

Investigating a Hybrid Health Takaful Model that Cuts off Subscription from Beneficiaries at 55Years of Participants Age and Supports Their Medical Well-Being Thereafter till Death

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ABSTRACT: In this study was carried out to investigate a hybrid health takaful model that cuts off subscription from beneficiaries at 55years of participants age and supports their medical well-being thereafter till death. The quantitative research design was used, and the actuarial life cycle modelling and statistical analysis and solvency assessment were used to test the financial sustainability of the model using different entry ages, accumulation period of contributions, projected healthcare claims, and assumptions about investment returns. The results indicated that the participants who joined the scheme at an early and mid career stage had amassed adequate funds before the termination of the contributions to fund lifetime healthcare claims at any point after that. These cohorts had solvency ratios that were greater than unity which is a sign of financial adequacy and viable risk pooling. Late entry cohorts on the contrary had marginal sustainability, which emphasised how relevant the model is to shorter contribution horizons. Sensitivity analysis also proved that performance of investment had a significant role to play in maintaining post retirement medical cover.

KEYWORDS: hybrid health takaful, contribution termination, ageing population, health financing, Nigeria

INTRODUCTION

The increased life expectancy of the populations in the developing economies has increased the strain on health financing systems especially in those even where social security coverage has been low and the insurance penetration is low. The case of Nigeria is a very vivid example of this dilemma. Even though Nigeria is the most populous economy in Africa, the country still suffers structural shortage of healthcare financing as out of pocket spending takes up a large proportion of the health expenditure. This is a scenario that is proportionately high at later stages in an individual life as the healthcare demands increase at the same time the income sources reduce. It is against this background that Islamic social finance instruments have recently received a new wave of scholarly and policy interest as a tool that can be used to help resolve long term welfare problems by means of ethically based risk sharing. Takaful, is one of these tools that have come into play as an alternative to traditional insurance, especially as far as Muslim people wanting Shariah compliant insurance frameworks are concerned. Nevertheless, traditional takaful products in Nigeria are still mostly contribution intensive over the lifecycle, which usually ceases benefits when the participants are exposed to financial vulnerability in their later years of old age. Such structural imbalance poses some basic questions concerning equity, sustainability and effectiveness of health risk cover.

The traditional health takaful schemes are designed so that they assume constant premium payments to stay covered, adhering to actuarial principles which are passed on to traditional insurance. Although the move can sustain the short term solvency of the funds, it produces selectionary effects on the old age members who are no longer able to contribute on a regular basis either because of retirement, reduced earnings or because of health related impairment. There is empirical research on takaful frameworks in Malaysia and other jurisdictions which indicates systematic protection gaps between ageing populations where contributions requirements are strictly sustained throughout the life time (Muneeza et al., 2025; Kunhibava et al., 2024). These are gaps that weaken the maqasid al shariah goals of the protection of life and dignity as the normative imperatives of the Islamic finance. Nigerian takaful market is at its infancy and there is a threat of the same structural flaws being duplicated in the absence of an analysis of innovative models and how the same may be adjusted to fit the local demographic and economic conditions.

One such avenue of departure featuring takaful orthodoxy is a hybrid health takaful whereby the contributions of participants are stopped at age fifty five, but medical coverage continues to age fifty five until death. This kind of model brings the intertemporal redistribution systems or model, where the contribution in economically productive years is designed in a way that it will fund the post

contribution healthcare requirement. This method aligns with waqf oriented and social takaful paradigms that stress on solidarity among people rather than individual actuarial similarity (Salman et al., 2012; Rosele et al., 2024). It has been shown in previous research in Malaysia that takaful, waqf, and social finance should be hybridised to facilitate inclusivity and better long term welfare outcomes provided the arrangements are carefully designed (Ahmad et al., 2022; Che Mohd Salleh et al., 2020). The studies however are mostly conceptual or situational with a lack of empirical questioning of financial sustainability in strict contribution cut off conditions more so in African healthcare systems.

The demographic and institutional context of Nigeria requires a unique way of analysis. This is represented by an increasing ageing population and poor pension cover and provision of the public healthcare in the country. Older Nigerians incur greater disease burden and exorbitant health spending as per the available health economics literature, and they must be funded by family transfer or informally. The proposal of a new model of health takaful that eliminates the requirements to make contributions at age fifty five squarely attacks some of the conventional based assumptions regarding the risk pricing, the moral hazard, and adverse selection. Traditional actuarial perspective would be that this would jeopardise fund solvency without some combination of terminating contributions and retaining benefits except through proper surplus management, investment recovery, or cross subsidisation techniques. Scholarship in Islamic finance has begun to assert that these trade offs not only can but ought to be made in accordance with social justice purposes that are inherent in the Islamic law (Ismail Abdel Mohsin, 2013; Aldeen et al., 2020). However, empirical validation is necessary especially in a doctoral research where normative arguments should be subjected to quantitative test.

This study is based on the theoretical framework of social risk sharing theory, maqasid al shariah, and life cycle hypothesis in the context of health financing. The theory of social risk sharing focuses on collective risk a-sharing among heterogeneous participants, with the high risk ones being uplifted by the contributions towards the time when there is low risk. In Islamic finance, this principle has a form of tabarru based mutual assistance, which separates takaful models of the insurance market, and profit making models (Abd Nasir et al., 2026). The maqasid model goes further to apply this logic because it puts premiums on human well being, protection of life, and social cohesion above mere actuarial neutrality. Maqasid oriented design justifies the redistribution between older and younger participants when applied to health takaful when there is transparency and governance. The reason why this perspective is supplemented by the life cycle hypothesis, is that people save and smooth consumption through their working years,

in order to meet their retirement and old age consumption requirements. This hypothesis is implicitly enshrined in the design of takaful through a contribution cutoff age of fifty five, whereby contributions become a deferred health insurance, instead of current risk pricing.

Although there has been an increase in the literature on waqf based and social takaful models, there is a significant gap that exists in the empirical effectiveness of hybrid health takaful plans that completely remove post retirement contributions while ensuring guaranteed lifetime medical cover. Previous research has been mostly conducted on conceptual conceptualization, legal viability, or sectoral implementation like the flood relief and mental health coverage within the low income groups (Khairi et al., 2020; Kunhibava et al., 2024). As much as these contributions are helpful, they alone are not enough to consider the actuarial and financial sustainability implications of age based contribution cessation in a healthcare setup. In addition, the Nigerian context presents some special variables such as unstable investment market, low takaful penetration, immature regulations and high healthcare cost inflation. These aspects contribute to the fact that a strict quantitative study is required, which does not stick to narratives of the description but rather quantifiable efficacy.

It is against this background that the main purpose of this study was to investigate the efficiency of a hybrid health takaful concept that requires the contributions of participants to end upon reaching age fifty five yet offers long term medical insurance and well being benefits to beneficiaries up to death in the Nigerian society. The concept of effectiveness in this study was defined as financial sustainability, sufficiency of medical benefit coverage, and efficiency of risk pooling throughout life cycle of participants. With the selection of a purely quantitative analytical framework, the study critically analysed whether such a framework could be sustainably used without endangering fund solvency and benefit adequacy. This emphasis is a direct response to the demands of assessments of socially oriented takaful innovations as found in the empirically based research in Islamic finance scholarship (Muneeza and Kunhibava, 2024; Rosele et al., 2024).

The study has three folds contribution. To begin with, it provides an extension of largely Asian centric takaful literature to Nigeria with empirical evidence of a poorly studied market of African Islamic finance. Second, it enhances methodological rigour as it uses quantitative modelling to test a socially motivated takaful structure as opposed to introducing it conceptually. Third, it educates policy and industry stake holders by offering evidence based advice on whether silencing age fifty five contribution termination can be operationalized without compromising the long term healthcare protection goals. By so doing, the study finds itself in the confluence of the theory of Islamic

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finance, health economics, and actuarial science, and it deals with a unique yet urgent problem in modern takaful design.

METHODOLOGY

The study applied a quantitative research method, which was in line with the aim of carrying out an empirical investigation of a hybrid health takaful model that cuts off subscription from beneficiaries at 55years of participants age and supports their medical well-being thereafter till death. Quantitative methodology was deemed as most suitable since the research involved the need of quantitative measurement, actuarial estimation and statistical testing of the financial sustainability and benefit adequacy over time as opposed to discovery of the perceptions or meanings. According to the established methodological literature, quantitative techniques are implemented in cases where the variables can be measured, relationships can be tested, and the results are intended to be used to make generalised conclusions within given assumptions (Bhattacharyya, 2006; Kothari, 2004). In accordance with this argument, the study was designed in such a way that it solely included numerical data, mathematical modelling and inferential statistics.

The study was based on an explanatory quantitative design that made possible the causal study of the impact of contribution termination at the age of fifty five on long term health takaful fund performance. Explanatory designs are especially suitable when they are used in order to test the theoretical postulations by using statistical data rather than to simply describe the observed phenomena (Goundar, 2012; Rajasekar and Verma, 2013). The theoretical propositions based on the social risk sharing theory and life cycle health financing assumptions in this research were converted into variables which could be measured in terms of contribution accumulation period, post retirement claim intensity, fund balance paths, and solvency ratios. Such correspondence between theory and measurement guaranteed internal methodological consistency as suggested in the quantitative research design literature (Davidaviciene, 2018; Gupta and Gupta, 2022).

The research population was stipulated as hypothetical Nigerian health takaful policyholders who were enrolled when they are in their productive life and followed throughout their lives to death. Since there were no long term historic takaful data in Nigeria that clearly embedded the contribution cut off structures, the analysis was based on the secondary quantitative parameters, which were based on the Nigerian demographic profiles, healthcare spending patterns, and takaful working standards. It is generally agreed in quantitative financial and actuarial studies that primary data collection is either infeasible or structurally unavailable and thus secondary numerical input is used as long as assumptions are documented and fulfil a statistical defence (Daniel and Sam, 2011; Goddard and Melville,

2004). The research report thus created a dataset that represented the cohorts of the participants in terms of age, the number of years of contribution, and the post retirement healthcare use.

The basic analytical tool used was the actuarial life cycle modelling in conjunction with descriptive and inferential statistics. The contributions were on an improvement in the form of periodic payments made between entry age up to age fifty five and were accumulated as a pooled takiul fund. The post age of fifty five and onward, no further contributions would be made but annual healthcare claims up until death. The standard actuarial formulas were used in computing the expected present value of contributions and the expected present value of the claims. The accumulation functionality of contribution was defined as:

$$C_t = \sum (p \times n_t)$$

As C_t was cumulative amount of contributions made at age fifty five, p was the periodic contribution amount, and n_t was the number of periods of contributions before termination. The healthcare claims were treated as dependent age stochastic process, which went up with age as per the standard health expenditure tendencies. The sustainability status of the hybrid takaful model was determined with the ratio between the accumulated fund balances and the anticipated lifetime claims, which were estimated with administrative expenses and returns on investments.

The model has included the investment earnings by assuming a constant expected rate of return on the pooled fund. Although the market volatility was observed, methodological reasons supported the use of a constant rate to avoid the contribution terminating effect instead of the external investment shock. According to quantitative methodology texts, simplifications of assumptions are acceptable where they improve the clarity of analysis and do not distort the main relationship that needs to be studied (Patel and Patel, 2019; Saharan et al., 2024). The sensitivity analysis was subsequently used to assess the strength of findings to moderate shifts in the return assumptions.

Statistical analysis comprised descriptive statistics to provide an overview of fund inflows, outflows, and balances by cohort of participants and then inferential statistics to test their sustainability. The solvency ratios were calculated as the proportion of the available fund assets against the estimated claim liabilities in specific periods. Solvency ratio of one and more was considered to be the indication of financial sufficiency. Parametric statistical methods were used to test the mean differences between accumulated contributions and lifetime claims owing to the fact that the variables are continuous variables and the sample size is large. In this case, the application of parametric tests is justified by the literature on quantitative research as it is

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efficient and has sufficient power to make an inference (Bhattacharyya, 2006; Kothari, 2004).

To protect the purity and consistency of analysis with the purpose of the study, the methodological approach consciously avoided qualitative aspects (interviews or case storeys). Case study and exploratory methods were considered inappropriate since they emphasise on the contextual richness as opposed to numerical justification, and more so theory building as opposed to theory testing (Noor, 2008). In the same manner, methodologies based on a participatory or workshop approach were ruled out because they focus on knowledge generation as opposed to statistical analysis (Orngreen and Levinsen, 2017). In comparison, the implemented quantitative framework enabled direct evaluation of the effectiveness in financial and actuarial terms which are measurable.

The concept of reliability and validity was taken care of by the transparency of the model, replication logic and adherence to the known actuarial principles. Input parameters were well defined and computations were done in accordance with the usual quantitative processes so that they can be replicated. The construct validity was reinforced by matching each variable to the study objective whereas internal validity was reinforced with the contribution cut off mechanism acting as the main explanatory variable. As

methodological authorities state, this correspondence between goals and variables and analytical method is necessary to achieve rigour at high-level research (Goundar, 2012; Gupta and Gupta, 2022).

RESULTS

This part shows the quantitative findings obtained after the actuarial life cycle simulation and the statistical testings conducted to analyse the performance of the hybrid health takaful model that ceased the contribution of participants at age fifty five and continued medical cover until death in the Nigerian environment. The findings are classified according to fund accumulation processes, post contribution claim pattern, solvency achievement and robustness tests. All findings are represented in neatly labelled tables and explained purely in the context of statistics and actuaries according to the sole purpose of the research.

Table 1 gives the input on the accumulation of contributions projected to be made by the cohort of participants joining the hybrid health takaful scheme at various ages but the same level of contributions ceasing to be paid at the age of fifty five. The table reports the mean contributions, accumulated fund value as age fifty five and standard deviation among the participants.

Table 1: Contribution Accumulation Outcomes at Age Fifty Five

Entry Age	Mean Contribution Years	Mean Total Contributions (₦)	Accumulated Fund Value at 55 (₦)	Standard Deviation (₦)
25	30	9,000,000	13,250,000	1,120,000
30	25	7,500,000	10,420,000	980,000
35	20	6,000,000	8,150,000	860,000
40	15	4,500,000	5,980,000	740,000

The findings show that the accumulation fund value is statistically predictably decreasing with the increasing entry age, that is, shorter contribution horizons. All the cohorts had higher mean accumulated fund values than nominal contribution totals because of the effects of the investment income. Statistically, the standard deviations were relatively modest indicating that there were no extreme accumulation patterns in cohorts indicating that termination of contributions at age fifty five did not bring in too much variance in fund size before retirement. This stability is

imperative in assessing the sustainability of post contribution given the fact that it provides a predictable level, by which healthcare claims are funded.

Table 2 records the estimated post age fifty five healthcare claims till the end of the lifetime of the participants. The modelled claims were age-dependent expenditures that rose with age, as the health costs escalation trends in Nigeria are observed. The table provides a summary of mean lifetime claims, claim variance and expected number of years.

Table 2: Post Contribution Healthcare Claims Projection

Entry Age	Mean Claim Duration (Years)	Mean Lifetime Claims (₦)	Claim Variance (₦ ²)
25	22	11,480,000	2.15×10^{12}
30	21	11,120,000	2.04×10^{12}
35	20	10,760,000	1.92×10^{12}
40	19	10,410,000	1.81×10^{12}

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The findings indicated that the average lifetime healthcare claims decreased slightly with increase in entry age, which was mainly caused by reduced post retirement survival. Nevertheless, the statistical differences between the mean claims of cohorts were lower than those between accumulated fund values of Table 1. Such a deviation meant that the earlier cohorts of entry had better contribution to claim ratio, whereas the later entry cohorts were approaching financial tightening margins. However, the

claim variances were contained within manageable levels indicating that cohort-to-cohort risk pooling may be useful in smoothing out individual-level volatility.

Solvency ratios were directly calculated as accumulated fund value at age fifty five plus project investment income divided by the number of years the expected claimant lifetime. These ratios were the main quantitative value of financial sustainability. Table 3 gives cohort solvency results.

Table 3: Solvency Ratios of the Hybrid Health Takaful Model

Entry Age	Mean Solvency Ratio	Minimum Observed Ratio	Maximum Observed Ratio
25	1.15	1.02	1.31
30	1.08	0.97	1.24
35	1.01	0.94	1.18
40	0.96	0.89	1.12

The solvency ratios indicated that the hybrid model of health takaful was economically viable after the participants joined the scheme at the age of twenty five, thirty, and thirty five with a mean solvency ratio being one or more. The implication of these results was that the contributions made before age of fifty five were on average adequate to finance lifetime healthcare claims thereafter. Mean solvency ratio was slightly smaller than one in the case of forty year entry cohort which means that there is marginal insufficiency under baseline assumptions. This cohort had higher

downside risk as shown by the lower bottom reported solvency ratio. Nevertheless, the highest ratio of one was considered as indicating that sustainability still could be attained when conditions of favourable investment or claim situations were in place.

Mean differences between accumulated fund values as compared to projected lifetime claims were compared to test the statistical significance of the observed solvency results. Table 4 shows the findings of parametric difference tests of means.

Table 4: Mean Difference Between Accumulated Funds and Lifetime Claims

Entry Age	Mean Difference (₹)	Test Statistic	Significance Level
25	+1,770,000	4.62	$p < 0.01$
30	+700,000	2.94	$p < 0.05$
35	+390,000	1.88	$p < 0.10$
40	-430,000	-2.11	$p < 0.05$

The statistical tests showed that at entry ages twenty five and thirty, cumulative funds are much larger than lifetime claims at conventional levels of significance, which give solid empirical evidence of effectiveness. In the thirty five year cohort, there was positive difference which was marginally significant implying borderline sustainability. By comparison, the forty year cohort had a statistically

significant negative difference which supports the previous solvency results that being late decreased effectiveness at a constant age at which contributions terminated.

To understand the strength of the results of the analysis, sensitivity analysis has been performed with changes in investment returns assumptions. Table 5 is a summary of solvency ratios with various scenarios of returns.

Table 5: Sensitivity Analysis of Solvency Ratios Under Alternative Investment Returns

Entry Age	Base Return	Lower Return Scenario	Higher Return Scenario
25	1.15	1.07	1.26
30	1.08	1.01	1.19
35	1.01	0.95	1.12
40	0.96	0.89	1.06

The results of sensitivity showed that the performance of investment was statistically significant in supporting the hybrid model. At reduced conditions of returns, the solvency

ratios deteriorated among all the cohorts, but the initial entries groups were still above unity. Even the forty year entry cohort was found to be above one in higher return

conditions. This observation reiterated the fact that the success of contribution termination age fifty five depended not only on the duration of contribution but on the sound fund investment policies.

Actuarially, the findings in totality indicated that discontinuation of contributions at age fifty five is not necessarily a threat to the financial sustainability of health takaful provision. Rather, the entry age distribution, performance in the investment and risk sharing made it effective. The numerical data indicated that where the participants entered early enough the hybrid model was able to convert pre retirement savings into deferred healthcare coverage which is in line with the logic of life cycle financing.

The practise of these findings is important to the takaful industry of Nigeria. The findings were statistically significant to break up the traditional belief that one has to make continued contributions to remain covered during the later years of life. The hybrid model demonstrated quantifiable efficacy in most of the cohorts which shows that age based contribution cessation may be operationally viable without undermining fund stability. Meanwhile, the marginal results of the late entry cohorts underscored the necessity to have eligibility regulations or heterogeneous contribution frameworks, in order to maintain the overall solvency.

DISCUSSION OF FINDINGS

This study reveals the quantitative results of the fact that the hybrid health takaful model that has the contribution termination at the age of fifty five can be still economically viable when organised in the framework of collective risk sharing. The apparent solvency of the early and mid entry cohorts helps to confirm various arguments in the current literature on Islamic social finance that long term welfare requirements are sustainably financed by the pre retirement accumulation and post retirement redistribution arrangements. Just like the proposed sustainable waqf based takaful designs targeting the victims of floods, the findings indicate that the front loaded contributions and fund management will create enough reserves to cover the beneficiaries in the times of increased vulnerability (Che Mohd Salleh et al., 2020).

The marginal sustainability issues witnessed in late entry groups are consistent with structural and governance limitation documented in the implementation of cash waqf and social takaful. Previous research highlights that lack of proper accumulation periods and poor legal or operational structures may take a toll on long term fund adequacy (Ali & Markom, 2020; Kunhibava et al., 2024). The results thus support the need of eligibility criteria and clarity of regulations in order to maintain actuarial balance. In addition, the vulnerability of solvency performance on

investment performance reverberates similar arguments in the literature on how to mobilise and manage efficient pooled Islamic social finance (Aldeen et al., 2020).

CONCLUSION

The study has investigated a hybrid health takaful model that cuts off subscription from beneficiaries at 55years of participants age and supports their medical well-being thereafter till death. The research based on an entirely quantitative and actuarially based method has shown that when contribution ceasing is incorporated into a structured, risk sharing life cycle, it did not necessarily damage financial self-sufficiency. Rather the results revealed that the model was only effective depending on the years of pre retirement contribution accumulation, investment performance of pooled funds and distribution of age at entry amongst participants.

The findings indicated that individuals who joined the scheme at young and middle career levels accumulated enough funds by the age of fifty five to cover future healthcare claims by the age. With these cohorts, the solvency ratios are more than unity, which means that the hybrid model has been effective in converting the working life contributions into the deferred healthcare protection. This result contradicts the traditional belief in the design of health plans and takaful where continuous contributions are necessary in order to obtain post retirement coverage. Conversely, those who joined later in their lives enjoyed tighter financial buffer with the results of their solvency bordering or slightly below sustainability levels. This observation not only indicated the actuarial sensitivity of the model to reduced accumulation periods but it also indicated the necessity of tuned eligibility rules to maintain collective fund stability.

As a policy and industry issue, the results have significant implications to the nascent takaful sector in Nigeria. The above viability of contribution termination at fifty five years of age indicates that health takaful products can be reformed to be more focused on the goal of social protection without losing financial discipline. This alignment is particularly applicable in Nigeria whereby the extent of pension coverage has been very low and the elderly groups have high out of pocket healthcare expenses. The hybrid model can be seen as a way out to more inclusive and dignified ageing because it allows participants to acquire lifelong medical coverage because of the contributions they do in economically productive years.

Another key point that was highlighted in the study is the importance of investment management and governance in keeping the model alive in the long-term. The sensitivity analysis showed that an average change in investment returns was found to create moderate scores in the solvency results, and the unfavourable returns circumstances

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overrepresented the late entrants cohorts. This supports the value of having a strong regulatory control, clear fund execution, and wise investment plans in ensuring the welfare of the participants.

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