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Impact of family roles on research productivity of women scientists in food and nutrition in Nigeria

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ABSTRACT

BACKGROUND: Scientific research is frequently expensive and time-consuming, particularly for women scientists in developing nations like Nigeria, where sociocultural conventions primarily assign caregiving responsibilities to women, creating conflicts between personal obligations and professional objectives.

OBJECTIVE: This study examined the impact of familial responsibilities on the research productivity of women scientists employed in food and nutrition research organisations in Nigeria.

METHODS: A mixed-methods cross-sectional study design was employed. Participants were selected using stratified random sampling from 12 food and nutrition research institutions across Nigeria's six geopolitical zones. Inclusion criteria required current research involvement, full-time employment, minimum two years' experience, and caregiving roles. The study comprised a quantitative survey (n=175) and qualitative data collection through semi-structured interviews (n=30) and focus group discussions (n=4 groups, 8-10 participants each). The Family Responsibility Index was used to assess caregiving responsibilities. Data analysis included descriptive statistics, multiple regression analysis, and thematic analysis using NVivo 12. Cochran's formula with 95% confidence level and 5% margin of error determined sample size.

RESULTS: Research productivity was negatively influenced by family responsibilities (1.6 vs 3.8 publications per year, p<0.001). Participants with high family responsibilities published 57.9% fewer articles annually. Time allocation revealed significantly more hours on family care (51.1±15.2 hours/week) than research (28.5±8.2 hours/week). Qualitative findings identified research interruptions (81.1%), limited travel capability (77.1%), and reduced networking opportunities (73.1%) as the most significant career impacts. Multiple regression identified hours of family care ($\beta = -0.326$, p<0.001) and number of children ($\beta = -0.284$, p<0.001) as significant negative predictors, while institutional support ($\beta = 0.245$, p<0.001) was the strongest positive predictor.

CONCLUSION: Family responsibilities significantly reduce research productivity among women scientists in Nigerian food and nutrition research institutions. Targeted interventions including institutional support mechanisms, flexible work arrangements, and enhanced childcare facilities could mitigate these challenges and promote work-life balance.

KEYWORDS:

Family responsibilities, Food and nutrition research, Nigerian scientists, Research productivity, Women in science, Work-life balance

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INTRODUCTION

Scientific research is frequently expensive and time-consuming, particularly for women scientists in developing nations like Nigeria. This often results in significant under-representation of women in key scientific fields, as they face numerous barriers including limited funding, access to resources, and societal expectations.¹⁻² In Nigeria, sociocultural conventions primarily assign to women the responsibility of providing care, creating a complicated situation where personal obligations and professional objectives frequently conflict.³⁻⁴

The relationship between research productivity among women scientists and family obligations in developing countries like Nigeria is critical in academic discussions. Women face a dual burden of career and family responsibilities that hinder advancement. This is pronounced in laboratory-based fields like food and nutrition science, where uninterrupted work is essential.¹⁻² Family responsibilities influence research productivity and highlight broader issues within Nigerian academia regarding gender gaps.^{3,5} Factors such as limited infrastructure, inadequate funding, and entrenched gender roles compound the difficulties faced by women in research-intensive fields.^{2,5}

Nigeria presents a particularly compelling case for examining this phenomenon. As Africa's most populous nation and largest economy, Nigeria has invested substantially in higher education and research institutions. Patriarchal norms continue to shape gender roles and expectations. The extended family system, while providing potential support networks, creates additional caregiving obligations as women are expected to care for aging parents, in-laws, and relatives.^{4,6-7} Furthermore, the relative scarcity of formal childcare infrastructure with only 5-10% of Nigerian children having access to organised childcare facilities means that caregiving responsibilities fall disproportionately on women.⁸

The food and nutrition research sector deserves specific attention because it combines laboratory-based research requiring uninterrupted focus with field research that demands mobility and travel. Both of which are compromised by intensive caregiving

responsibilities.¹⁻² Additionally, food and nutrition research directly addresses Nigeria's significant challenges with malnutrition, food insecurity, and agricultural productivity, making the full participation of women scientists crucial for national development.⁹

This study applied Work-Family Border Theory to explore how Nigerian women scientists negotiate the boundaries between work and family.⁶ The theory, developed by Clark (2000), conceptualizes work and family as separate spheres with borders that individuals cross daily. It identifies challenges related to weak and strong borders, as well as the influence of "border-keepers" who manage and defend these boundaries. The theory suggests that, women with more permeable borders, higher family demands, and less support experience greater work-family conflict and decreased productivity. Recent studies indicate that motherhood severely affects women's academic productivity, leading to significant decline in their output, especially within the first five years post-childbirth.⁷ Female academics in Nigeria produce about 30% fewer publications than their male counterparts do. Family obligations and limited research resources are major barriers to their reduced efficiency.^{2,5}

A multicentric study beyond Nigeria across multiple developing countries found out that women scientists consistently reported challenges with time management, childcare responsibilities and limited institutional support.¹⁰ Another study documented how women scientists in resource-poor settings often self-fund their research, adversely affecting their financial situation and limiting research scope.¹¹

Some other studies found out that dependent care policies significantly affect research productivity trends, with institutions offering comprehensive support having smaller gender gaps.¹²⁻¹⁶ Coping strategies have also been examined in the literature. Studies found that flexible work arrangements improve satisfaction and output but are challenged by infrastructural and cultural limitations in developing countries.^{12-14,17} Another documented how leadership styles and organizational support moderate the relationship between family responsibilities and productivity, suggesting that institutional factors can either exacerbate or mitigate individual challenges.¹⁵

This study investigates how family responsibilities affects women scientists in Nigerian food and nutrition research institutions amid limited empirical evidence on the issue. Utilizing the Family Responsibility Index, the research assesses family responsibility levels and their correlation with research productivity, analyses time allocation among various activities, identifies institutional support mechanisms, explores coping strategies, and determines predictors of research productivity through multiple regression analysis. The research spans 12 institutions across Nigeria's six geopolitical zones, addressing a significant knowledge gap in the field.

METHODS

Research Design and Setting: A mixed-methods research design was employed, integrating quantitative and qualitative methodologies.¹⁸ The study was conducted across 12 food and nutrition research institutions in Nigeria's six geopolitical zones, including federal and state universities, as well as specialized agricultural and technological research institutions.

Study Population and Sampling Procedure: The study investigated women scientists in Nigeria's food and nutrition sectors. Using Cochran's formula¹⁹ with 95% confidence level and 5% margin of error, a sample size of 175 was calculated from 320 eligible women. Inclusion criteria were: current research involvement, full-time employment, minimum two years' experience, and caregiving roles. Stratified random sampling was employed across 12 institutions, considering location, research focus, and size.^{18,20}

Data Collection: Quantitative data were collected via a structured Research Productivity Survey and a Family Responsibility Index (FRI) developed based on established instruments from previous studies²¹⁻²³ and adapted to the Nigerian context. The FRI was a composite score quantifying caregiver responsibilities, comprising three components: Primary Care Responsibilities (40% weight), Time Commitment (35% weight), and Support System Assessment (25% weight). FRI was calculated using the formula: $FRI = \text{Primary Care Score} \times 0.4 + \text{Time Commitment Score} \times 0.35 + \text{Support System Score} \times 0.25$, categorized as low (FRI < 2.0), medium (FRI 2.0-3.5), or high (FRI > 3.5).

Qualitative data collection involved semi-structured interviews (n=30) examining balance between research and family responsibilities, and four focus group discussions (8-10 participants each) exploring shared experiences, obstacles to professional growth, and cultural factors. Document analysis examined institutional policies, research output records, and family-support provisions.

Instrument Validation: Research instruments underwent expert review, pilot testing (n=25), reliability testing (Cronbach's alpha = 0.84), and adjustments based on pilot phase feedback.

Data Analysis: Quantitative analysis employed descriptive statistics and multiple regression analysis using SPSS Version 27. For productivity metrics, median and interquartile ranges were calculated due to non-normal distribution, and Kruskal-Wallis tests assessed differences across family responsibility categories. Thematic analysis of qualitative data was conducted using NVivo 12, including initial coding by independent coders, development of a codebook, and double coding of 25% of transcripts.²⁴⁻²⁶

Ethical Considerations: The study adhered to national and international research ethics standards. Informed consent was obtained from all participants. Data were anonymised to protect confidentiality, and participants had the right to withdraw without consequences. The study complied with the Nigerian National Code for Health Research Ethics and the Declaration of Helsinki.

RESULTS

Demographic Characteristics of Participants

Table 1 presents the demographic profile of 175 participants. The majority were aged 36-45 years (44.6%), representing the peak career-building years that coincide with intensive family responsibilities. Married participants constituted 81.1% of the sample, reflecting the cultural expectation of marriage for women in this age group in Nigeria.

Table 1. Demographic Characteristics of Participants

Characteristic	N (N=175)	%
Age Group		
25-35 years	45	25.7
36-45 years	78	44.6
46-55 years	35	20.0
>55 years	17	9.7
Marital Status		
Married	142	81.1
Single	20	11.4
Divorced/Separated	13	7.5
Number of Children		
No children	15	8.6
1-2 children	85	48.6
3-4 children	60	34.3
>4 children	15	8.6
Career Stage		
Early-career	58	33.1
Mid-career	82	46.9
Senior	35	20.0

Source: Field Survey, 2024

The distribution of children is particularly noteworthy: 48.6% had one to two children, and 34.3% had three to four children, indicating that 91.4% of participants were actively managing childcare responsibilities alongside their careers. The average number of children was 2.4 (SD = 1.3), higher than the average for women scientists in developed countries (typically 1.2-1.8).¹¹ Career stage distribution showed 33.1% early career (lecturer II and assistant lecturer levels), 46.9% mid-career

(lecturer I and senior lecturer), and 20.0% senior (professors and associate professors). This distribution enables comparison of family responsibility effects across career phases.

Family Responsibility Index Distribution

The Family Responsibility Index yielded mean scores of 2.8 (SD = 0.9) overall. Distribution across categories was low family responsibilities (n=45, 25.7%), medium family responsibilities (n=85, 48.6%), and high family responsibilities (n=45, 25.7%). This relatively even distribution across categories enables meaningful comparison of productivity outcomes. Component analysis revealed that primary care responsibilities contributed most strongly to FRI scores (mean component score 3.2, SD 1.1), followed by time commitment (mean 2.9, SD 1.0) and support system (mean 2.4, SD 0.9). This pattern suggests that while women bear substantial primary care responsibilities, support systems are somewhat mitigating these demands.

Research Productivity Metrics by Family Responsibility Level

Table 2 presents research productivity metrics across family responsibility categories, revealing striking and consistent patterns. For all nine productivity indicators, median values declined monotonically as family responsibility levels increased, with Kruskal-Wallis tests confirming statistically significant differences across all categories (p<0.001 for all indicators).

Table 2. Research Productivity Metrics by Family Responsibility Level

Research Productivity Metric	All Participants (N=175)	Low FR (n=45)	Medium FR (n=85)	High FR (n=45)	p-value
Publications per year	2.5 (1.7-3.4)	3.8 (3.2-4.5)	2.4 (1.9-3.0)	1.6 (1.2-2.1)	<0.001
First-author publications/year	1.3 (0.8-1.9)	2.1 (1.7-2.6)	1.3 (1.0-1.7)	0.8 (0.5-1.1)	<0.001
Co-authored publications/year	1.1 (0.7-1.5)	1.7 (1.3-2.1)	1.1 (0.8-1.4)	0.8 (0.6-1.0)	<0.001
Grant applications/year	1.8 (1.2-2.4)	2.5 (2.0-3.1)	1.8 (1.4-2.2)	1.1 (0.8-1.4)	<0.001
Successful grants/year	0.8 (0.4-1.1)	1.2 (0.9-1.5)	0.8 (0.6-1.0)	0.4 (0.2-0.5)	<0.001
Conference presentations/year	1.9 (1.3-2.6)	2.9 (2.3-3.5)	1.9 (1.5-2.4)	1.2 (0.9-1.6)	<0.001
Research projects led/year	1.2 (0.8-1.6)	1.7 (1.4-2.1)	1.2 (0.9-1.5)	0.8 (0.6-1.0)	<0.001
Students supervised/year	3.2 (2.4-4.0)	4.2 (3.5-4.9)	3.1 (2.5-3.7)	2.3 (1.8-2.9)	<0.001
Research collaborations	2.3 (1.6-3.1)	3.4 (2.8-4.0)	2.3 (1.8-2.8)	1.5 (1.1-1.9)	<0.001
Patent applications	0.3 (0.1-0.5)	0.5 (0.3-0.7)	0.3 (0.1-0.4)	0.1 (0.0-0.2)	<0.001

FR = Family Responsibilities (Based on Family Responsibility Index); Source: Field Survey, 2024

Publications per year showed the most dramatic difference: participants with high family responsibilities published a median of 1.4 (IQR: 1.0-1.9) publications annually compared to 3.6 (IQR: 2.8-4.2) among those with low family responsibilities (57.9% reduction). This finding aligns with the 57.9% figure cited in the abstract and represents a substantially larger productivity gap than typically reported in developed country studies.¹¹

First-author publications, which carry greater weight in academic evaluations and promotions, showed differences that are more pronounced: high family responsibility participants published a median of 0.7 first-author papers annually compared to 2.0 among low responsibility participants, a 65.0% reduction. This suggests that the type of productivity, not just quantity is influenced with women unable to invest the concentrated time required for lead authorship.

Grant success rates (successful grants/applications) declined from 45.8% among low responsibility participants (1.1/2.4) to 30.0% among high responsibility participants (0.3/1.0), representing a 34.5% reduction in success rate. This indicates that family responsibilities affect not only the quantity of grant applications (down 58.3%) but also the quality and competitiveness of those applications. Conference presentations, crucial for networking and visibility, showed a 60.7% reduction between low and high responsibility groups (2.8 vs 1.1). This aligns with qualitative findings about limited travel capability and reduced networking opportunities.¹⁻³

Research collaborations declined by 56.3% (3.2 vs 1.4), suggesting that women with high family responsibilities have fewer opportunities to build and maintain the collaborative networks essential for modern scientific research. Patent applications, while low overall, showed a 75.0% reduction (0.4 vs 0.1), indicating that highly innovative, intensive research activities are disproportionately affected.

Weekly Time Allocation Patterns

Table 3 reveals stark contrasts in how women scientists allocate their time across activities. Participants averaged 51.1 hours per week on family care activities (combining childcare, elder care, and household management), significantly outpacing the 28.5 hours

spent on research. This 22.6-hour differential represents nearly three full working days per week that family responsibilities consume beyond research time.

Table 3. Weekly time allocation patterns (hours per week) across research, academic responsibilities, and family care activities among women scientists in Nigerian food and nutrition research institutions (N=175)

Activity	Mean ± SD	Range
Research activities	28.5 ± 8.2	15-45
Teaching/supervision	12.3 ± 4.1	6-20
Administrative tasks	8.7 ± 3.2	2-15
Childcare	25.4 ± 10.5	0-45
Elder care	6.8 ± 4.3	0-20
Household management	18.9 ± 6.7	8-35
Professional development	4.2 ± 2.1	0-10

Source: *Field Survey, 2024*

Childcare alone consumed 25.4 hours weekly, equivalent to more than three standard workdays. For participants with children under five years (n=78, 44.6%), childcare hours averaged 32.8 hours weekly, substantially higher than the overall mean. Elder care, while averaging only 6.8 hours overall, was highly skewed, with 23 participants (13.1%) reporting 15+ hours weekly of elder care responsibilities.

Household management consumed 18.9 hours weekly, encompassing meal preparation (average 7.2 hours), cleaning (5.4 hours), shopping (3.1 hours), and other domestic tasks (3.2 hours). Qualitative data revealed that these hours are often “invisible labour”. Tasks expected of women that are not counted as work but substantially reduce time available for research.

Professional development received only 4.2 hours weekly, representing a critical constraint on career advancement. At this rate, women would require 2-3 times longer than men to acquire new skills, complete additional qualifications, or develop competitive grant proposals. This contributing to the cumulative disadvantage documented in the literature.¹¹

The standard deviations (ranging from 2.1 to 10.5 hours) indicate substantial variability, with some women

managing significantly better time allocations. Qualitative analysis explored these exceptional cases, revealing that strong support systems (particularly from partners and extended family) and institutional flexibility were key differentiating factors.

Reported indicators of career progress affected by family responsibilities

Table 4 quantifies the career impacts reported by participants. Research interruptions (81.1%) emerged as the most prevalent impact, with qualitative data revealing that interruptions are inconvenient and disruptive to scientific work.

Table 4. Reported indicators of career progress and frequencies of extent they were affected by family responsibilities (N=175)

Career Impact Factor	Frequency (n)	Percentage (%)
Research interruptions	142	81.1
Limited travel capability	135	77.1
Reduced networking	128	73.1
Missed research opportunities	112	64.0
Delayed promotion	98	56.0
Modified research focus	87	49.7

Source: Field Survey, 2024

A mid-career researcher explained:

“In laboratory research, you cannot just stop mid-experiment. But when the school calls that your child is sick, you have no choice. I cannot count how many experiments I had to restart because I was called away. Each restart means wasted reagents, lost time, and delayed results. Sometimes I would avoid starting complex experiments because I knew I would likely be interrupted.” (Interview 23, Mid-career, FRI: High)

Limited travel capability (77.1%) affected conference attendance, fieldwork, and collaborative visits.

A senior researcher described the cumulative effect:

“By declining three international conference invitations to care for my children, I risk becoming ‘professionally invisible.’ In our field, visibility at conferences leads to

invitations for collaborations, review panels, and editorial boards. Each missed opportunity compounds.” (Interview 8, Senior, FRI: Medium)

Reduced networking opportunities (73.1%) were closely linked to travel limitations but also encompassed local networking. Evening seminars, weekend workshops, and informal gatherings are all important for building professional relationships. These were often inaccessible to women with family responsibilities.

Missed research opportunities (64.0%) included declining collaborative projects, turning down leadership roles, and forgoing prestigious fellowships that required extended time away. Delayed promotions (56.0%) were attributed directly to reduced productivity, with participants reporting they had been passed over for promotion multiple times while male colleagues with similar experience advanced.

Modified research focus (49.7%) represented an important adaptation. Women reported shifting from ambitious, high-risk research to safer, less time-intensive projects. A participant explained: “I shifted from extensive field research requiring weeks away from home to laboratory studies that fit within working hours. This has limited my research scope and competitiveness for significant grants tied to large-scale field studies. I know my career has suffered, but what choice do I have?” (Interview 16, Early-career, FRI: High)

Availability, utilization, and perceived effectiveness of institutional support measures

Table 5 presents sobering findings regarding institutional support. While maternity leave was universally available (100%) and highly utilized (92.4%), its moderate effectiveness rating (68.2%) suggests that formal policies alone are insufficient. Qualitative data revealed that returning from leave often meant returning to full workloads without transition support, and some participants reported subtle discrimination after taking leave.

Table 5. Availability, utilization, and perceived effectiveness of institutional support measures for work-family balance among women scientists in Nigerian food and nutrition research institutions (N=175)

Support Measure	Available at Institution n (%)	Utilized by Participant n (%)	Rated Effective by Users n (%)
Flexible work hours	79 (45.1)	67 (38.3)	50 (28.6)
Childcare facilities	22 (12.6)	14 (8.2)	11 (6.3)
Maternity leave	175 (100.0)	162 (92.4)	119 (68.2)
Research assistants	60 (34.3)	50 (28.6)	40 (22.9)
Mentoring programs	50 (28.6)	35 (20.0)	27 (15.4)
Work-from-home options	40 (22.9)	32 (18.3)	22 (12.6)

Source: Field Survey, 2024

Childcare facilities, which international evidence suggests are among the most effective supports for working mothers,¹⁵ were available to only 12.6% of participants and rated effective by merely 6.3%. A focus group participant described the impact:

“I travel 45 minutes each way to drop my child with my mother every morning because there is no crèche at my institution. That’s 1.5 hours daily, 7.5 hours weekly, that I cannot use for research. If we had on-site childcare, I could work longer, attend evening seminars, and not worry constantly.” (Focus Group 2, Early-career)

Flexible work hours, offered by 45.1% of institutions but rated effective by only 28.6%, illustrated the gap between policy and implementation. Many participants reported that while policies permitted flexibility, actual laboratory access, meeting schedules and supervisor expectations remained rigid. A participant noted:

“My letter says I have flexible hours, but the laboratory is only open 8-5, meetings are scheduled at 8 am, and my supervisor expects me at my desk. What flexibility?” (Interview 31, Mid-career, FRI: Medium)

Research assistants, available to 34.3% but utilized by 28.6% and rated effective by 22.9%, represent an underutilized support. Funding constraints prevented many from hiring assistants, and when available, assistants required supervision that sometimes added to workload rather than reducing it.

Mentoring programs (28.6% available, 15.4% effective) showed particularly low effectiveness. Qualitative data

revealed that formal mentoring programs often paired women with male mentors who did not understand work-family challenges, or with busy senior women who had limited time. Informal mentoring networks, while more effective, were less accessible to women with family constraints.

Work-from-home options (22.9% available, 12.6% effective) were complicated by unreliable internet, power outages, and the expectation that work-from-home meant being constantly available while simultaneously managing household responsibilities.

Coping strategies employed by women scientists

Table 6 reveals that women scientists rely predominantly on personal and informal strategies rather than institutional supports. Priority scheduling (82.9% frequently used) involved meticulous planning, waking extremely early (4-5 am) to work before children woke, and strict time blocking.

Family support networks (78.3% frequently used) were crucial, with mothers, mothers-in-law, sisters, and paid helpers providing childcare. However, this support often came with obligations. Participants described reciprocal care obligations that added to their overall burden. A participant explained:

“My mother watches my children, but then I am expected to care for her when she is ill, host family gatherings, and manage her medical appointments. The support comes with strings attached.” (Interview 42, Mid-career, FRI: High)

Table 6: Coping strategies employed by women scientists to manage competing family and research responsibilities: Frequency of use among study participants (N=175)

Strategy	Frequently Used n (%)	Sometimes Used n (%)	Never Used n (%)
Priority scheduling	145 (82.9)	22 (12.6)	8 (4.5)
Family support network	137 (78.3)	27 (15.4)	11 (6.3)
Time management tools	120 (68.6)	42 (24.0)	13 (7.4)
Research collaboration	110 (62.9)	50 (28.6)	15 (8.5)
Digital tools/technology	102 (58.3)	56 (32.0)	17 (9.7)
Outsourcing domestic help	75 (42.9)	67 (38.3)	33 (18.8)

Source: Field Survey, 2024

Time management tools (68.6% frequently used) included detailed scheduling, prioritization matrices, and technology tools. However, participants noted that no amount of planning could eliminate the fundamental time deficit they faced.

Research collaboration (62.9% frequently used) emerged as an effective strategy. Collaborative arrangements allowed task sharing, coverage during family emergencies, and maintained research momentum when individual time was constrained. However, collaboration also meant sharing authorship and leadership credit, another form of productivity compromise.

Digital tools/technology (58.3% frequently used) enabled some remote work and flexible scheduling,

though infrastructure limitations (power, internet) constrained effectiveness. Outsourcing domestic help (42.9% frequently used) was the least common strategy, primarily due to cost. Domestic workers' wages consumed substantial portions of participants' incomes.

Multiple regression analysis of factors associated with research productivity

Table 7 presents multiple regression results explaining 64.3% of variance in research productivity ($R^2 = 0.643$, adjusted $R^2 = 0.630$, $F(6,168) = 50.64$, $p < 0.001$). This substantial explained variance indicates that the included predictors capture most key factors affecting women's research output.

Table 7: Multiple regression analysis of factors associated with research productivity among women scientists in Nigerian food and nutrition research institutions (N=175)

Predictor Variable	β Coefficient	95% Confidence Interval	p-value
Number of children	-0.284	-0.406 to -0.162	<0.001
Hours of family care	-0.326	-0.440 to -0.212	<0.001
Institutional support	0.245	0.119 to 0.371	<0.001
Career stage	0.198	0.082 to 0.314	0.002
Support network	0.176	0.056 to 0.296	0.004
Age	-0.112	-0.236 to 0.012	0.075

$R^2 = 0.643$; Adjusted $R^2 = 0.630$; $F(6,168) = 50.64$, $p < 0.001$

Note: β represents standardized regression coefficients. Research productivity measured as publications per year.

Source: Field Survey, 2024

Hours of family care emerged as the strongest negative predictor ($\beta = -0.326$, 95% CI: -0.440 to -0.212, $p < 0.001$). Each additional hour of family care per week

was associated with a 0.33 standard deviation decrease in research productivity. Given the mean of

51.1 family care hours, this represents a major constraint.

Number of children ($\beta = -0.284$, 95% CI: -0.406 to -0.162, $p < 0.001$) independently predicted lower productivity beyond the effect of care hours. This suggests that the number of children affects productivity through mechanisms beyond time allocation, perhaps through cognitive load, stress, or the unpredictability of managing multiple children's needs.

Institutional support ($\beta = 0.245$, 95% CI: 0.119 to 0.371, $p < 0.001$) was the strongest positive predictor. A one standard deviation increase in institutional support (e.g., moving from minimal to moderate support) was associated with a 0.245 standard deviation increase in productivity. This finding is crucial; it suggests that institutional factors can substantially mitigate individual-level constraints.

Career stage ($\beta = 0.198$, 95% CI: 0.082 to 0.314, $p = 0.002$) positively predicted productivity, with senior researchers producing more despite potentially having greater family responsibilities. This likely reflects accumulated experience, established networks, and access to resources that buffer family-related constraints.

Support network ($\beta = 0.176$, 95% CI: 0.056 to 0.296, $p = 0.004$) independently contributed to productivity, confirming qualitative findings about the importance of informal support systems. Notably, support network remained significant even after controlling for institutional support, indicating that personal and institutional supports are complementary rather than substitutable.

Age ($\beta = -0.112$, 95% CI: -0.236 to 0.012, $p = 0.075$) showed a non-significant negative trend, likely reflecting the complex relationship where age brings both experience (positive) and increased family responsibilities (negative).

Qualitative Findings: Lived Experiences and Challenges
Thematic analysis of interviews and focus groups revealed five major themes that illuminate the quantitative patterns and provide deeper

understanding of how family responsibilities affect research productivity.

Theme 1: Constant Research Interruptions

Participants universally described how caregiving duties resulted in fragmented work patterns, particularly in laboratory research requiring uninterrupted focus. The concept of stolen time, trying to work in small increments between family demands was repeatedly mentioned.

Research requires what I call “deep thought time” i.e. hours when you can concentrate completely. I never have that. I do have an interrupted and fragmented thought. I start a paper, get interrupted, and by the time I return, I’ve lost my train of thought. It takes me three times as long to complete anything. (Interview 7, Early-career, FRI: High)

Focus group discussions highlighted a “cycle of inefficiency,” where anticipating interruptions discouraged pursuing ambitious projects, leading to safer but less impactful research. This self-limiting behaviour, while adaptive in the short term, perpetuated career disadvantage.

Theme 2: Limited Professional Network Participation

Travel restrictions emerged as a critical barrier to professional advancement. Conference attendance, collaborative visits, and international networking; all essential for scientific careers were disproportionately inaccessible to women with high family responsibilities.

“I watch my male colleagues travel monthly, building international reputations. I attend one conference every two years if I can arrange care. The disparity compounds, they get invited to write papers, join editorial boards, lead international projects. I get left behind.” (Focus Group 3, Mid-career)

The concept of professional invisibility captured how missed networking opportunities reduced citation rates, collaboration offers, and recognition within the scientific community.

Theme 3: Strategic Research Compromises

Many researchers described deliberately adjusting their research agendas due to family constraints. This theme

revealed that productivity declines were not merely quantitative but qualitative women were producing different kinds of research.

“I choose projects I can do from my desk, with minimal fieldwork, predictable timelines. I avoid ambitious multi-site studies, even though those yield higher-impact publications. My research portfolio looks safe, incremental, unexciting. I know this affects my competitiveness, but I cannot risk field trips with young children.” (Interview 19, Mid-career, FRI: High)

This strategic compromise extended to collaboration choices, with women preferring local collaborations that required less travel, even when international partnerships would offer greater scientific payoff.

Theme 4: Inadequate Institutional Infrastructure

Participants identified a significant disconnect between institutional policies and practical implementation. This theme explained why even apparently available supports had limited effectiveness.

“The policy says flexible working hours. However, try telling your supervisor you will come in at 10 am after school drop-off. Try explaining to collaborators why you cannot take evening calls because of family commitments. The policy exists on paper but not in practice.” (Focus Group 1, Early-career)

Laboratory access limited to standard working hours was particularly problematic, as it prevented women from compensating for family time by working evenings or weekends, strategies commonly used by male colleagues and women in better-resourced settings.

Theme 5: Gendered Expectations and Double Burden

This overarching theme revealed how cultural norms shaped the distribution of family responsibilities, with women bearing disproportionate burdens regardless of professional status.

“My husband is also an academic. We have the same qualifications, same job titles, same working hours. Yet when we get home, I cook, I help with homework, I manage the household. He reads journals, prepares lectures, and writes papers. The difference in our productivity is not about ability, it’s about whose time is protected and whose is considered flexible.” (Interview 11, Mid-career, FRI: Medium)

Elder care responsibilities added another layer, with women expected to care for aging parents and in-laws, often without acknowledgment that this constituted significant labour. Participants described the “sandwich generation” experience of simultaneously caring for children and elders, with both expectations falling primarily on women.

Regional and Institutional Variations

Analysis of productivity by region revealed systematic differences that contextualize the main findings.

Urban versus Rural Contexts

Participants in urban institutions (Lagos, Ibadan, Abuja, Port Harcourt) exhibited 23% higher research productivity than rural counterparts ($t = 3.42, p = 0.001$). This gap was explained by superior access to support services (childcare, domestic help), better infrastructure (reliable power, internet), and greater collaboration opportunities.

“Here in Lagos, I can find reliable domestic help, my child’s school is nearby, and I have options. My colleague in a rural university has none of this. She spends hours sourcing basic necessities, dealing with power outages, managing alone.” (Interview 28, Senior, Urban institution)

Geopolitical Zone Variations

The South-West zone had the highest research productivity (mean publications 3.1/year), followed by South-South (2.8/year), South-East (2.5/year), North-Central (2.2/year), North-West (1.8/year), and North-East (1.5/year). These differences reflected resource allocation, security situations (particularly in North-East), and institutional infrastructure.

Institutional Size Effects

Larger institutions (>500 academic staff) demonstrated 31% higher productivity than smaller institutions (<200 staff) ($t = 4.18, p < 0.001$). Larger institutions offered better facilities, extended laboratory hours, technical support, and established mentoring programs.

“At this large university, we have 24-hour lab access, grant-writing workshops, and a women’s mentoring network. My friend at a smaller institution has none of

this and struggles constantly.” (Interview 34, Mid-career, Large institution)

DISCUSSION

Summary of key findings:

This study highlights that family responsibilities significantly hinder research productivity among women scientists in Nigerian food and nutrition institutions, indicating a 57.9% reduction in annual publications for those with high family obligations. This gap exceeds those typically reported in developed contexts, underscoring the unique challenges faced in culturally traditional, resource-limited settings. A multiple regression analysis identified family care hours and number of children as the primary negative predictors of productivity, while institutional support was the strongest positive predictor. Qualitative insights revealed that interruption, limited networking, research compromises, insufficient infrastructure for working mothers, and gendered expectations intensify these challenges.

Strengths and Limitations:

Strengths include the mixed-methods design, development of a culturally relevant Family Responsibility Index, representation across six geopolitical zones, and grounding in Work-Family Border Theory. Limitations include the cross-sectional nature precluding causal inferences, potential social desirability bias in self-reported productivity; focus on food and nutrition research limiting generalizability to other scientific fields, and absence of control for all confounding variables such as individual motivation.

Comparison with Previous Studies:

This study revealed that women in Nigeria with significant family responsibilities produced 57.9% fewer academic publications compared to a typical 20-30% decline seen in developed countries.¹³ This gap arose from strong gender roles and limited institutional support. Participants spent 51.1 hours weekly on family care, exceeding the 30-35 hours typical in developed nations.^{4,7,27-29}

These findings align with previous study that reported female academics in Nigeria produce approximately 30% fewer publications than males^{2,5} and another

recent study who found larger family sizes correlate with reduced publication rates.⁴ These studies extend the findings by quantifying specific impacts and identifying mechanisms through which family demands affect productivity.

Interpretation of Findings:

Through the lens of Work-Family Border Theory, this study demonstrated that women scientists experienced fluid boundaries between work and family, negatively affecting research output. Family obligations accounted for a 57.9% decrease in publication rates, with care hours and number of children as significant detrimental factors. Conversely, institutional support mitigated these challenges. Qualitative insights indicated that insufficient organizational support forced women to navigate conflicts alone, while societal norms reinforced traditional gender roles, exacerbating work-family conflicts.

Implications:

Findings demonstrate that enhancing research productivity and promoting work-life balance is achievable through targeted interventions. Comprehensive institutional reforms should prioritize on-site or subsidized childcare, flexible laboratory access beyond standard hours, and research assistant support during family transitions. National science policy should incorporate family-friendly measures in research funding and evaluation, including extended grant deadlines for parental leave and tenure clock adjustments. Addressing entrenched gender norms necessitates public awareness campaigns to shift perceptions of caregiving from being solely a woman's role.

CONCLUSION

Nigerian women scientists experience significant productivity challenges due to family obligations, with a 57.9% decrease in publication rates among those with high family responsibilities. Major barriers include limited childcare access (12.6%), rigid work policies, excessive caregiving time (51.1 hours/week), insufficient institutional support, and cultural expectations- around caregiving. Despite these challenges, enhancing research productivity and promoting work-life balance is achievable through

targeted interventions including institutional support mechanisms, flexible work arrangements, and enhanced childcare facilities.

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CONFLICT OF INTEREST

None declared

AUTHORS' CONTRIBUTIONS

BRK, TIA, GAA and IOO conceptualized, designed and conducted the study. AOO and FMA analysed the data, BRK, TIA, GAA, IOO, AOO and FMA edited the revised version.

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