, when they found out they were infected with the Zika virus during pregnancy, was avoidant in 12 (26.1%) women and approach in 34 (73.9%) women. One woman presented the same score for the use of both strategies, being excluded from the analyzes as she could not be classified within a predominant strategy category.

The components of the predominant coping strategies used are described in Table 1. It can be seen that the component of the avoidant coping with the highest average score, 4.9, was "Self-blame", while the prominent component of the approach coping was "Planning", with an average score of 5.9. "Religion", although not considered a component of either strategy, was also a relevant aspect in coping with the situation assessed in this study, with an average of 4.9.

The avoidant strategy was significantly associated with being black or mixed race (p-value = 0.043) and the approach strategy with the fact that the child was breastfed (p-value = 0.053) (Table 2). Analyzing the distribution of proportions of strategy use among brown and black women, we observed that brown women used the approach strategy more (Table 2). As race is an important social marker, it was assessed whether this difference was not due to another factor, such as education or income. The analysis of the interaction term between white/(black or mixed) race, higher/lower level education in relation to the type of coping strategy used and income showed that white women, with higher education (higher education) and higher average monthly income adopted the approximation strategy.

In this sample, the mean language scores were below expectations. In the subscales, we found higher scores in expressive and fine motor language. Children whose mothers predominantly used the avoidant strategy had significantly lower means in all domains covered by the Bayley Scales, when compared to mothers who used the approach strategy (Table 3).

In the multivariate model, support from religion (B: 2.24, p-value <0.0001) and the use of a support network to help coping (B: 1.95, p-value 0.015) were positively associated with the predominant approach coping strategy, adjusted for maternal age, family income, comorbidities, use of humor and use of emotional support. For the predominant strategy of avoidant coping, the significant factors were the use of humor (B: 3.55, p-value 0.008) and the use of emotional support (B: 2.01, p-value 0.013) with a positive association, and support from religion (B: -2.49, p-value <0.0001) with a negative association, adjusted for maternal age, family income, comorbidities, use of support network support.

Table 1. Average scores in the components of the coping strategies used by the mothers of the children in the study determined by the Brief COPE Inventory (N=46)

Types of strategies and components	Average (SD)
Avoidant (n = 12)	
Self-distraction	2.9 (0.9)
Negation	3.2 (1.4)
Drug use	2.2 (1.0)
Disengagement behavior	2.8 (1.3)
Venting	3.9 (1.3)
Self-blaming	4.9 (1.8)
Approach (n = 34)	
Active coping	4.7 (0.7)
Use of emotional support	3.6 (1.1)
Use of information support	3.0 (0.9)
Positive reframing	5.4 (2.0)
Planning	5.9 (1.8)
Acceptance	3.1 (0.9)
Humor	2.1 (0.9)
Religion	4.9 (1.5)

*The mother who presented the same average score for both strategies was excluded.

Source: own elaboration.

Table 2. Predominant type of strategy used, according to maternal characteristics (N=46)

	Avoidant (12)		Approach (34)		
	N	%	N	%	
Color*					
White	2	12%	15	88%	0.043
Brown/black	10	34%	19	66%	

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	Avoidant (12)		Approach (34)		
	N	%	N	%	
Mother's education					
Elementary school	2	33%	4	67%	
High school	7	23%	23	77%	0.835
University	3	30%	7	70%	
Work during pregnancy					
Working	5	20%	20	80%	0.305
Not working	7	33%	14	67%	
Delivery type					
Cesarean	9	27%	25	74%	0.921
Normal	3	25%	9	75%	
Hipertension					
Yes	4	33%	8	67%	0.58
No	8	25%	24	75%	
Diabetes					
Yes	0	0%	4	100%	0.199
No	12	30%	28	70%	
Breastfed					
Yes	8	22%	29	78%	0.053
No	4	57%	3	43%	

* In relation to races, the distribution found was 17 white women, 20 brown women (avoidant coping 4, approach coping 15), 9 black women (avoidant coping 5, coping 4).

Chi-square test

Source: own elaboration.

Table 3. Mean scores for the development domains assessed by the Bayley Scales 3rd Edition in the total population and between the two types of predominant coping strategies used by mothers

	Total population	Avoidant	Approach	P-value*
	Average (SD)	Average (SD)	Average (SD)	
Cognitive	90.8 (10.6)	83.8 (10.5)	93.2 (9.8)	0.007
Language Receptive	7.1 (2.2)	5.3 (2.6)	7.8 (1.6)	0.007
Language Expressive	9.2 (13.3)	5.8 (3.0)	8.0 (1.6)	0.028
Language Composite	83.9 (12.6)	73.8 (16.1)	87.9 (8.8)	0.012
Fine motor	9.5 (1.8)	8.1 (2.2)	10.1 (1.3)	0.012
Gross motor	7.3 (2.5)	6.3 (1.9)	8.0 (1.2)	0.001
Motor composite	91.3 (8.9)	82.8 (11.0)	94.2 (6.0)	0.004

* Student *t* test.

Source: own elaboration.

Discussion

In this population, the predominant coping strategy used by mothers was approach. When facing adversity, people look for a way to adapt to events. These adaptive mechanisms can have several consequences. These can focus on positively coping with the problem or denial, depending on how the individual will deal with the situation. In the coping, there is a definition of the problem being experienced and alternative solutions are sought. In avoidant coping, there are cognitive and behavioral efforts to avoid thinking about the stressful situation in which the person finds themselves, with a tendency to withdraw attention from negative and stress-inducing episodes (Rodgers et al., 2012).

These strategic actions depend on the context, resources and personal construction of each person. Braunstein-Bercovitz (2014) says that it is important to consider the physical, mental, financial, material and social resources that people have available to deal with different situations and determine the coping strategies they will use to face such situations. However, despite the availability of a support network, its use will depend both on the individual's expectations in relation to this network itself, and on the way in which the individual will be inserted into it (Rapoport;

Piccinini, 2006). Their decisions and choices will result from the balance between these perceptions, between what he expects and what is offered.

Within the approach strategy, the components most used by mothers were planning, positive reframing and positive coping. Planning is used as a way of confronting the stressor, planning the actions taken; Positive reframing would be a way of dealing with the situation by trying to see the problem in a more optimistic way. In the case of positive coping, the person seeks information about the problem to be faced, to modify the cognitive representation of the situation and act accordingly.

The use of strategies are actions designed to deal with stress in a particular situation, as an attempt to maintain control over the situation (Pires; Santos, 2011). They are supported by three mechanisms: problem solving (perception that there is a solution to the problem), controlling emotions (when one thinks that the solution is to "hold on") and obtaining social support (seeking understanding, emotional and affective support). Seeking social support and help from other people, and emotional coping, are common and considered important mechanisms (Kuo, 2013).

In the avoidant strategy, the most used components were self-blame and venting. Venting is understood as a strategy to release feelings, while in self-blame the person would feel responsible for what is happening. In venting, mothers would be exposing their anxieties regarding the risk of disability in their child, and in self-blame, they would be questioning whether this would have been the best time to get pregnant.

When more vulnerable mothers experience strong pressure, they may realize that their abilities are limited to deal with the situation, and unconsciously adopt denial strategies (Liga et al. 2020). Some mothers tried to develop alternative, self-distracting activities, such as reading, talking, watching television, in order to disconnect from the stressful focus and avoid thinking about the problem. The expectation of the possibility of the birth of a baby with severe brain malformation, created around the maternity ward during the Zika virus epidemic, and of uncertainties regarding their personal life and all the difficulties to be faced by the child with a disability, to for some women it became a great emotional burden (Moreira et al., 2022). From this emotional overload, they used avoidant coping as an escape, an unconscious defense tool (Clímaco, 2020).

There was a fairly frequent search for support in religion. Parents find in religiosity and spirituality a meaning and an answer to all their doubts regarding the illness and threat to their children's lives (Zani *et al*., 2015). Religion is considered to have a

strong impact on health, strengthening the person, increasing their positive initiatives, contributing to the learning of strategies to deal with different situations (Alves *et al*., 2010). Dessen, Domingues and Queiroz (2015) concluded that resorting to spirituality through faith brings comfort and favors the construction of meaning for your experience, and they emphasize that faith facilitates confrontation with changes and helps to reorder priorities. Spirituality activates subjective processes, giving new meaning to situations of adversity and providing resilient actions in relation to reality.

Scores in all Bayley III domains were significantly lower when mothers used the avoidant strategy. Gestational anxiety has negative consequences for child growth and development (Brouwers; Van Baar, 2001; O'Connor, 2003; Buss et al., 2010; Beltrami; Moraes; Souza, 2013), and we can assume that this anxiety has persisted in this group of women who used the avoidant strategy. However, a child's development involves diverse factors, both biological and environmental, in addition to the stimulation received in the family (Walfisch et al., 2013; Appleyard et al., 2005).

The children evaluated in this study had a normal exam at birth. In developing countries, several risk factors, such as nutritional deficits, poverty, violence, parental education, access to social resources, among others, are negative influences on neurodevelopment (Walker et al., 2007). However, the finding of lower scores in all Bayley III domains among children whose mothers adopted the avoidant strategy was significant.

Women with higher education and higher average monthly income used approach strategies more frequently. This result is similar to the finding of Fernandes (2011), who states that women with a high level of education and higher socioeconomic status tend to adopt more positive coping strategies and less frequently use negative coping strategies.

Maternal age, level of education, and stress influence the mother/child relationship and the child's future (Nogueira; Altafim; Rodrigues, 2013). From birth, there is a continuous process of acquiring capabilities with advancing age, caused by the interaction between the demands of the task, the individual's biology and environmental conditions (Medina Alva *et al*., 2015). During this period, the emotional bonds between children and their parents are fundamental (Lago, 2010). The mother's mental health and emotional changes, such as anxiety and depression, can affect the mother-baby relationship, making the child insecure and unprotected, which is reflected in their development in the medium and long term

(Sameroff, 2010; Flores, 2013). It is through this bond that the child will develop their language (Flores, 2013), and the language area was the most compromised.

A significant association was found between maternal race and the type of strategy used by mothers, with the approach strategy being mostly used by white mothers with higher education. This coping strategy was reflected in higher Bayley III scores. These results probably reflect social inequality.

Black or brown races and low education are important indicators of social inequality. The unfavorable environment in which families from lower social classes live possibly favors a more negative coping strategy. This attitude, seeking to deny a problem, may arise from a feeling of impotence in relation to finding a way out. This strategy was associated with worse assessment outcomes across all domains of development. Furthermore, poverty and social inequality prevent children from reaching their development potential, as has been demonstrated in studies in developing countries, including Brazil (Walker *et al*., 2007; Davidson *et al*., 2003; Paiva *et al*., 2010; Mancini, 2004). Therefore, the results found in our study probably reflect the cumulative effect of unfavorable situations on these children, as discussed by Appleyard *et al*. (2005).

The significant association between the approach strategy and breastfeeding may indicate that mothers with a positive coping strategy have greater availability or emotional tranquility to breastfeed. We can assume that the emotional structure of these women provides more positive attitudes in different situations, both in facing potential risks, in terms of emotional investment or in recognizing the importance of breastfeeding for their children.

Another issue was that, while there was great visibility for children who were born with microcephaly, involving associations created and government support, there was not the same strategy for exposed children who were not born with microcephaly, but who later presented other forms of developmental delays.

Among the limitations of the study is the fact that many families faced difficulties in keeping scheduled appointments. The absence of a control group is a limitation, as it prevents comparison with children not exposed to the Zika virus.

As positive points of the study, the fact that it was carried out with children who were already being monitored, and whose mothers were guided in relation to stimulation measures, stands out. However, the results of the psychometric assessments, despite being partially influenced by the guidance received, could

reflect the emotional situation of these mothers, which would be influencing their ability to stimulate their own children.

In conclusion, this study showed that the predominant approach strategy used by mothers was an important aid for these mothers to stimulate their children. Religion and the use of support networks proved to be important support for these women. The results found indicate the importance of supporting women and mothers in similar situations. Recognizing the strategies used by mothers in similar risk situations can provide support for more targeted guidance and monitoring work for pregnant women and mothers, in addition to contributing to the better development of children.[1]

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Note

[1] R. P. Costa: study design; data interpretation; article writing; final approval of the version to be published; responsible for all aspects of the work, ensuring the accuracy and integrity of the study. M. D. B. B. Méio and M. E. L. Moreira: study design, analysis and interpretation of data; article writing and critical review and approval of the final version. M. F. J. Marinho: relevant critical review of the manuscript and approval of the final version to be published.

Resumo

Estratégia materna de enfrentamento à confirmação de infecção pelo vírus Zika na gravidez: reflexo no neurodesenvolvimento de seus filhos

A infecção pelo vírus Zika na grávida resulta em alterações do desenvolvimento neuropsicomotor nas crianças afetadas, sendo importante fator de estresse para essas mulheres. O objetivo deste estudo foi avaliar a estratégia de enfrentamento das mães a essa situação e como isto se refletiu no neurodesenvolvimento dos seus filhos. Estudo transversal com 46 mulheres e seus filhos. A estratégia de enfrentamento foi avaliada pelo Inventário Brief Cope, aplicado às mães, e o desenvolvimento neuropsicomotor das crianças, foi avaliado aos 24 meses de idade pelas Escalas Bayley III. A estratégia predominante de enfrentamento mais frequentemente usada pelas mães foi a de aproximação (73,9%), com destaque para o componente planejamento. A utilização da estratégia de negação esteve associada aos escores mais baixos na escala Bayley III, sendo nessa escala o componente mais utilizado o de auto culpabilização. A religião foi o componente de apoio auxiliar mais utilizado pelas mães. A utilização da negação como estratégia predominante de enfrentamento pelas mães mostrou associação com os piores resultados na avaliação do desenvolvimento infantil e reforça a necessidade do apoio a estas mulheres, para que possam lidar mais diretamente com os sentimentos decorrentes das situações vivenciadas.

➤ **Palavras-chave:** Vírus Zika. Brief Cope. Transtorno do neurodesenvolvimento. Psicometria.