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Athens Journal of Health and Medical Sciences

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The current issue is the third of the tenth volume of the *Athens Journal of Health and Medical Sciences* (AJHMS), published by the **Health & Medical Sciences Division** of ATINER.

Gregory T. Papanikos
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- **Dr. Vickie Hughes**, Director, [Health & Medical Sciences Division](#), ATINER & Assistant Professor, School of Nursing, Johns Hopkins University, USA.

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- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **27 May 2024**

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- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **8 April 2024**

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Physical Activity for the Treatment of Phantom Limb Pain

By Ingrid Brenner^{*}, Alex Jalsevac[±] & Kirsten Woodend[°]

Phantom limb pain (PLP) is a complex and multifactorial phenomenon whereby individuals with an amputation feel intermittent pain or discomfort where the limb used to be. Although there is no specific treatment for PLP, research suggests that participation in regular physical activity may reduce PLP symptoms. This study was designed to examine the relationship between PLP and regular physical activity. Nine lower-limb amputees (18 to 80 years) volunteered to participate in this study. Participants were recruited from online support groups and were invited to complete a Qualtrics survey. Questions regarding time since amputation, PLP symptoms, prior treatments and involvement in physical activity were asked. Most volunteers participated in some form of physical activity but noted they were either unsure or did not have a reduction in the duration of their PLP episodes. However, participation in regular physical activity did lead to a reduction in the intensity and frequency of PLP. Combining physical activity with other treatments did not alter the experience of PLP. These results indicate that health care providers (HCPs) should encourage patients with lower-limb amputations to participate in regular physical activity to maintain and promote physical health and as an intervention to reduce the intensity of PLP.

Keywords: *amputees, phantom limb pain, treatment, physical activity, exercise*

Introduction

Phantom limb pain (PLP) can be defined as pain or discomfort in an area of the body that is no longer there or no longer functions (for example, in paralysis) (Flor 2002). It may be perceived as a shooting/shocking type of pain, a burning sensation, a stabbing pain, a muscle cramp or even the feeling of a squeezing of a tight band around the affected area. This pain is unique in that it is perceived in the missing limb and not at the site of surgery nor proximal to the lesion. The main reasons for amputation include: vascular deficiency, infection, diabetes and trauma (Aternali and Katz 2019). Following an amputation, PLP appears during the first month and then again becomes more predominant 1 year later (Kuffler 2018). Afterwards, with time, the frequency and intensity of the pain is reduced. Approximately 50 to 80 percent of all amputees experience PLP. PLP appears to be neuropathic in origin, involving peripheral neurons (stump and neuroma hyperactivity), central neural mechanisms (spinal cord changes, cortical reorganization and cortical-motor sensory dissociation, changes in body schema),

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and psychogenic mechanisms (Flor 2002, Geneen et al. 2017, Subedi and Grossberg 2011). PLP used to be thought of as psychotropic in origin (Subedi and Grossberg 2011). Understanding the multifactorial component of PLP allows one to direct treatment procedures towards reducing phantom limb pain in amputees.

Participation in regular, moderate exercise by individuals has been demonstrated to decrease the chronic pain associated with a variety of conditions (e.g., fibromyalgia, arthritis, back and menstrual pain) (Geneen et al. 2017, Landmark et al. 2011, Law and Sluka 2017). Regular exercise may alter the centrally-mediated pain processing pathways by decreasing the excitability of central neurons and increasing the release of serotonin and endogenous opioids within the inhibitory pain pathways of the brainstem. However, very little research examining the effects of physical activity on phantom limb pain has been done. The purpose of this study is to investigate the role of exercise in the modulation of phantom limb pain by first examining the literature on physical activity and PLP and then conducting a survey on the effects of physical activity in amputees on their perceived PLP.

Literature Review

Within the clinical setting, pain management is commonly determined by the cause of pain (i.e., surgery cancer, bone fractures, neuropathic pain, osteoarthritis, rheumatoid arthritis, and herpes zoster etc.). For amputees, pain management is targeted towards the source of pain (peripheral, central and spinal), using analgesics, physical and psychological measures (Chapman 2011). A combination of analgesics and physical measures have been used to treat PLP (Batsford et al. 2017). These treatments focus mainly on reducing the intensity of pain. Medications to help alleviate the pain or discomfort with PLP include anesthetics, opioids, acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs) and/or antidepressants (Subedi and Grossberg 2011). The type of pain medication prescribed will depend upon the time since the amputation occurred (McCormick et al. 2014). Commonly, intravenous ketamine and morphine are used for short-term (perioperative) treatment of PLP, gabapentin is used to treat for an intermediate duration (6 weeks) and oral morphine is prescribed 8 weeks to 1 year post-operatively.

Acetaminophen and NSAIDs are the most commonly used medications to treat PLP over the long-term (Kuffler 2018, Subedi and Grossberg 2011). Although, its exact mechanism of action is still not completely understood, acetaminophen works in the central nervous system involving serotonergic pathways to block pain perception. NSAIDs reduce nociception peripherally and centrally by inhibiting the enzymes that are required for prostaglandin synthesis. Opioids have been known to help diminish cortical reorganization, disrupting one of the proposed mechanisms of PLP. Gabapentin has analgesic properties which reduce the amount of pain felt (Abbass 2012). Tricyclic antidepressants have shown promise in helping to reduce symptoms of PLP by inhibiting neuropathic pains (Kuffler 2018). Other medications such as pre-emptive analgesia and

anesthesia, anticonvulsants, and NMDA receptor antagonists need further research to understand their effects on PLP.

Non-pharmacological treatments are used in tandem with medications or on their own. These approaches are used more frequently due to the lower risks associated with them, as some pharmacological treatments may increase PLP symptoms and can lead to potential addiction (Hyung and Wiseman-Hakes 2022). These treatments include mirror therapy (the use of a mirror to mimic the idea that one's limb is intact and seeing painless movement), transcutaneous electrical nerve stimulation (TENS), acupuncture, massage, surgical intervention (removing scar tissue; muscle reinnervation), biofeedback (using a device to measure physiological changes in the body), hypnosis, graded motor imagery (limb recognition, imagined movement followed by mirrored movement), physiotherapy and phantom exercises (Aternali and Katz 2019, Batsford et al. 2017). Surgical intervention is highly invasive and problematic for postoperative complications, so it is often avoided (Hyung and Wiseman-Hakes 2022). Thus, it is vital to find a treatment option that works consistently for individuals to manage their symptoms of PLP.

Participation in regular physical activity may reduce the intensity, frequency, or duration of chronic pain (Geneen et al. 2017). Although there has been a substantial amount of research performed to examine the effects of physical activity or exercise on aerobic capacity in amputees, this research does not appear to include the effects it may have on PLP. The research that has been done to date focuses predominantly on phantom exercises whereby the participants of a study are asked to move their amputated limbs through their range of motion every time they begin to feel a sensation of pain (Ülger et al. 2009) instead of participating in regular physical activity as a treatment option (Brunelli et al. 2015). A summary of the studies investigating phantom exercise as a treatment for phantom limb pain is provided in Table 1.

Ülger et al. (2009) were one of the first to examine the effects of a generalized exercise program (involving dynamic exercise, isometric exercise, muscle stretching and muscle strengthening) combined with prosthetic training on PLP. Each of the general exercises were performed ten times in one session and repeated twice daily. They compared this exercise program with that of a program of phantom exercises that also included prosthetic training. The phantom exercises were repeated up to fifteen times whenever phantom limb pain was experienced. After four weeks of daily exercise, the intensity of PLP decreased in both groups. The results of the study indicated that exercise can be used to treat PLP.

Zaheer et al. (2021) recently used a similar idea with phantom exercises, however they chose to include other treatments such as physiotherapy and mirror therapy along with the exercises. They compared the effects of mirror therapy and conventional physical therapy (involving conventional therapeutic exercises) with a group of participants who also performed a combination of treatment approaches including phantom exercises, mirror therapy and physical therapy (i.e., the experimental group). Results of their study indicated a significant reduction in the intensity of pain in the experimental group, as well as the participants having an easier time managing their PLP.

Both studies mentioned above suggest the important role which phantom exercises can have in pain management for patients with PLP. However, it is important to note that when phantom limb exercises are compared to mirror therapy both through experimentation (Külünkoglu et al. 2019) and as well as through a review of the literature (Wang et al. 2023), mirror therapy appears to have greater efficacy. Thus, more research is needed to determine effective pain management techniques for amputees with PLP.

Table 1. Studies Examining the Effects of Phantom Exercises on PLP

Reference	Design	Participant	Pain Tool	Intervention	Duration	Results
Külünkoglu et al. (2019)	RCT	23M /17F 18 to 45 years	VAS BDI	Mirror therapy vs phantom exercise	4 weeks	Decrease in PLP and increase in QoL with both treatments, greater with mirror therapy
Ülger et al. (2009)	RCT	16M / 4F 30 to 45 years	VAS	Phantom exercise vs general exercise training	4 weeks	Decrease in PLP intensity
Zaheer et al. (2021)	RCT	17M / 4F 40 to 45 years	VAS	Mirror therapy and physiotherapy vs mirror therapy, physiotherapy and phantom exercise	4 weeks	Decrease in PLP intensity

Legend: BDI = Beck Depression Inventory; F = females; M = males; RCT = randomized control trial; VAS = visual analogue scale

This study is one of the first to look at physical activity, in general, as a potential treatment to reduce PLP. It is hypothesized that regular physical activity will decrease PLP.

Methodology

Participants eligible to volunteer for this study were between the ages of 18 to 80 years old, had a lower limb amputation and experienced phantom limb pain. Although our goal was to recruit at least 20 participants; a total of 9 amputees volunteered to participate in this study. The study was approved by Trent University’s research ethics committee (protocol number 27917).

Due to COVID-19 restrictions, this study was conducted online during April 2022 (April 4th to 17th, 2022), using a virtual survey link. The survey was comprised of 25 open-ended questions and took on average 10 to 15 minutes to complete.

The survey was shared on the social media platform “Facebook” and with permission from the administrator of four amputee support groups (Central East Ontario Amputee Support Group, Northwestern Ontario Amputee Support Group, Amputee Coalition of Canada, and Amputee Coalition of Toronto). A link to the survey was directly posted on these pages and the survey was completed anonymously. Each participant provided informed consent before beginning the survey after reading through the consent form. The survey was created using Qualtrics software.

The questions which were asked of the participants are outlined in Table 2. To be eligible for the study, participants had to experience PLP. The participants were first asked general questions regarding their amputation and use of a prosthesis. If participants used a prosthesis, they were asked about the type they used. They were also asked when they first began to feel pain after being amputated, how long each episode of PLP lasted and the extent of their pain. To gain a better understanding of how PLP was treated, questions regarding the types of treatments the amputees were prescribed were asked. This included use of medications, therapies to help visualize the missing limb (mirror therapy or virtual reality), physiotherapy, phantom exercise, and anything else they may have tried. If participants combined a variety of treatments, this was acknowledged, and they were asked if a combination of treatments was more helpful than a single treatment alone. The types of medications that were used to control pain was also assessed by the survey.

Table 2. Phantom Limb Pain Questionnaire

General Questions	Activity-Related Questions
1. Do you experience PLP?	13. Do you participate in PA?
2. When did your amputation occur?	14. Was PA selected by choice or prescribed?
3. Amputation type?	15. Does PA help the frequency of PLP?
4. Do you have a prosthesis?	16. Does PA help the duration of PLP?
5. Prosthesis type?	17. Does PA help the intensity of PLP?
6. How long post-amputation did feelings of PLP begin?	18. Describe your level of PA
7. How long does your PLP pain last?	19. What types of PA do you participate in?
8. How severe is the pain?	20. How often do you work-out?
9. Treatments used for PLP?	21. How long do you work-out for?
10. Do you take meds for PLP?	22. Do some PA work better than others?
11. Medication type?	23. Do you combine PA with other treatments?
12. Did alternative treatments help treat PLP?	24. Does the treatment combination help PLP?
	25. What treatment combinations help PLP?

The participants’ physical activity patterns were also assessed with the survey. This included examining whether the amputees were physically active or not and if the decision to become physically active, post-surgery, was by choice or suggested by a healthcare professional (physician or nurse). We investigated whether participation in regular physical activity reduced the frequency, duration, or intensity of phantom limb pain. Questions were also asked about how often participants were physically active and the type of physical activity they participated in. Participants were asked if they combined physical activity treatments with other treatments or medications. The survey data was also used to examine any trends between participants’ experiences, their past treatments, and

current experiences with physical activity. The collected data was analyzed using Microsoft Excel and descriptive statistics and confidence intervals were calculated.

Results

Most participants became amputees within the last 5 years. Seven participants had below the knee amputations (with two reporting a trans-tibial amputation) and two participants had an above the knee amputation. One participant was a bilateral amputee. Participants in this study all experienced PLP symptoms, with symptom severity ranging between moderate to severe. The amputees experienced the start of their PLP either immediately after surgery or a few days afterwards (Table 3). Participants reported that each episode of PLP lasted a few minutes to never subsiding (i.e., lasting 24 hours/7 days a week). All participants reported use of a prosthesis for daily activities. The types of prosthesis that the participants used ranged from suspension sleeves to pin locks. For some individuals, use of a prosthesis contributed to some of the pain that was experienced while performing physical activity.

A variety of treatment approaches were taken by the participants to control their PLP. Five of the nine participants (56 percent of participants) used massage to soothe their phantom limb pain; one individual relied on meditation and prayer; another participant used self-hypnosis to minimize their pain and two individuals relied on mirror therapy. Regarding the effects of massage, participants could feel parts of the body that were not there when they massaged their stump. One individual reported the following: "I can rub underside of the stump and feel my heel, same with sides of the foot, a certain spot and feel each toe...fascinating". A slightly higher proportion of participants utilized pain medication for pain control. Sixty-six percent of the participants (6 out of nine participants) were currently using medications to treat their PLP symptoms. Tylenol and ibuprofen were most used to treat PLP, however, medications such as gabapentin, Lyrica and cannabinoids were also taken by the participants to control their pain. Two individuals took pain medications, and one individual massaged their limb prior to participation in physical activity to prophylactically reduce any pain they might experience during activity.

Table 3. *PLP Characteristics of the Participants*

Variable	Number (n)	Percentage (%)
Start of PLP following amputation		
• Immediately	3	33
• After a few days	3	33
• After 1 week	2	22
• After 1 month	1	11
Length of each PLP bout (duration)		
• Few min	4	44
• Few hours	3	33
• 24/7	2	22
Pain Severity of PLP (intensity)		
• Moderate	4	44
• Severe	4	44
• Very severe	1	22
Take medications to relieve PLP?		
• Yes	6	66
• No	3	33
Participate in physical activity to relieve PLP?		
• Yes	7	78
• No	2	22

Of the nine participants, seventy-eight percent participated in mild to moderate physical activity regularly to relieve their PLP. Most of these individuals did so by their own volition, whereas two of the participants were also encouraged to do so by their health care practitioner. Table 4 summarizes the activity patterns of the participants. Each exercise session lasted in duration between 10 to 60 minutes. Of those that were active, the most common activity was walking. Swimming was the second most common activity for those individuals that did not have an open wound. The participants noted that no specific exercise worked better at reducing PLP than the others. The other eighteen percent of participants did not partake in physical activity and were likely sedentary despite answering “not applicable” and “mild” as the level of physical activity intensity question on the survey. We also determined whether participation in physical activity helped with PLP.

Table 4. Activity Patterns of Participants with PLP

ID	Type of Preferred Activity	Intensity	Frequency	Duration
1	Walking, line dancing	Moderate	>3 times/week	30 – 60 min
2	Walking	NA	Never	NA
3	Wheel-chairing	moderate	>3 times/week	20 – 60 min
4	Stretching, walking, yoga, swimming.	moderate	“not enough”	NA
5	Walking	Mild	< 30 min/week	Up to 30 min
6	Yoga, swimming	moderate	< 30 min/week	45 min
7	Walking	Mild	NA	NA
8	Swimming, walking, hiking	Moderate	>3 times/week	2 – 6 hours
9	Walking	Mild	>3 times/week	10 min per day

Table 5 represents the responses of the participants on the extent that participation in physical activity helped with either the intensity, frequency and/or duration of PLP.

Table 5. Effects of Physical Activity on Reducing PLP of the 7 Active Participants

Phantom Limb Pain	Yes		No		Not sure		95% CI
	N	%	N	%	N	%	For “yes”
Intensity	4	57	2	29	1	14	[29 to 100]
Frequency	3	43	3	43	1	14	[10 to 90]
Duration	1	14	4	57	2	29	NA

Legend: CI = Confidence interval; NA = not applicable

Participation in regular physical activity had the greatest effect on the intensity of PLP, with fifty-seven percent of the participants reporting a reduction in the intensity of pain they experienced during a PLP episode, this was in the ninety-fifth percent confidence interval [29-100 percent] for this response. Similarly, the frequency of PLP episodes was altered by participation in regular physical activity as the proportion of “yes” responses also lay within the 95 percent CI [10 to 90 percent]. In contrast, fifty-seven percent of participants indicated that the duration of PLP symptoms was not altered by participating in physical activity.

Discussion

The results of this study demonstrated that pain management (specifically for PLP) by amputees was directed towards physical measures such as physical activity, massage as well as medication use. There were a few participants who also used psychological measures to help with their pain which included mirror therapy, prayer, and self-hypnosis. More participants selected physical activity over medication use for PLP relief. The most prominent finding of this study was

that participation in regular physical activity reduced the severity (intensity) and frequency of PLP and as such these results support our hypothesis.

Seventy-eight percent of participants regularly performed physical activity and sixty-six percent of participants relied on use of medication to relieve PLP. Lansbury (2000) examined pain management in 72 elderly individuals who were over 65 years of age and were experiencing chronic pain. Preferred pain-treatment methods were those methods that could be self-administered. Conventional treatment methods such as medication, exercise (which is more standardized than physical activity) and physiotherapy were least preferred. This may explain why medication used in this study was less preferred over participation in physical activity for pain management.

Several mechanisms have been proposed to explain why participation in physical activity might reduce pain severity and frequency in individuals experiencing pain. This includes modulation of physiological responses within the central nervous system (i.e., decreasing the excitability of central neurons and changing neuroimmune signaling) as well as stimulation of the release of endogenous opioids and serotonin within the brain pain inhibitory pathways (Law and Sluka 2017). Studies which have been designed to specifically examine the effects of phantom exercises on PLP have suggested that pain, muscle cramps and fatigue occur when a limb is held in one position for a long time. Phantom exercises are designed to move the patient's limb through their range of motion. The intensity of PLP is reduced when the limb is moved through phantom exercises (Külünkoglu et al. 2019, Ülger et al. 2009, Zaheer et al. 2021). This movement reduces tension and induces relaxation of the muscles above the amputated limb which in-turn reduces PLP. Although, our study participants did not report participating in phantom exercises, perhaps due to a limited awareness of this method, participation in regular moderate exercise might have the same effect.

Alternative physical methods used by the participants to control PLP, such as massage and mirror therapy, may work through different mechanisms. Massage therapy of a 30 minute duration has been shown to reduce pain in a variety of patient populations (medical, surgical and obstetric patients) (Adams et al. 2010). Massage therapy may be effective in relieving the burning sensation associated with PLP, since it is thought to stimulate large nerve fibers and reduce the transmission of noxious stimuli. Mirror therapy may have a role in cortical re-organization as pain relief with this method may be due to activation of contralateral neurons in the alternate brain hemisphere (Ülger et al. 2009).

For individuals that reported that they participated in physical activity, on average they participate in at least 30 minutes of exercise at least 3 times per week. The most common types of exercises were walking or stretching but other types of physical activity were swimming, yoga, resistance training and dance. The participants noted that no specific exercise works better at reducing physical activity than the others. Fifty percent of the participants combined various treatments with physical activity.

Of the individuals who combined treatments, they reported combining pain medication (acetaminophen) with their participation in physical activity and yet

they experienced no additional difference in frequency, intensity or duration of PLP when this was done. Further research could be done to determine when pain medication should be taken (prior to, during or following physical activity) or what type of pain medication might be most effective to attenuate PLP that occurs during activity. In Canada (where this study takes place), cannabis use is legalized and some individuals in this study responded to the survey that they used cannabis for the treatment of their PLP and, as a result, have seen reductions in their symptoms. If possible, researchers might examine how cannabis affects an individual with PLP and if using this substance in combination with physical activity may further reduce or even eliminate episodes of PLP.

Furthermore, a few of the participants noted that they found that their PLP symptoms were increased when exercising with a prosthesis on. There is minimal research on how individuals who have a prosthesis are impacted in their ability to be physically active, whether it be due to the type of prosthesis, or the forces being applied to the amputated limb through the prosthesis or another reason. There does not appear to be any peer reviewed articles that address this issue. To further understand whether participation in physical activity is modulated by a prosthesis, an in-depth study is needed, and this may also help address the issue of why some individuals with amputations struggle to be active or choose to remain more sedentary. The data collected through this study demonstrates that there is a significant amount of variability between the amount of physical activity performed by the participants.

Although regular, moderate-intensity aerobic physical activity of at least a 30 minutes duration, has been recommended for over 2 decades (Esposito and Fitzpatrick 2011) for health promotion, health care professions are still remiss on prescribing it. Only two participants (22 percent) of our study had physical activity prescribed by their health care practitioners as treatment for improved health and possible pain reduction. This value is lower than what is normally reported in the literature. In previous research it has been shown that between 34 to 48 percent of physicians (Damush et al. 1999, Wee et al. 1999) and 48 percent of nurse practitioners (Tompkins et al. 2009) prescribe physical activity as treatment. The lack of exercise prescription for the population of our study is most likely because they were amputees and there is limited information available on role of exercise for these individuals. Possible ways to adapt the idea that physical activity benefits those with PLP may include looking in depth at the effects of specific types of exercise, such as resistance training, anaerobic exercise, high intensity interval training and/or aerobic exercise on PLP. To the best of our knowledge, there are no studies specifically looking at individual exercise plans for amputees with PLP. Moreover, most health care practitioners tend to target sub-groups of patients that are known to benefit from regular physical activity (i.e., younger patients, sedentary individuals, and obese patients). Another factor to consider are that physicians and nurses who prescribe exercise for their patients are more likely to do so if they are active themselves (Abramson et al. 2000, Esposito and Fitzpatrick 2011).

Limitations

The small sample size of this study was a significant limitation to our outcome. Only nine individuals volunteered to participate when the intended goal was twenty participants. Should the study have been conducted over a longer time frame, and possibly including more amputee support groups from across Canada or around the world, there would have likely been a higher number of participants and the results would have been a more accurate representation of the population studied. There are also many limitations with a survey-based research study. This type of research may yield inaccurate results due to the individuals not answering the questions honestly or not understanding the questions and there was no way for the participants to be monitored. We could not ensure that someone else was answering the questions on the survey while the surveys were being completed. Finally, to avoid personal identification in such a small group, we did not include the sex or specific age of the participants. This additional information may have provided insight into which individuals are more likely to participate in physical activity as a treatment for their PLP.

Conclusions

This study was intended to be a pilot study, suggesting that physical activity in general and not just exercises of the phantom limb (phantom exercise) has the potential to improve the effects of PLP in individuals, specifically people with amputated limbs. This is one of the first studies to examine the effects of amputees' participation in regular physical activity on PLP. The results of our study demonstrate that regular moderate-intensity physical activity can be used safely to decrease the intensity and frequency of lower-leg PLP in amputees. This is encouraging for amputees as it has been demonstrated that the presence of PLP leads to a reduction in the quality of life (QoL). A reduction in QoL is a major factor limiting amputees from participating in rehabilitation programs and their future prognosis (Padovani et al. 2015). Thus, it may be assumed that a reduction in the intensity and frequency of PLP episodes could lead to an improvement in the quality of life of these individuals and subsequently enhance their prognosis.

Nurses are in a unique position to recommend physical activity to their patients (Speck 2002) since they are the one health care professional that spends the most time with their clients. Health care professionals should encourage their patients with amputations to exercise, recommending daily walks and stretching. Future research should be done to examine the effects of regular exercise programming "in person" on PLP in amputees.

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A Case Study of a Pilot Smart Home Monitoring System with Older Adults Living Alone in East Midlands

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The aim of this project was to examine older adults and their next-of-kins' experiences of using smart home technology. The technology unobtrusively monitors the older adult's physical functional ability to undertake their daily activities at home. Using a case study approach, the participants comprised three family units: three older adults with a history of long-term co-morbidities and who lived alone, along with their next-of-kin (n=4). The older adults were all female aged between 72- 82 years of age, while the four next-of-kin were all females aged between 40 and 55 years of age. Participants experiences of using the smart home technology was evaluated at three- and eight-months post-installation via in-depth one-to-one interviews with the older adults and their next-of-kin. The older adults described how the smart home sensors reduced their levels of anxiety because they were 'not feeling alone'. Likewise, their next-of-kin described how the sensors gave them an insight to their older relatives' activities of daily living, as well as the challenges they experienced. The findings highlighted the benefit of smart home technologies in terms of helping older adults and their next-of-kin monitor their daily activities, reduce social isolation, and adopt positive health and behavioural changes.

Keywords: *older adults, home-sensors, functional ability, activities of daily living, intergenerational relationships*

Introduction

Lifestyle or behavioural monitoring forms a subset within the wider and more general model of e-health and telecare (Brownswell et al. 2011, Peiris et al. 2018), reflecting an approach that is increasingly being considered by health and social care providers as having an enormous potential to maintain older adults in their own homes (Brownswell and Bradley 2003, COM 2009). For the older adults, living as independently as possible in their own home is an important aspect of

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maintaining their dignity and independence (Facchinetti et al. 2023). Furthermore, feelings of empowerment and functional capacity can generate a sense of self-worth, reducing social isolation and allowing them to feel connected to their family and to wider society. Whilst treatments and research into ageing will continue to support longevity, it has been suggested that by combining these innovations with diverse breakthroughs in artificial intelligence, digital technology can contribute to the quality of life of older adults as well as freeing up health and social care professionals and other resources that can potentially save the health and care sector £5 billion over the next decade (Napton 2016). Furthermore, the NHS Long Term Plan (NHS England 2019) sets out several ambitions for improvements over the next decade, including underpinning the importance of technology, and establishing the critical priorities that will support digital transformation and provide a step forward in the way the NHS cares for citizens (NHS England 2020a). The 2012-2020 eHealth Action Plan (EPHA 2017) outlines the vision for eHealth across Europe, recognising the added benefits of digital health in managing chronic diseases and co-morbidities. These predictions become even more important when taking the global demographic shift to an ageing population into account (Reeder et al. 2014).

The ratio of an ageing population has risen significantly in recent years, and as it is expected to continue to rise (Economics Online 2019), this comes with its own challenges. The progressive decline in physical and cognitive skills, the development of chronic diseases and co-morbidities, and the increasing incidence of Alzheimer's disease may interfere with the older adults' abilities and capacities to perform the basic activities of their daily living. Equally, multi-morbidity in the older adult increases the likelihood of hospital admission, the length of stay, and readmission rates, reduces the quality of life, and increases dependency and mortality (Mousa et al. 2018). Forecasts suggest that, between 2015 and 2035, multi-morbidity prevalence in older adults will increase, the proportion that have 4+ diseases almost doubling. Older adults living with combinations of frailty and multi-morbidities in the community have some of the highest levels of health and care needs in the population (Glynn et al. 2011, Gould et al. 2016, Peters et al. 2019). Related to this, the lack of direct continuous observation may mean that impending illness associated with inadequate social care support – such as anxiety (Gould et al. 2016) – will not be recognised until a relatively late stage. Adding to this issue is the sometimes relatively slow physiological response of a frail older person to illness; even a manifest temperature rise in response to an infection may be delayed in this group of individuals, who instead might respond through non-specific changes in function such as reduced activity levels, confusion, or reduced mobility (Leitjen et al. 2018). According to Payne et al. (2013), multi-morbidity is likely to result in unplanned frequent admissions to hospitals, plus the subsequent increase in the use of health care services. In their study, the researchers found that physical multi-morbidity was strongly associated with unplanned admission to hospital, including admissions that were potentially preventable. Thus, a key challenge for health and social care providers is to find new ways of enhancing the care of older adults in the community with improved outcomes. This has necessitated the integration of technology in the care of older adults to allow them

to live at home longer, independently, while delaying transition to acute or secondary care.

Methods

A service development was designed by a group of General Practitioner (GP) practices in the East Midlands, UK to introduce Howz sensors as mechanisms to identify and address the care needs of older adults living alone with long-term multi-morbidities. The Howz sensor is used successfully amongst healthy older adults in the UK (Rogerson et al. 2019), but not amongst older adults with multi-morbidity who live alone. The Howz kit – developed by Intelesant – is also available on the NHS app library (NHS England 2020b). Upon receiving consent, the home sensors are placed in participants' homes on everyday appliances such as electric kettles, toasters, bread makers, and doors they use daily. The app is then downloaded to the older adults' next of kin's (NoK) smartphone, and through this app the next of kin is able to receive information transmitted from the sensors about their relatives' routine physical activities (see Figure 1). After the installation of the smart home sensors, the activity recognition is performed, in which the detected activities are labelled. The daily routine of the participant is then analysed over the next seven days. Once their daily routine at home has been established, the sensors continue tracking their daily physical activities on an ongoing basis. During this period, if the baseline routine changes – such as the individual not switching on their kettle at the expected time or opening the bedroom door at unusual times during the night – the sensors transmit alerts to the app on their NoK mobile phone. When a change is detected, the NoK could then make an informal check of their ageing relative via phone, and intervene if necessary. In this study, the information was also relayed to the older adults' GP on a weekly basis with a summary of the participants physical activities (see Figure 2, an example of information sent to GP).

Figure 1. *Smart-Home Sensors and App*

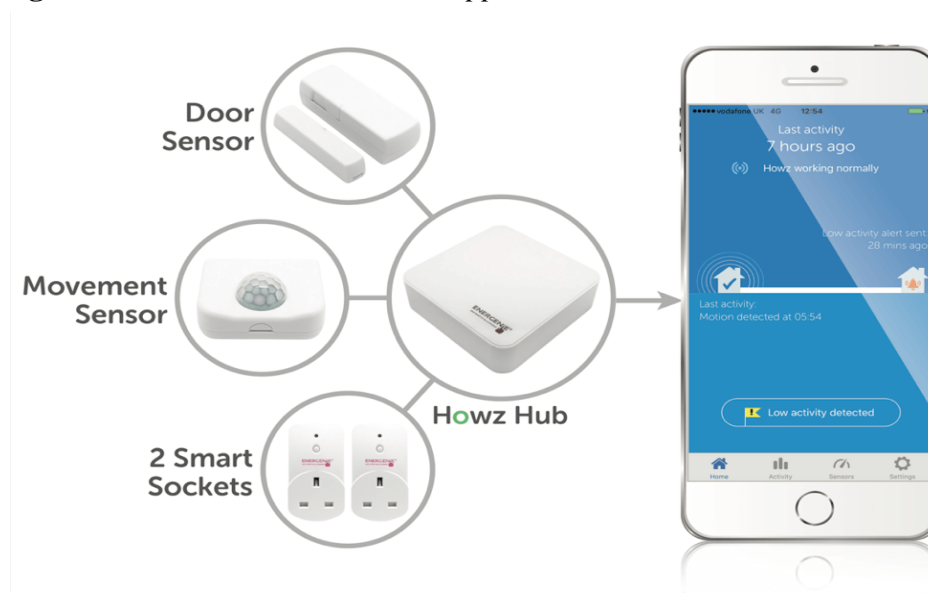
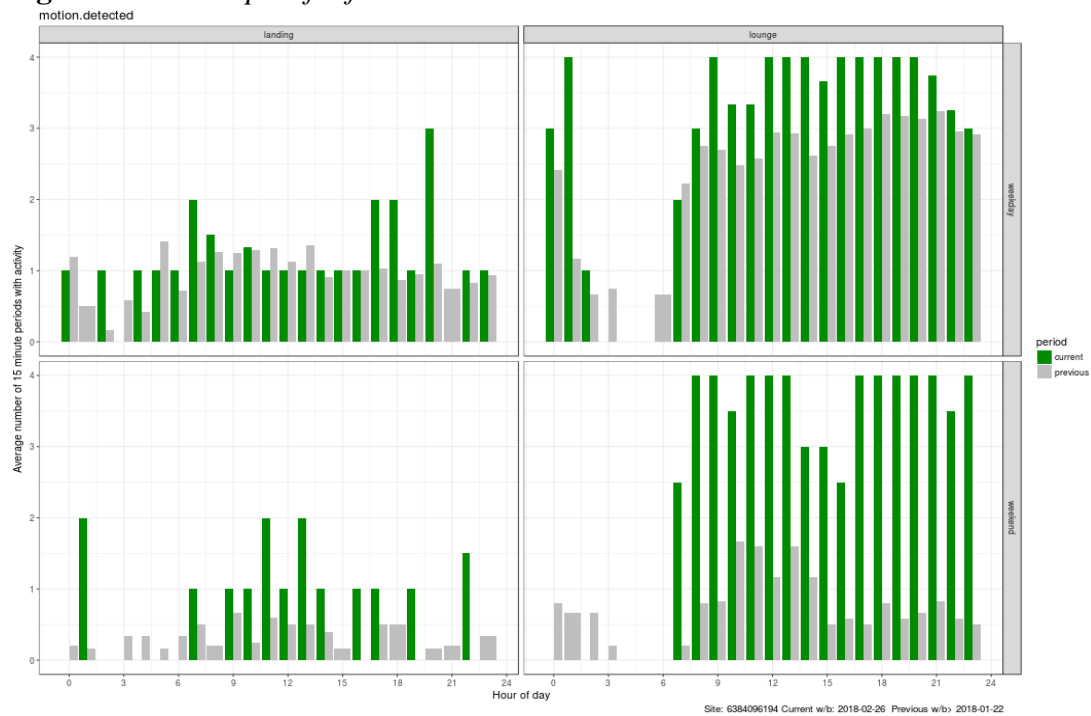


Figure 2. An Example of Information Sent to GP

Permission to conduct the service development evaluation was obtained from the Head of the NHS Services, according to guidance (Holmes et al. 2013, UK-PFHSCC 2017). All participants and NoK had previously consented to having the Howz sensors installed as part of the practice service development. The principles of purposive sampling were applied to identify a convenience sample of three family units, which comprised an older adult with multi-morbidities who lived alone and who was in contact with a carer/next of kin. Participants and their NoK were given participant information sheets detailing the service development evaluation, and were asked to give their consent before any data collection could commence.

Data collection included the baseline information to determine the older adults' perception of their wellbeing before the installation of the home sensors, as well as their demographic information. Following the installation of the smart home sensors, data from the older adults and their NoK was collected after one, three and eight months (December 2017- August 2018) post installation via one-to-one in-depth interviews that lasted from 60 to 90 minutes in the participants' homes. Two of the NoK were interviewed via the phone because they lived approximately 80 and 300 miles away from their older relatives. The aim of the evaluation was to assess the older adults' and NoK's acceptability and satisfaction of the software, as well as the benefits they saw to having the sensors. The interviews were recorded and transcribed accordingly. The case study approach allowed the researchers to focus on a single phenomenon within its real-life context (Yin 1999), make informed judgements about cause and effect in a particular case (Thomas and Myers 2015), and for participants to provide an insight into the complexity of their unique experiences as a family unit (Carolan et al. 2015).

Using an exploratory case study approach (Yin 2018) also allowed for a detailed in-depth evaluation of the participants and their NoK's experiences of having the home sensors. In this study, the narratives provided by participants offered extremely rich information in a complex setting. Table 1 summarises a profile of the three case studies.

Table 1. *Demographic Details of the Three Case Studies*

Demographic	Case study One	Case study Two	Case study Three
Gender of older adult	Female (<i>SM1</i>)	Female (<i>SM2</i>)	Female (<i>SM3</i>)
Age of older adult	77 years of age	72 years of age	82 years of age
Immediate family ties	Two daughters, one son, their partners and children	Two daughters, their partners and children	Three daughter, one son, their partners and children
Main carer	Daughter (<i>NoK-S</i>)	Daughter (<i>NoK-R</i>)	Daughter (<i>NoK-V</i>) Daughter in law (<i>NoK-W</i>)

Thematic analysis was applied to identify themes within the data, though several general themes had already been identified through ongoing reflection during the one-to-one in-depth interviews, which was used for the initial coding. The critical aspect of the analysis was to ensure that the voices of the older adults and carers were heard – therefore, before organising the findings into categories, the process included reading and rereading the texts to identify consistencies and differences. This was followed by a systematic process to identify components that were central to the aims of the evaluation. In analysing the findings from the three cases, we also applied a cross-case analysis approach (Yin 2018) to identify commonalities and differences across the three case studies, the results that emerged were broadly similar and, therefore, their findings are presented as a part of the whole. The interim results were also discussed with all the participants, both to ensure that the final categories were informed by the participants and to minimise the influence of the researchers' interpretations.

Results

Baseline Interviews: Before Installation of Home Sensors by Participants

Experience of Social Isolation, Loneliness, and Resilience

All three older adults reported being lonely, with varying degrees of social isolation. A number of issues came together that made social isolation and loneliness a challenge in older age, including bereavement of their partners which, at times, led to anxiety:

I do feel lonely sometimes, television is a big help but I do like to be in company... I like a good film, I watch most of the soaps... it helps 'cos the days are so long... I suppose most people are a bit nervous when they are on their own. I am when I go to bed at night (*SM1*).

I am a bit scared to go out to tell you the truth, because of falling down twice within a couple of minutes last time I went out (SM2).

It all depends, because my health, one day it could be fine and the next day not, therefore I don't really go out and my daughter she lives far (SM3).

It must be noted that, although all three older adults reported having contact with their adult children, according to them this contact was less than it used to be. Most of their children were reported to be living farther away with their own families; some of their NoK even lived nearly 300 miles away from the older adult relative, which also made the participants less likely to tell their NoKs about any emergencies or accidents.

I just say when I get off the phone, when do you want me to ring you again? I leave it in her court, because I don't want to be ringing her all the time (SM2).

All three older adults reported not immediately telling their NoK if they felt unwell, had a fall, or had chores they could no longer do because of their underlying medical condition, because they didn't want to be a burden or stand in the way of their family's lives.

I didn't let them [NoK] know till afterwards. I don't worry them unless I have to. No, I don't even tell them straight away that I'm poorly in bed. I let them know eventually and then my daughters will say we'll come over and I say there's no need, I'm fine (SM3).

In addition, all three reported being reluctant to visit their GPs unless they felt it was an emergency:

I won't go straight away [to the doctor], I always think you are being a nuisance when you go to the doctors... I always think when you are getting older they can't be bothered with you (SM1).

I mean, I need to see him [doctor] now but I just feel that I shouldn't be bothering him... I don't think they listen to you when you get older, they think you just come because you want to go out (SM2).

I went to see Dr... because he wanted to assess me. He gave me all these papers about being resuscitated if anything happens... I said I don't want to be resuscitated, what's the point, I'm in my 80s... (SM3).

Examining Home Sensors to Monitor Physical Activities of Older Adults Living Alone: Data Collected at Three and Eight Months

Thematic analysis revealed four themes from the three family units, suggesting that the placement of the sensors had a positive effect on the participants' lives.

Home Sensors and Association with Active Social Engagement

In all participating families, there was increased engagement between the NoK and their older adult relative, which was sustained during the data collection periods. Being able to keep track of certain routines allowed the NoK to pick up on changes, as well as prompting them to discuss with their older relatives their daily activities or non-activity, and unusual activity. Participants also reported that their NoK discussed with them the rich information provided by the sensors, which allowed more interactions and discussions about their physical health and issues that they may otherwise not have been aware of. The NoKs reported an increased awareness of their ageing parent's daily activities compared to before:

If there's anything wrong, even if she doesn't say, at least I can see what's what and we can discuss it (NoK-R).

She does sit down and watch a lot of telly, and then you'll see that she's been into the kitchen because she's gone and got her lunch or her breakfast or whatever, so... I don't worry as much, but I've spoken with her about moving about because I've realised how much she just sits at home alone, and I am now making more effort – and my brother too, and his family. We all try to reach out and talk to her more; she won't ask, you know (NoK-S).

If there's anything untoward I can call her and ask her: 'I noticed last night you opened your bedroom door five times at night, is everything OK, Mum?' and a few times after a discussion I've prompted her to see her GP, make sure she has her meals and just moves about. You know, she's now joined a local computer class! That's all good for her, you know (NoK-V).

Feelings of Security and Social Support

All older adults reported only being actively aware of the sensors directly after placement in their homes, getting used to them within days. All reported feeling more secure, and narrated how they felt if 'something were to happen', happy that their NoK would be alerted by the app. For example, if the older adult had not opened her bedroom door or switched the kettle on as per the routine that was reported on several occasions, this would prompt an alert and call from their NoK. This gave both the older adult and the NoK a feeling of safety and peace of mind, allowing each to feel more relaxed.

I know there are no cameras but it feels like I am being looked after and it makes me feel safe, I'm safeguarded, I don't feel as anxious. I have felt more relaxed knowing that someone will know if I am unwell... well, they will eventually know if there is a problem and I've not had to ring my GP or been to hospital since I've had the sensors (SM1).

You watch these adverts on the television about a stroke and I have often laid there and thought well I have got a phone at the side of me all the time – mobile phone. And everybody just says you let us know if there is a problem but if you have a stroke you probably can't get the phone to ring anybody. And that's one thing that used to play on my mind because I am at risk of a stroke because I can't take the

medication for my heart racing. But with this sensor, I know that somebody will know if I've not moved for a while and that makes me less anxious now (SM2).

Enhancing Family Engagement and Promotion of Healthy Physical Behaviour

The placement of the sensors, and the active engagement from those alerted by the sensors, allowed for a growing relationship in which the participant put their trust in their NoK to check on their activity regularly – and where the NoK got to know their ageing parent's daily routines. After the placement of the sensors, all participants reported some growth in the relationship with their adult children and the family network. This could be directly with the NoK, who is alerted by the app, or by having the alerted NoK keep other relatives up to date using the information from the app. This easy access to information regarding their ageing parent's daily activities allowed family members who do not live nearby to become more engaged socially with each other and to care for their ageing parents.

I mean if I didn't get out of bed and go to the toilet any night, then she would worry, because she knows I am a regular one for tripping off across the landing, and they talk amongst themselves, so even my grandchildren now ring me more often, you know (SM1).

I wouldn't draw my other daughter into anything anyway because it's not been easy with her, but she is on the computer so the other daughter tells her little bits about me and she has started ringing me too (SM1).

Well, I had not been eating well, but I didn't want to bother my daughter. Anyway, the weekend before she said to me, 'Do you want to come and stay here for a few days? You might feel a bit better then,' so I went over and stayed with my daughter and her family. It was lovely being there for a few days, you know, but I just wouldn't ask (SM2).

Well, we are in more contact, she is sort of keeping her eye on me (SM2).

The NoK reported that it was a great way for their ageing relative to maintain their independence, but still receive support where necessary. Moreover, for the NoK it allowed them to identify – in an unobtrusive manner – the areas in which their ageing relative may require support.

I don't think she's quite ready yet to give up her independence, if you know what I mean. She's quite happy to carry on, plodding along on her own. I mean, as long as someone is at the end of a phone, that's fine (NoK-R).

I now know when she's had a bad night because you can see the alert that the door to the bathroom has been opened several times at night, or she's not been to the bedroom, then I can sort of prompt her to go to the doctors and make an appointment if she needs to, whereas before I wouldn't have known that she was having bad nights unless she told me. For example, there was a time I was receiving alerts that the bedroom door was not being opened, and when I spoke with Mum, she wasn't using her bed and she was having problems getting to sleep. So, I got her to come here [...] and she slept better when she came here, because she wasn't on her own,

and it helped when she went back to her house, you know we were talking the other day with my sister that mum has not been to hospital since we've had the sensors (NoK-S).

Like I say, my sis-in-law [name redacted]'s got the app and I have. And she's monitoring it as well as myself, and if she's got a query then she'll call me and I'll say: 'No, don't worry, I've called Mum and she's okay.' and it's like a three-way-communication. And because my sister lives a bit of a way out, then we communicate to her as well. It's a valuable experience within the family (NoK-V).

All three older adults reported changes in their behaviour, which appeared to have a positive impact on their wellbeing – including the participant who had initially reported that she did not want to be resuscitated. At her three and 8-month interview, she reported feeling more positive about her wellbeing, largely because of the improved engagement with her adult children and grandchildren, which was facilitated by the routine dialogue regarding the alerts from the app. Similarly, another participant was prompted by their NoK to increase their fluid intake, following alerts that the kettle was being used only once a day and at times not at all for two or three days. The discussion between the NoK and the participant prompted an increase in their intake of hot drinks and water in order to stay hydrated. In addition, questions by the NoK about activity in the house motivated the participant to reflect on her health behaviours.

My daughter sent me a text message one weekend, so I rang her and she said I sent this text message because you are not drinking enough! She had looked on her phone and said you have not drank, you have only turned the kettle once the whole day the last few days. She then wanted to know how much fluid I was taking; since then I've been taking more. I'm on so many tablets and my mouth gets all dry, my daughter says my kidneys will go because I'm hardly having any fluids because it's the cold weather also, you see, so I've started drinking more (SM2).

The Benefits of Non-Wearable Unobtrusive Home Sensors

Participants who had wearable sensors, such as a pendant they'd obtained through the local authority, indicated that these relied on the individual remembering to wear the pendants all day long, and that they preferred the unobtrusive home sensors over the use of an alert pendant or bracelet for several reasons – including the fact that the link was with their relatives, while the pendant was linked to emergency health and social care providers as first responders.

Because I think things like that [the pendant] makes you feel that you are an invalid or... do you know what I mean? It's just like a badge of honour sort of thing of an invalid that you wear around your neck, and I'd rather my daughter rings me than having the social care to check on me. Whereas this [the sensor] nobody would see it, you know, it just makes me feel more independent. So, I keep the pendant for major issues (SM3).

Well, I think it's really useful because it lets me know what my mum is doing without seeming to be over her; it just lets us know that she's fine, really (NoK-R).

Although the information provided through the app is quite basic, it provided family members with more insight into the daily activities of their relatives. Quick and easy access to the app allowed family members to check on their relatives more often, and to incorporate this into their daily lives. Family members were able to deduct routines, time spent at home or outside, and time spent in certain rooms, as well as monitoring food and drink intake and sleeping times – all without seeming to be intrusive or meddling.

It's easier, rather than having to keep running around because you can't get through – because obviously you're relying on phone calls, whereas this alert shows me there's activity. So during the course of the day I can log on where there's WIFI anywhere and know that there's been activity during the day, whereas before if I couldn't get through then I'd be panicking because of her age... has she fallen? That's the advantage that you've got the app on your phone (NoK-W).

I log on every morning just to make sure she's up and about. I check her once in the afternoon and then in the evening. If I can see that she's gone out, then I check to make sure she's got back okay and then I check at bedtime just to see that she's trotted off to bed – really it's something that should have come out a number of years ago. I think it's very beneficial to the elderly (NoK-S).

It's just basically so I know whereabouts she is and what time she's got up and if she's had a bad night [...]. It gives me an idea on what's going on in her life. [...] It's very informative; it tells you quite a bit, really (NoK-R).

Discussion

The findings from the baseline interviews highlighted the challenges of social isolation amongst older adults who live alone, something that also undermined their wellbeing. Our participants reported that their adult children had their own families with their own lives, as well as being busy with their jobs, resulting in less time to engage with their ageing parents. Moreover, the opportunity to travel far becomes impaired when older adults have comorbidities – which was reported by our participants. Furthermore, feelings of social isolation were also largely attributed to experiences of bereavement due to the death of their husbands/partners and their preference to continue living in the same house and community, which has also been reported in other studies (Brittain et al. 2017, Clayton et al. 2022). The literature shows that social isolation forms a risk factor for both physical and mental health, with associations involving higher rates of morbidity and depression (Age UK 2021). A study looking into the different contributions of social disconnectedness and perceived social isolation or loneliness found that social disconnectedness is associated with worsening physical health (Brittain et al. 2017). The findings from the present case study also support previous work demonstrating that a change in the quality of relationships in older adults – such as having close family support and engagement – has a positive impact on their physical and mental wellbeing (Lam et al. 2023, Whitehead 2016).

In this present study, the home sensors appear to have facilitated engagement between the NoK and their ageing parents, which in turn was reported to decrease feelings of social disconnectedness, as well as appearing to have a positive impact on older adults' self-reported mental wellbeing. Moreover, the home sensors allowed the NoK to discuss with their parents their own routines and behaviour patterns while at home. There were several examples whereby the NoK's intervention resulted in their ageing parent adopting health-enhancing behaviours such as an increase in fluid intake, more physical activities, and better sleeping patterns.

Studies investigating monitoring technologies have demonstrated the benefits of home sensors in prolonging independent living for older adults (Facchinetti et al. 2023, Aggar et al. 2023). In the present case study, the NoKs' reported that the use of the Howz sensors allowed for the independence and privacy of their ageing parent while maintaining a family support system. Information obtained through the sensors allowed for a starting point from which they could converse about daily activities without being intrusive, as well as allowing for a dialogue about activities that were beneficial to the wellbeing of their ageing parent. In a study by Whitlatch and Feinberg (2003), they found that 30% of caregivers were unaware of the assistance needed by their relatives. In this study, the information from the sensors enabled the NoK to have an awareness of their ageing relatives' needs and to open up the possibility for dialogue. For family members that live farther away, it provided a sense of closeness and involvement in the lives of their ageing parents, while also allowing them to contribute to their care management. All NoKs reported learning something new about their ageing parent's daily activities, as well as forming a closeness through family dialogue that positively impacted the participants' wellbeing. According to participants and their NoK, the older adults had fewer visits to their GP compared to pre-installation, and no reported transition to acute or secondary care during the time of the study. All the family units informed us they would be continuing to use the monitors.

Inevitably, the potential impact of these technological developments for older people is huge, limited currently only by market development, costs, time, and human ingenuity. However, for technology to be accepted by older people and their careers, it has to be affordable and easy to use, it has to address the challenges around data sharing, it has to align with a clear ethical and legal framework, and it has to capture the trust of the individuals involved (CPA 2014, Auffray et al. 2016, Cole and Towse 2018). In our case study, the older adults did feel a reinforced sense of security and increased engagement with the wider family, without feeling that the system was intrusive or disruptive (Rogerson et al. 2019, Doyle et al. 2015). Lie et al. (2015) argues that the development of assistive technologies such as smart home monitoring systems is one solution for the older adults who do not describe themselves as old or frail enough to require personal care provision; it assists them in maintaining their identity, autonomy, and independence while still being supported by their family network. The smart home device used in this study collects timely data relating to the individual's functional ability, and for future studies it may be useful to integrate such findings with health and social

care records to inform better decision-making in the care of older adults in the community.

Implication and Conclusion

The evidence from this study highlights the positive impact technology could have on older people who live alone at home while maintaining positive engagement with their families. Technology may also improve the socialisation and wellbeing of vulnerable older adults who live alone. The technology could also enable the triangulation of data from health and care records which, in turn, could expedite rapid decision-making in the care delivery and timely interventions for older adults. However, the caveat remains that research needs to keep abreast with an ‘escalating creep of technological advances’, using a rapidly evolving and changing interface regarding the health and social care delivery landscape. Critically, due to the dependency on technology, which is often expensive and can be unfamiliar to many users, it may widen socioeconomic-related health disparities. While a critical limitation of this study is the focus on only three family units, the findings could be used to design a larger scale randomised controlled study that examines the use of smart home sensors in enhancing the wellbeing of older adults, as well as undertaking a social and economic evaluation and a cost-benefit analysis in the provision of health and social care.

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Behavioral and Emotional Problems among School Children in Tripoli, Libya: What Impact does it have on Community Public Health?

By Adel M. Zeglam* & Najah S. Wahra[‡]

Objective: to detect the prevalence of mental health problems, including behavioral and emotional difficulties among school children (6-15 years) in Tripoli, Libya as observed by their parents and teachers. **Methods:** The study took place in Tripoli, Libya. Data was collected over three months period between January and March 2022 from parents and teachers. The Arabic version of Strengths and Difficulties Questionnaire (SDQ, Goodman 2002) were used. The sample size was 300 children aged between 6 and 15 years who were attending compulsory education. Four schools were randomly selected and then children were randomly sampled from each class. Parents were asked to hand over the questionnaire to their child's teacher and collect them later. Data was analyzed to describe normative scores, bandings and cut-offs for normal, borderline and abnormal scores. Only public schools were included in the study. **Results:** When it came to the perception of teachers and parents, it was found that the response rate for parents and teachers were almost the same only 245 questionnaires were returned (134 male and 111 female) giving a response rate of 81.6%. out of these, 208, both the parents and teacher questionnaires were returned (84.8%), 26 filled in only the parents' questionnaires (10.6%), and 11 returned only the teacher's questionnaire (4.4%). TEACHERS rated their pupils consistently as showing difficulties in all areas with (23.0 %) of the children considered to be displaying abnormal behavior (Total Difficulties Score). The highest proportion of abnormal behavior was for peer relation (17.0%) and conduct problems (18.0%). PARENTS rated their children as having fewer problems than rated by teachers, but rates were still high with (15%) of the children receiving total difficulty scores in the abnormal band. The most problematic areas as assessed by parents were peer relations (29%) followed by emotion problems (22%). **Conclusion:** Parent SDQs revealed high rates of children with conduct, emotional and peer problems falling above the 90th centile established in the UK sample. Teachers SDQs revealed higher rates of children with conduct problems. Comparison with UK and Egypt data showed abnormal total difficulties score of 11.9% which is a bit higher than UK (10.1%) but lower than that of Egypt (20.6%). Much greater investment in child mental health care is needed. More efforts are needed to identify those children and decide what we can usefully do to help the many-not only the few.

Keywords: Tripoli, Libya, behavioral problems, school children, SDQ, mental health

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Introduction

Minimal researches have been directed toward children and adolescents' mental health including behavioral difficulties in Arab countries as data from these countries are poor and limited (Afifi 2005). Some data are available from few studies carried out in UAE (Eapen et al. 1998, Okasha 2004), Egypt (Hamid et al. 2009, Eapen and Ghubash 2004), Yemen (Alyahri and Goodman 2008) and Gaza strip (Thabet et al. 2000).

The SDQ has become one of the most widely used tools in child and adolescent mental health care across the globe. Although the SDQ was originally developed and validated within UK (Goodman 1997) and its reliability and validity have been simulated in many countries including Arab countries, important cross-cultural issues have been raised (Du et al. 2008, Alyahri and Goodman 2008). Having accurate and up-to-date information about the prevalence of behavioral difficulties in children is important in determining and influencing the health policy of any country. There is a wide spread wrong belief among parents, child health professionals, and politicians in Egypt that mental health disorders in children are not a major public health problem (Goodman et al. 2000a). Two advantages of SDQ are that it collects information from multiple informants and so reflects children's emotional and behavioral symptoms in different settings, and by using all the information from all respondents, enables an epidemiological rough estimate of the size of the problem as well as simple behavioral symptoms (Goodman et al. 2000b, Samad et al. 2005).

We have conducted a prevalence study in Tripoli, Libya using SDQ in order to detect the rates of behavioral difficulties among school children (6-15 years).

Method

Setting

The study was carried out in the city of Tripoli, the Capital of Libya. Tripoli is a cosmopolitan city and represents that of Libya as a whole. The populations of Tripoli are approximately two million. Schools were selected at random from different districts in the city. Only public schools were included in the study.

Sampling

Data were collected over three months period between January and March 2022 from parents and teachers. The Arabic version of Strengths and Difficulties Questionnaire (Goodman 2002a) were used .

SDQ is one of the most widely and internationally used measure of child mental health and has been translated into more than 80 languages. The tool can pick up the viewpoint of children and young people, their parents and teachers.

The sample size was 300 children aged between 6 and 15 years who were attending compulsory education. The Education Authority provided us with a list

of public schools. Schools were randomly selected and then children were randomly sampled from each class of selected school. Four schools were selected from different districts in Tripoli. All schools agreed to participate but some parents declined to fill-in the questionnaires. We randomly sampled 300 children from the 4 schools to cover the age group between six and fifteen years. Parents and teachers were informed of the study formally by letters delivered to them by a doctor through the school head-teacher. With the letter the parents were sent questionnaires and their return of the questionnaires was considered as consent to participate in the study. Teachers were also given a similar questionnaire to complete it. Ethical approval was not required under the local regulation from either the health or education authorities.

Data Collection and Tools

For each child a parent and the teacher were asked to complete the Arabic version of SDQ. This questionnaire includes 25 core items. The 25 items generate five scales: (1) emotional symptoms (2) conduct problems, (3) hyperactivity symptoms, (4) peer-relationship problems and (5) pro-social behavior. Each of these scales is scored from 0 to 10 and can be classed as “normal”, “borderline”, or “abnormal” depending on how the score compares with population standards based on original validation work in UK (Samad et al. 2005). All but the last scale (Pro-social behaviour) are summed to generate a total difficulties score ranging from 0–40.

Parents completed their questionnaires without any interference from the school teachers.

Analysis

The results from the five subscales of the SDQ and the total difficulties score were classified using the standardized cut-off values into “abnormal”, “normal” and “borderline”. Prevalence values were calculated. Data analysis was carried out using the Statistical Package for Social Scientists (SPSS version 12).

Results

When it came to the perception of teachers and parents, it was found that the response rate for parents and teachers were almost the same. Only 245 questionnaires were returned (134 male and 111 female) giving a response rate of 81.6%. out of these, 208, both the parents and teacher questionnaires were returned (84.8%), 26 filled in only the parents’ questionnaires (10.6%), and 11 returned only the teacher’s questionnaire (4.4%).

PARENTS rated their children as having fewer problems than rated by teachers, but rates were still high with (15%) of the children receiving total difficulty scores in the abnormal band. The most problematic areas as assessed by parents were peer relations (29%) followed by emotion problems (22%).

TEACHERS rated their pupils consistently as showing difficulties in all areas with (23.0%) of the children considered to be displaying abnormal behavior (Total Difficulties Score). The highest proportion of abnormal behavior was for peer relation (17.0%) and conduct problems (18.0%).

Reasons for some of the parents not responding and not returning the questionnaire could be due wrong belief that if their children are found to be abnormal there is a good chance that they will be kicked off the school; Stigma attached to the diagnosis is another cause of some parents refusing to fill-in the questionnaire. Some of the school teachers refused to cooperate simply because they do not want to have problems with the parents as a result of their comments. A significant teachers-parents discrepancy (n=91) in reporting the different problems in the SDQ were noted.

Table 1 summarizes the results of abnormal SDQ from parents completed questionnaires (n=208). The highest proportion of abnormal behavior were for Peer problem with (29.4%) followed by emotional symptoms (22%) of the children rated as in the abnormal category. 15% of children have total difficulties score in the abnormal band.

Table 1. *Abnormal SDQ Scores from Parents Returned Questionnaires*

Scales (n=208)	Male	Female	Total	Percentage
Pro-social	13	8	21	10%
Hyperactivity	14	6	20	10%
Emotional	20	26	46	22%
Conduct Problems	18	12	30	14%
Peer Problems	35	25	60	29.4%
Total Difficulties Score	20	11	31	15%

Table 2 summarizes the results of abnormal SDQ from teacher's completed questionnaires (n=208). The highest proportion of abnormal behavior were for conduct problems (18%) followed by Peer problem with (17.3%) of the children rated as in the abnormal category. 22.3% of children have total difficulties score in the abnormal band

Table 2. *Abnormal SDQ Scores from Teachers Returned Questionnaires*

Scales (n=208)	Male	Female	Total	Percentage
Pro-social	20	12	32	15%
Hyperactivity	16	14	30	14%
Emotional	12	16	28	13%
Conduct Problems	25	12	37	18%
Peer Problems	20	15	35	17.3%
Total Difficulties Score	26	20	46	22.3%

Table 3 shows the teachers-parents discrepancy (n=91) in reporting the different problems in the SDQ scales. Looking at the table we can see that in some cases (28) the teacher's questionnaire scored abnormal and in (25 children) the score was borderline. Surprisingly for the same children the parent's questionnaire scored normal.

Table 3. *Teachers-Parents Agreement on SDQ*

Scales	Male	Female	Total
Teacher _ Ab Parents _ N (scale 1)	14	14	28
Teacher _ Ab Parents _ BL (scale 2)	6	5	11
Teacher _ BL Parents _ N (scale 3)	13	12	25
Teacher _ N Parents _ Ab (scale 4)	4	6	10
Teacher _ BL Parents _ Ab (scale 5)	6	2	8
Teachers _ N Parents _ BL (Total difficulties score)	1	8	9

Table 4 compares the prevalence of behavioral problems in school children in Egypt, the United Kingdom, and Libya as assessed by teachers and parent using the multi-informant SDQ. The reported prevalence of total difficulties scores by both teachers and parents is much less in Libya than in Egypt but much higher than in United Kingdom.

Table 4. *Comparison of the Prevalence of Behavioral Problems in School Children in Egypt, the United Kingdom, and Libya*

	Egypt	United Kingdom	Libya
<i>Abnormal total parent's difficulty score</i>	20.6%	10.1%	15%
<i>Abnormal total teacher's difficulty score</i>	34.7%	9.8%	22.3%

Discussion and Conclusion

Parent SDQs revealed high rates of children with conduct, emotional and peer problems falling above the 90th centile established in the UK sample. Teachers SDQs revealed higher rates of children with conduct problems. When data were compared to those from the UK and Egypt, the abnormal total difficulties score was 11.9%, which is slightly higher than the UK's (10.1%) but lower than Egypt's (20.6%).

Care for children's mental health requires a lot more financial spending. It will take more work to find those kids and determine what we can do to assist and support the many, not just the few.

Any development in the provision of child and adolescent mental health services should take into account the requirements for ongoing parent and teacher

training sessions as well as programs that increase public awareness of mental health problems. Parents, teachers, and healthcare professionals should be aware of children's behavioral issues so that they can be treated as soon as possible and hence increasing the likelihood that the children will regain their normal mental health.

We believe that our sample is representative and a reflection of the whole Libyan children attending schools. However, we have demonstrated that the prevalence of the difficult symptoms, as assessed by teachers and parents, is substantially higher among Libyan children than UK but lesser than Egyptian children. A comparable study in Pakistan (Mullick and Goodman 2005) community group revealed similar patterns of findings. The abnormal rates were even greater on the SDQ (34.5%) and were not when the algorithm was applied (8.5%), despite the fact that their analysis only included parental reports. Mullick and Goodman (2001) in their study in Bangladesh, have also emphasized the significance of adopting the multi-informant algorithm and gathering data from two informants. Other studies among preschoolers generally revealed similar results of conduct problems. It is probable that the way we raise our children, excessive child protection, a lack of use of effective discipline techniques, and the relatively big sized family are all contributing factors to this pattern of a high prevalence of this abnormal behaviour. We have only included in this cross-sectional study children attending public schools; children who were attending private schools were excluded and this may have underestimated the true prevalence of behavioral problems in school children. Although the sample is relatively small, we believe that within the facilities at our disposal, the high rate of parental response, and the standardized questionnaire employed all contributed to the study's overall strength. Since it is outside the scope of this study, confirmation of diagnoses was not sought; even though we think the prevalence of the problem is probably true. Early detection procedures have the potential to have a significant impact on a child's education and health in a number of areas of child health, or at the very least lessen the severity of developmental difficulties; behavior difficulties are one of these. It would be quite fascinating to learn if any Arab nations including Libya have been able to find a solution to the issue of providing treatment for kids with behavioral and learning difficulties. This "hidden handicap" frustrates communities and otherwise normal families, often going unsuspected and unrecognized even by doctors and teachers. Health and education authorities must make greater efforts to identify these children and determine what can be done to help- the many—not just the few in order to decide what are the best practical measures to assist these children and their families and ensure that they receive the attention and care. As professionals, none of us can disagree that this is a serious issue, but what is the best course of action? In the best, and well-off, situations the children with behavioral difficulties can be helped; a few by medications, many by the care of parents, teachers and the community (Zeglam and Maouna 2011).

The only way for children with moderate to severe behavioral difficulties to reach their full potential are to attend special schools, which are expensive to attend in any country in the world. Early detection and intervention are top goals for these kids in order to- if at all possible- avert any disabilities. The population of

the world doubled between 1930 and 1975, growing by 2 billion people. Today the number is at 7 billion and growing. At least two-thirds of the population—including Arabs and Muslims—live in what are referred to as “underdeveloped or developing” countries. Behavior difficulties are now a significant issue that requires attention and answers due to the population growth and problems that have followed this increase in population.

There is a chance that these issues won't be given top priority in such nations. One may adopt an unenthusiastic and passive attitude and argue, “There are far worse problems in many Arab countries including Libya -- starvation, housing, sanitation, water supply, and war -- so why divert efforts?” Or “There are other issues that are frequently helped by straightforward steps, and we don't notice many behavioral issues around”.

There are certainly many other dreadful issues in Arab nations including Libya, but behavioral issues in children, especially autism spectrum, and attention deficit hyperactivity disorders, are such serious disabilities that every professional in the fields of health and education must at the very least advocate positively. Parental guidance is an additional responsibility that should be added to the primary health care workers' obligations, which are by no means small and simple (Zeglam and Darrat 2008, Zeglam and Maouna 2011, 2012).

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Examining the Most Important Factors Affecting the Egyptian Family's Choice of the Ideal Number of Children in the Light of the 2015 Demographic and Health Survey

By Mohamed Elkhoul^{*}

Purpose – This study aimed to identify the most important factors affecting the desire of Egyptian families to have ≤ 2 Child as a targeted situation in line with the national and global trends for replacement rates of 2.1 children for each family, and thus can provide various information and results supporting the decision-makers and planners at the demographic and development level in Egypt. Taking in the account that this paper also supports shaping the future populations strategies in preparation for supporting sustainable development opportunities to improve the demographic situation about the concept of ideal number of children in Egypt, as well as providing the suitable recommendations and proposals as points and areas for improvement of the current situation affecting access to achieving the Egyptian desires about targeting two children or less for each family. This study has pursued to support the officials and planners in various areas of comprehensive development, especially in light of what Egypt is facing from the aggravation of the population issue in relevance to the high population growth, as the number of Egypt's population rose from 72.8 million according to the 2006 census, then to 94.8 million in the 2017 census, and to 101.5 million population on 1 January 2021, an increase of 7.1 million people over the last census data, (51.5% males, 48.5% females), and the gender ratio was 106.1 males for every 100 females. So, this represented a direct threat to economic development that Egypt recently started to achieve a qualitative leap in the economy. The average ideal number of children amounted for 3.4 children per woman and slightly differ by family's residence, whereas it was generally higher for Upper Egypt governorates, as well as the urban governorates have somewhat gap to have one child compared to the desire of having two children that it was noticeable in Alexandria governorate in which there was 1.7 wanted births per woman compared to 2.7 mean ideal numbers of children. Thence, the study will aim to present which factors affecting the Egyptian family's choice the ideal number of children (two children per women according to the national objective of Egypt) to become Future-Proof towards supporting the SDGs in Egypt. **Design/methodology/ approach** – The study was adopted a descriptive and analytical approaches which focused on the data collected by the Egyptian Demographic Health Survey (EDHS) survey in 2015. This sample used by the current study is considered an indirect source that is nationally representing the Egyptian households in which were selected using a multistage sampling technique in terms of this survey consisted of 16671 family in which were interviewed randomly. To achieve the planned objectives of this study, the sample of the 2015 EDHS survey of the Egyptian families was divided into two main groups

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according to the dependent variable (the desire of the family for the ideal number of children) where the first group represents the desire of Egyptian families to have only two children or less, while the second group represents the desire of Egyptian families to have more than two children. Up-on this direction, the first group represents the national strategic objective of Egypt population development. The variables were selected upon supporting the study's purpose and the Chi-square-test (χ^2), t-test for independent samples and logistic regression analysis were used. The p-value (Sig.) of the statistical tests applied by this study was considered significant when $p \leq 0.05$. Additionally, the data selected was analyzed using SPSS ver. (26) software. **Findings** – The results has revealed a set of critical factors which were included in proposed statistical model representing both of making decisions for using money or health care within the family, marital status, ideal marriage age for a girl, and the no. of male children, it has shown that the these factors combined affecting significantly the Egyptian families choices about the ideal number of children in terms of are considered the most important factors determining the chances of the family towards having ≤ 2 Child. It recommended to continue to employ the alternative means and solutions within the awareness programs to control these factors, and this in turn to motivate Egyptian families to control population growth rate at two child per family at the level accepted internationally. **Originality/value** – This study confirms that the importance of continuing to further spread public awareness among all members of Egyptian families, in order to reach the ideal target number of two children or less as a strategic goal for the components of the national population policy in Egypt, in addition to implementing strategic initiatives, programs and projects that promote the achievement of Egypt's forward-looking vision in becoming Future-Proof by 2030, and alongside with the progress towards the human and sustainable development goals in Egypt by 2030 for the chances of next Egyptians generations.

Keywords: Ideal Number of Children, Egyptian Family, Arab Region (MENA)

Background

In late, the Family choices about childbearing is fully functional organism and it doesn't just represent an abstract idea without any impact on the quality of life within the community as a result of increasing of trends of fertility rates, so the reproductive behaviors and intentions are important elements to study, especially the dynamics of population vary from country to country depending on a number of internal and external factors, such as legislation, religion, culture, traditions, society and so on (Antic et al. 2013). Thus, this direction should be considered well by policymakers of each country to understand how these factors being exploited for supporting the development opportunities within the country in the right way. For the Arab countries of the Middle East and North Africa (MENA), recently the fertility rates are back on the rise in some Arab countries for 2005-2015 in which there was a slight increase of the fertility rate in both of Tunisia and Morocco while was a continuous increase of the fertility rate in both of Algeria and Egypt. Also, the fertility rates were stable in both Libya, Lebanon, and Oman,

whereas it had decreased in the rest of Arab countries like, Bahrain, Jordan, Kuwait, Qatar, Saudi Arabia, Syrian, United Arab Emirates, and Yemen (United Nations 2019).

According to UN data, Egypt's recent spike in fertility is an unexpected and concerning aberration in the Arab world's most populous country, whose population has doubled since the early 1980s and reached 106,966,158 inhabitants while total population of the world was 7,982,279,739 inhabitants in 2020. As well as, it has indicated that Egypt's share of world population amounted for 1.34%, and thus its global rank is 14th as well as the fertility rate of Egypt was 3.33 compared to 2.47 at the international level (United Nations 2022). In recent years, the atypical fertility has been increased particularly striking in Egypt and the demographic situation of Egypt is still characterized by relatively early marriage, with the preference of couples having their first child soon after marriage directly, and they usually don't like the family composition that has one-child (Samari 2017). As a result, the continuous increase in the Total Fertility Rate (TFR) has negative impact on devouring the chances of economic progress in Egypt and undermining the comprehensive development desired, which leads to greater stressing on Egyptian families continuously in light of the Egypt's already limited resources (Abdel-Tawab et al. 2020).

Indeed, a high rate of growth of Egypt's population is considered one of big obstacles and challenges facing the Egyptian officials and the decisions of policymakers to ensure achieving the sustainable development objectives and goals in the right direction at the long term. The TFR rose extraordinarily during the six-year period 2008-2014, from its lowest level of 3.0 child per woman to 3.5 child per woman according to the statistics of Ministry of Health and Population in Egypt (El-Zanaty et al. 2015). Moreover, the Ministry of National Planning in Egypt declared that the national goal of achieving a TFR of 2.1 by 2017 has not been achieved in terms of access to a target rate of replacement by two children to each family. Further, the ideal number of children is still much higher than the fertility goal at 3.4 children among men while 3.1 children among women (UNDP 2015). Consequently, this goal still doesn't achieve yet where the TFR increased to 3.5 in Egypt's Demographic and Health Survey (EDHS) 2014, compared with 3.0 in the 2008 EDHS, thus reversing a 25-year trend of declining fertility. It has been noted by the recent studies that fertility levels are affected by individuals' choices as a crucial priority and along with social norms, beliefs, and culture (Gehad et al. 2022).

Reducing the fertility rate to 2.4 per family by 2030 is considered a one of the most quantitative objectives stipulated in the new "Egypt National Population Strategy 2015-2030". This new strategy that put in-place to achieve this strategic objective must rise contraceptive prevalence rate (CPR) to 72% in 2030 from 58.5% in 2014, and the proportion of unmet need must decrease from 13% to 6% (National Population Council 2015). However, the targets of achieving these objectives have become elusive, especially the challenges facing currently Egyptian society and families arising from bearing more social and economic pressures in the wake of the 2011 revolution, besides the high cost of living standards due to the instability of global economic systems in light of there is poor

stability in political and security aspects at the global level, which puts continuous pressure on increasing the burden of living on Egyptian families in general.

One of the studies indicated that Egypt witnessed the birth of about 2.6 million births annually for the 2012-2016 according to national statistics (CAPMAS 2018). The trends of fertility rates showed contrasting fluctuations in which the TFR had decreased from 6.6 child per woman in 1990 to 3.0 child per woman in 2008 and then it raised to about 3.5 child per woman in 2014 (Ambrosetti et al. 2019). Besides, the fertility rates in the urban Governorates were lower than the rural Governorates in which the TFR in rural areas in Egypt amounted for 4.1 child per woman in 2014 compared to 3.6 in child per woman 2008 (UNICEF 2015). The mean ideal number of children in Egypt among households in rural governorates was higher than the urban ones, this variable's value among the people whose no education was higher than people educated, and its value among the households in the first wealth quintile layer representing the poorest was the highest compared to the households in other layers of wealth quintile (UNICEF 2017). The average ideal number of children amounted for 3.4 children per woman and slightly differ by family's residence, whereas it was generally higher for Upper Egypt governorates, as well as the urban governorates have somewhat gap to have one child compared to the desire of having two children that it was noticeable in Alexandria governorate in which there was 1.7 wanted births per woman compared to 2.7 mean ideal numbers of children (Egypt National Report 2018). Thence, the study will cover the answer to the following question: Which factors affecting the Egyptian family's choice the ideal number of children (two children per women according to the national objective of Egypt) to become Future-Proof towards supporting the SDGs in Egypt.

The Problem of Study

Despite the state's efforts to reduce fertility rates, it has not yet reached the hoped-for or desired rates to support sustainable development opportunities in Egypt optimally compared to the international levels for each family, which Fertility rate has amounted for 2.47 child to each woman in 2020 and will be expected to still at the same rate to reach at 2.62 child to each woman by 2025 (<https://www.worldometers.info/world-population>). Undoubtedly, the fertility rates are still relatively high within the Egyptian family, and if the trend of these rates is to increase or continues at their current levels, it will devour all development efforts exerted by the state that it is currently undertaking in all fields whether socially, economically and environmentally, as well as this issue may undermine the chances of achieving a decent living and how to access the enjoyment levels of living becoming better in the future for the Egyptian households In light of the governments facing future challenges to support the elements of food and water shortages, combat poverty, climate change, and global peace and stability, and this should be in comparison with the developed countries which in better conditions towards the readiness for the future. Indeed, the coming period is considered one of the crucial periods in the history of demographic

change in Egypt. Rather, it can be said that the coming period represents a challenge for governmental and non-governmental efforts towards their quest to reach the stage of population replacement at the Republic level by an average of 2.1 children/woman. Hence, there was the need to adopt the concept of ideal number of children that support the target level of replacement at (2 child/family) as maximum limit and to encourage these families to adopt this target rate of fertility in favor of refine the levels of human sustainable development for them and for their children as possible. This direction could preserve the happiness and stability of the Egyptian family at desired level and along with providing good chances to ensure a better life for current or future generations towards accelerating support for the SDGs by 2030.

Therefore, this study will seriously seek to identify the most important factors affecting the desire of Egyptian families to have two children or less as a targeted situation by the current study in line with the national and global trends for replacement rates of 2.1 children for each family, and thus can provide various information and results supporting the decision-makers and planners at the demographic and development level in Egypt. Taking in the account that this paper also supports shaping the future populations strategies in preparation for supporting sustainable development opportunities to improve the demographic situation about the concept of ideal number of children in Egypt, as well as providing the suitable recommendations and proposals as points and areas for improvement of the current situation affecting access to achieving the Egyptian desires about targeting two children or less for each family.

Justification

The importance of this study, as follows:

- Lacking studies that have focused on examining the relationship between the Egyptian families' desires of the ideal number of children and the factors can predict significantly with the value of this variable in which it will be two children or less using updated data about this direction of fertility that in line with the national goal of demography policy within Egypt. Especially, the causes of increasing the fertility context within Egypt are still unclear, so there is a need to further studies to test which factors significantly affecting the persistence of a high ideal number of children among Egyptian families, in particular the younger couples' cohorts. Egypt is already considered the biggest populations within MENA area with over around 106 million inhabitants in 2022 and it is expected to increase to access about 120 million by 2030 if the TFR rates continue at the same level of births per women (United Nations 2017).
- It has been confirmed that Egypt is currently witnessing a downhill in long-acting reversible contraception methods (LARCs) and alongside a high rate of unintended pregnancy among families, one of the Socio-cultural barriers causes this issue that there was reluctance to discuss

sexual behaviors and habits with medical staff freely, specific family composition of two or one girl and the desire about the ideal number of children that will be suitable to satisfy the desire of each party of two couples (Gad et al. 2021). Further, it has been referred that there is relationship between fertility behavior and understanding the desire of ideal family-size could be post-hoc rationalization of actual fertility soon (Bongaarts 2013).

- Accordingly, all the efforts to control higher population growth become useless when the household desire larger number of children (Khan and Khadija 2014). As the results have shown that studying the factors affecting the women within the family like woman's education, woman's empowerment through household decision-making, resistance to violence against woman and inter-spousal age difference can reduce the number of desired children (Khan and Khadija 2014). Therefore, this approach will be adopted for highlighting the most important factors affecting the Egyptian family's choice for the ideal number of children.

The Objectives of Study

This paper will address the following objectives:

- To examine the significance of correlation's relation between some variables and the ideal number of children desired by the Egyptian families whether (≤ 2 Children or > 2 Children).
- To determine the significance of the relative differences in the Egyptian family's perception about having the ideal number of children whether (the 1st group: two children and less vs the 2nd group: more than two children) according to the potential impact of a set of qualitative variables that are relevance to the characteristics of the head of household.
- To access the most important factors under the focus of the current study that can predict with the ideal number of children in Egypt according to the EDHS 2015.
- To provide recommendations for more targeted and sustainable interventions to address drivers of adopting the ideal number of children in Egypt optimally.

Literature Review

The problem of increasing fertility levels and the burden of childbearing on the family prompted researchers to address this problem from multiple aspects. This study was preceded by many studies related to the pattern and levels of fertility and its trends and the factors affecting fertility that hinder it to reach the target level. There was a study which focused on examining the effect of some intermediate variables on fertility rate in Egypt using the Bongartz model, which has showed that reducing fertility will be affected by increasing the use of family

planning and the extension of breastfeeding period of women within the Egyptian families (Abdel-Fattah 1983). One study showed that the desire to continue to have children decreases among Egyptian families that have number of males that exceed the number of females (Othman 1990). The programs of family planning and sustainable development in Egypt showed that the rate of family planning methods use in rural areas is two-thirds of the percentage of use in urban areas, and this percentage of use may be affected by the ideal number of children needed (Khalefa 1994).

The results of the National Family Health (NFHS-3) Survey in the state of Meghalaya which is located in Northeastern part of India concluded a significant correlation between the ideal number of children and both of residence, religion, highest educational level, work status, standard of living index and the respondents' age (Khongji 2013). It has pointed to the woman's desire to have more children had significant impact to increase the TFR of Egypt during the period between EDHS2008 and EDHS2014, and it expects to increase among vulnerable groups, and thus to rise TFR as a reason for contraceptive discontinuation (Khalifa et al. 2020). Another cross-sectional study aimed to determine the factors affecting the reproductive desires of the modern Bulgarian families which covered 243 couples were interviewed. Also, this study showed that three two-child model remains the most accepted concept of family and the Bulgarian families have intention and less motivation for children in the future (Hristova et al. 2018).

The factors of effective participation of Egyptian married women in family decisions on reproductive affairs, the region and place of residence are considered highly correlated with adopting the number desired of children for the men and women alike. This result leads to study the social context of couples to understand their desire about the fertility affairs (Ambrosetti et al. 2021). In addition, a comprehensive assessment of childbearing motivations has concluded a great need exists to involve couples who have not yet attained their desired family size in fertility regulation interventions to reduce fertility in the governorate of Beni-Suef (Gehad et al. 2022). The percentage of Egyptian unmarried women 15–34 who desired three children and more has increased from 47% in 2008 to 53% in 2014. This study also showed for Egyptian unmarried youth aged 15–29 that there was an increase in the desire to having more children in terms of this increase among young women was higher than young men, young women who were in the highest wealth level, those who live in Urban Governorates, and those with secondary education (Abdel-Tawab et al. 2020).

There was a bias to the approach involved relying only on a woman's preferences without considering men's preferences about knowing the ideal number of children that she would like to have over her lifetime if she could go back to the time when she did not have children, especially the empirical evidence on the measurement of this variable has shown that a considerable percentage of survey women respondents are either unsure about their desire for the ideal number of children or don't prefer a numeric response to this question without their partner (Karra 2021). Another study has disclosed the negative significance of correlation coefficient between the age of youth Empowerment and ideal number of children in all 10 study countries which covered both Ethiopia, Haiti,

Malawi, Mali, Nepal, Nigeria, Philippines, Senegal, Uganda, and Zambia (Kerry 2021). A Study has also noted that the desire of fertility is main focus for determining the family formation process in all countries over the world, and it is considered a significant factor for the expectation of the change of any population at the long term in increasing fertility rates , particularly the population experts are concerning about the countries that have desire to continue toward increasing two child per household due the passive potential impacts on the sustainable development levels (Yaya et al. 2018).

Syria was one of rare countries prefer large families in which the ideal number of children was 4.6 children per family which may affect the future of the demographic changes and perspectives at the Southern Mediterranean Region (Courbage 2007). But this concern may back to the civil wars that arose in Syria after 2011, and the Syrian families have still the desire to the ideal number over two children (UNICEF 2015). Cultural barriers of the ideal number of children are considered one of reasons impede accessing or not-using the family planning services optimally due to the bad belief that its impact limiting the intention to have children in the future (Eltomy et al. 2013). The family's preference of about three children is accepted by the authorities in Egypt and this will not encourage the composition of smaller families at the short and mid-term future according to the expectations. Alongside, the ideal number of children may differ according to varies factors like the age of respondent, region, residence, or education in which it is always within $\pm 15\%$ of that three-children value (Al Zalak et al. 2017).

The ideal number of children among never-married women and men focused in the aged 18-29 in Egypt based on the 2004 EDHS in which the results indicated 39% of women and 47% of men interested in having three or more children as ideal number (Casterline and Roushdy 2006). There is a need to examine which factors affecting on both of ideal number of children, the mean of ideal family size, and fertility intentions to ensure the alignment with the national population policies, as planned to reduce the fertility without restrictions (Basten and Baochang 2008). Also, one study concluded that the ideal number of children can predict based on some variables such as the age, education, residence, and wealth index of a woman aged (15-49) in Mizoram state in the Northeast part of India. It also inferred that the women in urban area need children less than the women in rural area, especially the rich women desire having more than two children (Lalvenmawii and Khongji 2019).

Most of these studies focused on the policies imposed or deliberated to reduce fertility and sought to highlight the importance to examine the variables affecting reducing fertility rates, but there are no sufficient studies has focused on the fertility in terms of examining the variations affecting the desire of families themselves to have the ideal number of children according to a set of factors proposed are related directly to this choice. In addition, some studies aimed to examine this issue since a long-term past period not considered the change of the family's desire over the time and conditions surrounding, besides, there was a lack of interest to examining the causal relationship between some potential factors and the ideal number of children for two children or less, as a part of sharing this study in the support of the state's directions to reduce fertility levels to the target level.

Accordingly, this study will try to identify the impact of the most important factors affecting families' choice towards adopting the ideal number of children, as dependent variable which will be divided into two main groups, the first group of the families have two children or less while the second group of the families have more than two children. This classification has been a great interest by this study at the first place to shed the light on this aspect in front of the officials and planners in the demographic field over the world.

Methodology

The study was adopted a descriptive and analytical approaches which focused on the data collected by the Egyptian Demographic Health Survey (EDHS) survey in 2015. This sample used by the current study is considered an indirect source that is nationally representing the Egyptian households in which were selected using a multistage sampling technique in terms of this survey consisted of 16671 family in which were interviewed randomly. The sample design of this survey aimed to gather data about various population and health indicators of interest in the Egypt country as a whole and in line with concentrating to have some background characteristics of the responding women in the age group 15-49 years (El-Zanaty et al. 2015). To achieve the planned objectives of this study, the sample of the 2015 EDHS survey of the Egyptian families was divided into two main groups according to the dependent variable (the desire of the family for the ideal number of children) where the first group represents the desire of Egyptian families to have only two children or less, while the second group represents the desire of Egyptian families to have more than two children. Up-on this direction, the first group represents the national strategic objective of Egypt population development.

In general, the current study takes into the account the focus on the first group to support the strategic directions of the new national strategy regarding access to the ideal number of children is 2.4 per women by 2030 in line with the population policies and development levels, as planned, especially, this direction adopted for becoming better Future-Proof towards enabling sustainability the fertility rate growth in Egypt optimally. Therefore, this study sought to examine a group of various variables be available in the 2015 EDHS survey based on the possibility of examining its impact on this dependent variable using some statistical techniques that are compatible with achieving the objectives of this study in an appropriate manner. Egypt is classified geographically into 26 governorates. The data collected and issued formally by EDHS were revised for ensuring the consistency and completeness of the target variables by the current study to include in the statistical methods and analysis that should be appropriate to achieve the objectives of this study. These variables or items selected for the study's purpose were then transferred to Statistical Package of Social Science Software program, version 26 for statistical analysis. Qualitative variables are described using both frequency and percentages while the quantitative variables are described using both the average and standard deviation (\bar{X} and STD). As well as Chi-square-test

(χ^2), t-test for independent samples and logistic regression analysis were used. The p-value (Sig.) of the statistical tests applied by this study was considered significant when $p \leq 0.05$. Additionally, the data selected was analyzed using SPSS ver. (26) software.

Results & Discussion

The Characteristics of the Egyptian Families Sample

The results of the current study as in Table 1 in accordance with the 2015 EDHS survey of Egypt that has revealed the sample background characteristics of the Egyptian families in which representing 51% of these households live in rural areas, while 49% live in urban areas, and 67% Households are still in a marriage relationship that still exist at the time of survey, while 33% of them were separation in the relationship or not married. Also, the low or medium-level education of the head of households represents 69% of the total, while 31% of them are of the high-level education, 10% of the respondents among the head of households locates in the age group 15-17, while 90% of them locates in the age group 18-59. The Egyptian families desire the ideal number of two children or less represents 59%, while the families whose desire a greater number of two children represents 41%. Moreover, there was 54% of Egyptian families did not use contraceptives, while 46% of them use contraceptive methods, and that only 24% of respondents prefer to Internet communications, while 76% did not use social interworking communications, and 12% of these families used media such as daily newspapers, radio and television, while 88% are not interested in using media on a regular basis. As for family decisions related to the use of money to meet the needs of the household, they are concentrated in women side by 85% compared to its concentration by 15% in men side, and it may be almost similarly with regard to making decisions about the access to health care that was concentrated among women side by 84%, compared to its concentration by about 16% among men side, Whilst the percentage of violence against women within the study sample was 30%, while 70% of the respondents showed that there is no violence directed towards the women within the family. Thus, this section has shed the light as a snapshot on the main characteristics of the sample of respondents which the current study relied on it to represent the Egyptian families' desire about the ideal number of children in achieving its objectives.

Table 1. The Background Characteristics of the Respondents of the Egyptian Families, EDHS 2015

Respondents Background		#	%
Gender	Female	9209	55.2
	Male	7462	44.8
Residence	Rural	8475	50.8
	Urban	8196	49.2
Marital Status	Terminated	5514	33.1
	Continuous	11157	66.9
Education Level	Low or Medium Level	11572	69.4
	High Level	5099	30.6
Religion	Muslim	15816	94.9
	Non-Muslim	855	5.1
Age Category	Age 15-17 years	1673	10.0
	Age 18-59 years	14998	90.0
Ever attended school	Yes	14203	85.2
	No	2468	14.8
Work Status	Yes	7569	45%
	No	9102	55%
Smoking Status	Yes	614	3.7
	No	16057	96.3
Caesarean Status	Yes	13565	81.4
	No	3106	18.6
Circumcision status	Yes	7433	44.6
	No	9238	55.4
Using Contraceptive method	Yes	7687	46.1
	No	8984	53.9
Partner preference for more children	Woman	1423	8.5
	Man	15248	91.5
Deciding how the use of money	Woman	14181	85.1
	Man	2490	14.9
Makes decisions about health care	Woman	13953	83.7
	Man	2718	16.3
Using Media (Journal, Radio, and TV)	Yes	2059	12.4
	No	14612	87.6
Using Social Networks "Internet communication"	Yes	4014	24.1
	No	12657	75.9
Violence Status against women	Yes	5002	30.0
	No	11669	70.0
Ever had a tattoo	Yes	888	5.3
	No	15783	94.7
Ever have your ears pierced	Yes	9044	54.2
	No	7627	45.8
Going Salon/Beauty center	Yes	11722	70.3
	No	4949	29.7
Ideal Child No. of the Family	≤ 2 Child	9778	58.7
	> 2 Child	6893	41.3

Source: Egypt, DHS Report in 2015.

Figure 1 showed the relative distribution of households according to the Egyptian governorates, ad Cairo governorate represents the highest percentage of total sample which amounted approximately for 7%, and then was followed by both of Giza and Qena governorates with the same percentage that amounted for

5%, while both of the Red Sea, New Valley and Matrouh governorates have the lowest rate of households' concentration by 1.2 %, 2%, and 2.4%, respectively, This may be due to the nature of those border governorates and their distance from the capital to a large extent compared to the rest of the other governorates, and this may reflect a quick overview of the proportion allocation to the shape of the distribution of population at the level of Egyptian governorates in accordance with the speed pace of development programs accompanying the central governorates compared to the border governorates, and this may push these families to concentrate within the regions or governorates that be close to the capital. In addition, the results of Figure 2 shown the relative distribution of the concentration of households at the level of the governorates of the Republic, and has also showed that Cairo governorate has the highest percentage of households whose have a desire to have an ideal number of children consisting of (≤ 2 Child), as their percentage amounted for 7.2% of the total sample of the target survey by the current study, and this is compared to the rest of the governorates that was followed by the governorates of Qalyubia, Qena and Beheira, where the concentration of families has the same percentage, approximately 5% of the total sample size. While the results of Table 3 showed that the governorates of the Red Sea, New Valley and Matrouh have the lowest rates of concentration for the families consisting of two children or less of the total survey sample, which amounted for 2.1%, 2.3%, and 2.3% respectively. In short, the findings in Table 2 summarized some additional quantitative features of the survey sample in which pointed out to the average of respondents' age of the head of households was 33 old years, the average number of children was 3 per family, the average of ideal age of women to marry was 21years compared to the average of ideal age to marry among men which was 26 years, and finally the average spacing period between births was amounted for 4 years by the Egyptian families.

Figure 1. The Relative Distribution of Respondents of the Egyptian Families, the EDHS 2015

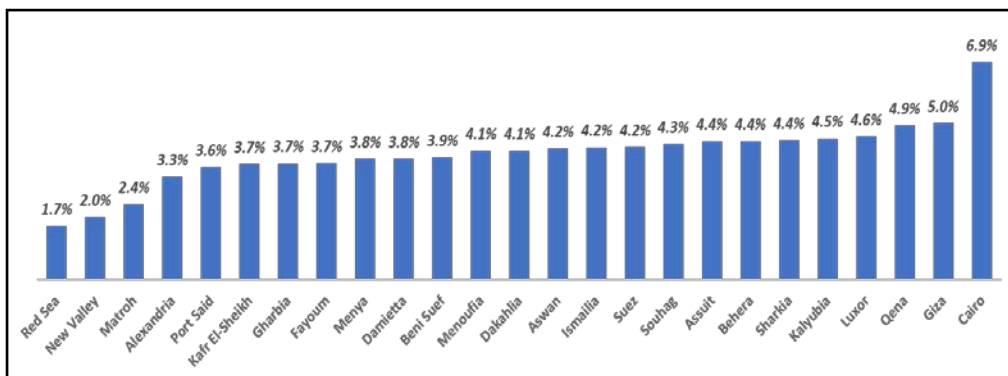
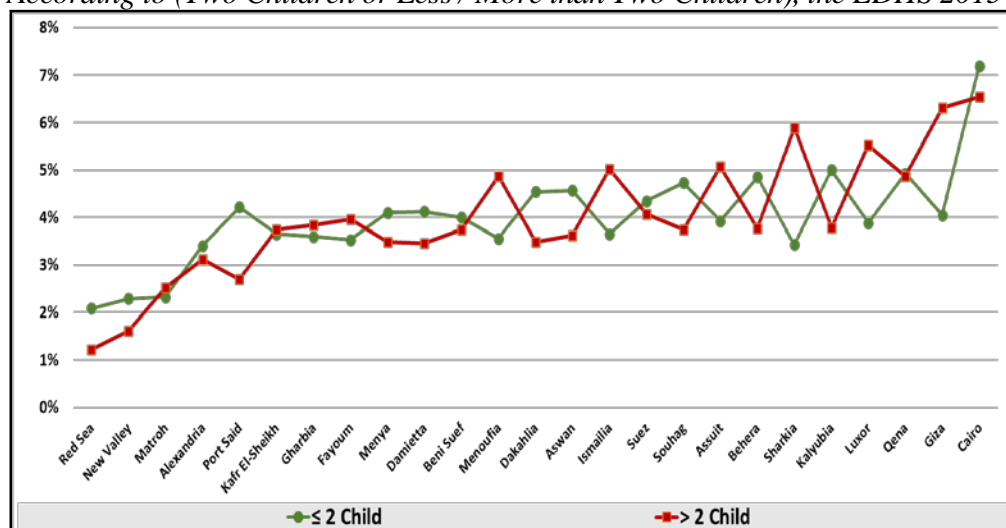


Figure 2. The Relative Distribution of the Respondents of the Egyptian Families According to (Two Children or Less / More than Two Children), the EDHS 2015**Table 2.** Descriptive Statistics for the Respondents of Egyptian Families according to Some Quantitative Variables, EDHS 2015

Key Variables	Mean	Std. Deviation
1. Age of respondent	33.61	12.454
2. No. of education years	4.56	1.853
3. Blood pressure Systolic	127.53	70.945
4. Blood pressure Diastolic	84.59	73.477
5. No. of Sons at home	1.38	1.007
6. No. of Daughters at home	1.19	1.024
7. Total children ever born	3.14	1.953
8. The ideal age for a girl to marry	20.82	7.087
9. The ideal age for a boy to marry	25.67	8.358
10. The ideal length of time between births (in years)	4.79	13.840
11. No. of children to have in family whole life	4.75	11.674
12. Ideal number of boys	1.10	1.378
13. Ideal number of girls	1.0	.926
14. Ideal number of either	1.35	1.898
15. Weight in kilograms	101.879	149.8691
16. Height in centimeters	186.786	136.2889
17. Body mass index for respondent	2881.09	700.988
18. Rohrer's index for respondent	1770.49	521.041
19. No. of births were delivered by Caesarean	1.0	1.103

Source: Egypt, DHS Report in 2015.

Table 3. *The Relative Distribution of the Respondents of the Egyptian Families about the Ideal Number of Children According to Two Main Groups (≤ 2 Child / > 2 Child), the EDHS 2015*

Key Variables		≤ 2 Child		> 2 Child		Total	
		#	%	#	%	#	%
Governorate	1. Cairo	704	7.2	451	6.5	1155	6.9
	2. Alexandria	333	3.4	215	3.1	548	3.3
	3. Port Said	412	4.2	186	2.7	598	3.6
	4. Suez	425	4.3	281	4.1	706	4.2
	5. Damietta	403	4.1	238	3.5	641	3.8
	6. Dakahlia	444	4.5	240	3.5	684	4.1
	7. Sharkia	335	3.4	406	5.9	741	4.4
	8. Kalyubia	489	5.0	261	3.8	750	4.5
	9. Kafr El-Sheikh	357	3.7	258	3.7	615	3.7
	10. Gharbia	352	3.6	265	3.8	617	3.7
	11. Menoufia	348	3.6	336	4.9	684	4.1
	12. Behera	475	4.9	260	3.8	735	4.4
	13. Ismailia	357	3.7	346	5.0	703	4.2
	14. Giza	396	4.0	435	6.3	831	5.0
	15. Beni Suef	391	4.0	258	3.7	649	3.9
	16. Fayoum	345	3.5	273	4.0	618	3.7
	17. Menya	401	4.1	240	3.5	641	3.8
	18. Assuit	384	3.9	350	5.1	734	4.4
	19. Souhag	463	4.7	258	3.7	721	4.3
	20. Qena	482	4.9	336	4.9	818	4.9
	21. Aswan	447	4.6	250	3.6	697	4.2
	22. Luxor	380	3.9	381	5.5	761	4.6
	23. Red Sea	204	2.1	84	1.2	288	1.7
	24. New Valley	224	2.3	111	1.6	335	2.0
	25. Matroh	227	2.3	174	2.5	401	2.4
Total		9778	100	6893	100	16671	100

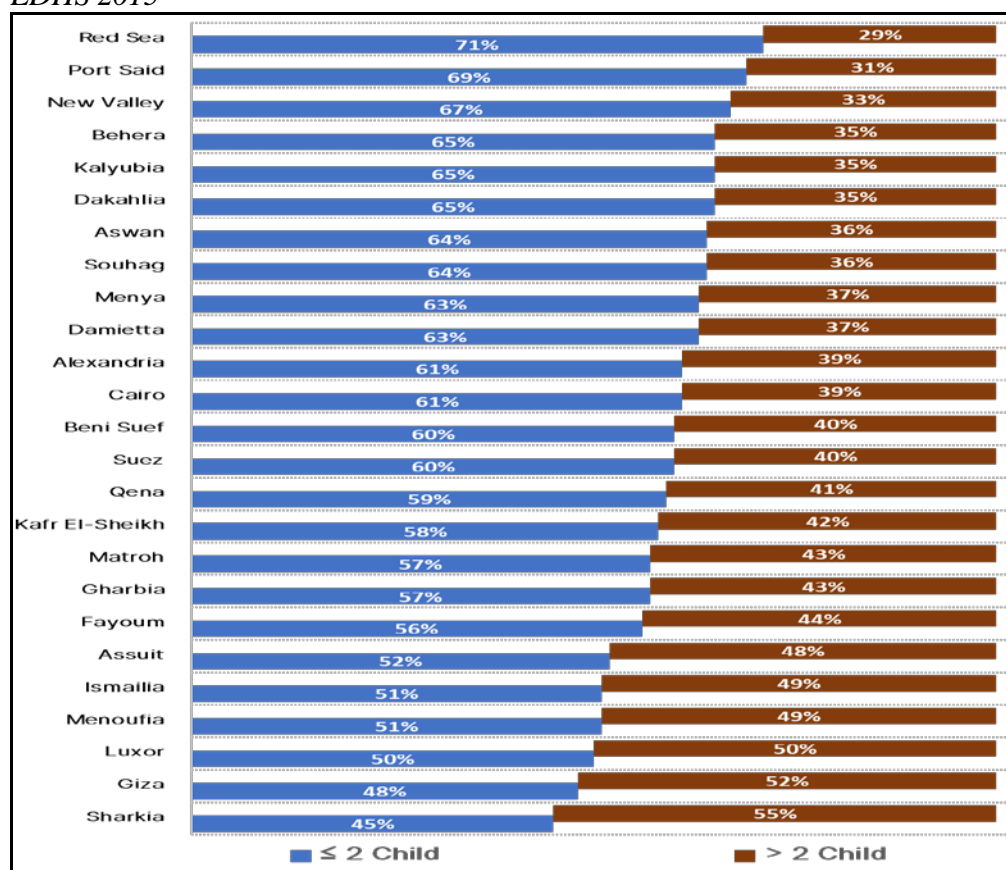
Source: Egypt, DHS Report in 2015.

The Features of Egyptian Families' Choices for (≤ 2 Child)

The results of the stratified sample representing the governorates in Figure 3 has indicated that the Red Sea Governorate represents the highest percentage of households having an ideal number of (≤ 2 Child), which amounted for 71%, and followed by Port-Said governorate which amounted for 69%, then the percentage of Al-New-Wadi Governorate which amounted for 67%. On the other hand, the governorates of Sharkia and Giza had the highest percentage of households with an ideal number of (> 2 Child), which amounted for 55% and 52%, respectively. By the way, this section shows some initial indicators that may attract a rearrangement of the priorities of decision-makers at the concerned government parties to reduce the high rates of fertility in those governorates, in particular by the officials in charge of demographic replanning at the next years. Obviously, the use of survey sample of EDHS (i.e., $n = 16671$ households) by the current study reached to the percentage of families that have two children or less, which represents 59% of the total sample, and was higher than the percentage of families that have more than two children, which represents 41%. It should be noted that this high percentage of the households consisting of (≤ 2 Child) per family could be reinforced to the

directions of the population national policy as a target rate and may be adopted by 2030. Nonetheless, the percentage of families that still their desire to have (> 2 Child), representing critical obstacle for decision makers and population program planners in Egypt to ensure change management of their reproductive behavior in appropriate manner be suitable for the other national strategies as well.

Figure 3. The Relative Distribution of the Respondents of the Egyptian Families according to Two Main Groups (≤ 2 Child / > 2 Child) in Each Governorate, the EDHS 2015



To study the relationship between both of the desire of the Egyptian family and the main variables of interest by the current study, therefore the test of Chi-Square (χ^2) was used as shown in the Table 4, and the results has indicated that there was a significant statistically relationship between the family desire variable and all the variables included in this table except the variable of residence due to the percentages of households consisting of (≤ 2 Child) are almost equal at the level of rural and urban areas alike. For the rest of the variables included in Table 4, the percentages of Egyptian families having (≤ 2 Child) amounted for 60% in case of the head of households of females, and was higher than their percentages in case of the head of these households of males which amounted for 57%. Also, the percentage of having (≤ 2 Child) among the separated couples was high compared to their percentage among the couples whose still in the relationship, and this considers a natural result for the couple still in the relation due to increase

in their chances for having (> 2 Child). As the percentage of having (≤ 2 Child) among respondents with higher education amounted for 61%, and was high compared to their percentage among respondents with low education which amounted for 54%, also this indicator among Muslim families that represents 58% was high compared to their percentage among non-Muslim families, which amounted to 61%. While their percentage among couples in the age group (15-17) years amounted for 73%, and was high compared to their percentage among couples in the age group (18-59) years, which amounted for 57%. As the percentage of this choice about the ideal number of children among the families in which the men are the decision-makers regarding the use of money or health care was high compared to their percentage among families in which the decision-makers are the women.

Table 4. Examine the Correlation between the Desire of Egyptian Families for the Ideal Number of Children (≤ 2 Child/ > 2 Child) According to the Respondent's Characteristics, the EDHS 2015

Key Variables		≤ 2 Child		> 2 Child		Total	Chi-Square (χ ²)
		#	%	#	%		
Gender	Female	5528	60.0%	3681	40.0%	9209	16.051**
	Male	4250	57.0%	3212	43.0%	7462	
Residence	Rural	4938	58.3%	3537	41.7%	8475	1.066
	Urban	4840	59.1%	3356	40.9%	8196	
Marital Status	Terminated	3610	65.5%	1904	34.5%	5514	157.880**
	Continuous	6168	55.3%	4989	44.7%	11157	
Education Level	Low Level	7039	60.8%	4533	39.2%	11572	73.810**
	High Level	2739	53.7%	2360	46.3%	5099	
Religion	Muslim	9251	58.5%	6565	41.5%	15816	3.310*
	Not-Muslim	527	61.6%	328	38.4%	855	
Age Category	Age 15-17	1222	73.0%	451	27.0%	1673	158.779**
	Age 18-59	8556	57.0%	6442	43.0%	14998	
Ever attended school	Yes	1060	42.9%	1408	57.1%	2468	294.548**
	No	8718	61.4%	5485	38.6%	14203	
Work Status	Yes	4220	55.8%	3349	44.2%	7569	48.043**
	No	5558	61.1%	3544	38.9%	9102	
Smoking Status	Yes	302	49.2%	312	50.8%	614	23.559**
	No	9476	59.0%	6581	41.0%	16057	
Caesarean Status	Yes	7722	56.9%	5843	43.1%	13565	89.526**
	No	2056	66.2%	1050	33.8%	3106	
Circumcision status	Yes	4232	56.9%	3201	43.1%	7433	16.315**
	No	5546	60.0%	3692	40.0%	9238	
Using Contraceptive method	Yes	5146	66.9%	2541	33.1%	7687	404.365**
	No	4632	51.6%	4352	48.4%	8984	
Partner preference (more children)	Woman	1001	70.3%	422	29.7%	1423	87.693**
	Man	8777	57.6%	6471	42.4%	15248	
Deciding how the use of money	Woman	8132	57.3%	6049	42.7%	14181	67.023**
	Man	1646	66.1%	844	33.9%	2490	

Makes decisions about health care	Woman	8044	57.7%	5909	42.3%	13953	35.435**
	Man	1734	63.8%	984	36.2%	2718	
Using Media (Journal, Radio, and TV)	Yes	1137	55.2%	922	44.8%	2059	11.408**
	No	8641	59.1%	5971	40.9%	14612	
Using Social Networks	Yes	2819	70.2%	1195	29.8%	4014	292.162**
	No	6959	55.0%	5698	45.0%	12657	
Violence Status against women	Yes	2866	57.3%	2136	42.7%	5002	5.416*
	No	6912	59.2%	4757	40.8%	11669	
Ever had a tattoo	Yes	548	61.7%	340	38.3%	888	3.619*
	No	9230	58.5%	6553	41.5%	15783	
Ever have your ears pierced	Yes	5434	60.1%	3610	39.9%	9044	16.699**
	No	4344	57.0%	3283	43.0%	7627	
Going Salon/Beauty center	Yes	7139	60.9%	4583	39.1%	11722	82.415**
	No	2639	53.3%	2310	46.7%	4949	

* Significant at the level less than 0.05. ** Significant at the level less than 0.01.

Source: Egypt, DHS Report in 2015.

Moreover, the percentage of having (≤ 2 Child) among the families using the methods of family planning reached at 67% and was high compared to their percentage among they do not use contraceptive methods, which reached almost to 52%. And also, this percentage among the families that suffer from violence against women reached to 59%, and was high compared to its percentage among the families that do not have violence against women, which reached to 57%. Subsequently, this violence may be a reason for women's unwillingness to have more children resulting from not feeling enough family and security stability. Also, this percentage among the families that use the Internet and social media reaching 70%, and was high compared to its percentage among the families that do not use the Internet communications in general, which reached to 55%. Also, this percentage increases among the families in which the partner is a woman who wants to have more children, reaching 70%, compared to its percentage which amounted for 57% among the families that the partner is the man who wants more children. In the same way, the rest of the variables listed in Table 4 has been reached that the desire to have the ideal number of (≤ 2 Child) for each family is almost closely similar between the categories of each one of these variables separately.

Importantly, the results of Table 5 showed that there is a statistically significant relationship between the variable of Egyptian families' desire for an ideal number of (≤ 2 Child) and the variable of governorate in which these families reside. There were three governorates had the highest percentage of households that have desire for (≤ 2 Child), which representing the Red Sea Governorate, Port-Said Governorate, and the New-Valley Governorate that reached to 71%, 69%, and 67% respectively, and it was high compared to discovering this percentage over the rest of the republic's governorates level in-

separately. On the other hand, the highest concentration of the percentage of households that have a desire for an ideal number of more than two children, which are representing Sharkia Governorate, Giza Governorate and Luxor Governorate in which their percentages reached to 55%, 52%, and 50% respectively. Therefore, this finding confirms what has previously referred to in more than one place in this study about the importance of attracting the attention of officials to these governorates that have the high levels fertility as one of priorities aimed to reducing the population growth, as well as the need to determine risks and the root causes of this reproductive behavior and understanding its justifications according to each area or governorate, thus this may support the dimensions of addressing the risk of increase population issue in Egypt by planning realistic scenarios controlling the fertility rates at the acceptable level of the state, and for enabling sustainability of the development efforts in an optimal way.

Table 5. Examine the Correlation between the Desires of Egyptian Families for the Ideal Number of Children (≤ 2 Child/ > 2 Child) According to the Governments, the EDHS 2015

Key Variables		≤ 2 Child		> 2 Child		Total		Chi-Square (χ^2)
		#	%	#	%	#	%	
Governorate	1. Cairo	704	61%	451	39%	1155	100%	290.593**
	2. Alexandria	333	61%	215	39%	548	100%	
	3. Port Said	412	69%	186	31%	598	100%	
	4. Suez	425	60%	281	40%	706	100%	
	5. Damietta	403	63%	238	37%	641	100%	
	6. Dakahlia	444	65%	240	35%	684	100%	
	7. Sharkia	335	45%	406	55%	741	100%	
	8. Kalyubia	489	65%	261	35%	750	100%	
	9. Kafr El-Sheikh	357	58%	258	42%	615	100%	
	10. Gharbia	352	57%	265	43%	617	100%	
	11. Menoufia	348	51%	336	49%	684	100%	
	12. Behera	475	65%	260	35%	735	100%	
	13. Ismailia	357	51%	346	49%	703	100%	
	14. Giza	396	48%	435	52%	831	100%	
	15. Beni Suef	391	60%	258	40%	649	100%	
	16. Fayoum	345	56%	273	44%	618	100%	
	17. Menya	401	63%	240	37%	641	100%	
	18. Assuit	384	52%	350	48%	734	100%	
	19. Souhag	463	64%	258	36%	721	100%	
	20. Qena	482	59%	336	41%	818	100%	
	21. Aswan	447	64%	250	36%	697	100%	
	22. Luxor	380	50%	381	50%	761	100%	
	23. Red Sea	204	71%	84	29%	288	100%	
	24. New Valley	224	67%	111	33%	335	100%	
	25. Matroh	227	57%	174	43%	401	100%	
Total		9778	59%	6893	41%	16671	100%	

* Significant at the level less than 0.05. ** Significant at the level less than 0.01.

In addition, the study pursued for examining the impact of significant differences of the variable of Egyptian families' desire to reach an ideal number of children after re-categorizing them into two main groups, the 1st group represents the households having (≤ 2 Child), while the 2nd group represents the households having (> 2 Child), and this was achieved by using a t-test for independent

samples according to examining the list of quantitative variables in Table 6 regarding the sample of respondents. The results of t-test analysis showed statistically significant differences between two main groups at the level less than 0.05 in terms of the following variables: (Respondent's age, number of years of education, number of males within the family, systolic blood pressure, total children born in the family, weight of the respondent, body mass index, and Rohrer's index for respondent). As this difference between the two main groups was in favor of the average of households group that their desire to have (> 2 Child). Even so, there were differences that statistically significant between the two main groups regarding some variables about adopting the ideal number of males or females in favor of the average of households group that their desire only to have an ideal number of (≤ 2 Child).

Table 6. Examination of the Relative Differences in the Family's Desire to Have the Ideal Number of Children According to the Impact of Some Quantitative Variables of the Egyptian Households

Test Variable	Grouping Variable	N	Mean	STD	T-test
Age of respondent	≤ 2 Child	9778	29.60	9.704	-53.635**
	> 2 Child	6893	39.30	13.651	
No. of education years	≤ 2 Child	8715	4.51	1.878	-4.326**
	> 2 Child	5483	4.64	1.811	
Blood pressure Systolic	≤ 2 Child	9762	126.32	76.486	-2.631**
	> 2 Child	6875	129.26	62.200	
Blood pressure Diastolic	≤ 2 Child	9762	84.52	79.523	-.141
	> 2 Child	6875	84.69	63.925	
No. of Sons at home	≤ 2 Child	5858	1.36	0.983	-2.742**
	> 2 Child	4889	1.41	1.034	
No. of Daughters at home	≤ 2 Child	5858	1.20	1.012	.789
	> 2 Child	4889	1.18	1.038	
Total children ever born	≤ 2 Child	6485	2.68	1.638	-28.917**
	> 2 Child	5598	3.68	2.143	
The ideal age for a girl to marry	≤ 2 Child	9778	20.90	7.449	1.632
	> 2 Child	6893	20.71	6.538	
The ideal age for a boy to marry	≤ 2 Child	9778	25.75	8.719	1.433
	> 2 Child	6893	25.56	7.815	
The ideal length of time between births	≤ 2 Child	9778	5.25	15.201	5.182**
	> 2 Child	6892	4.12	11.609	
No. of children to have in family whole life	≤ 2 Child	9778	3.06	1.609	-26.309**
	> 2 Child	4442	8.48	20.258	
Ideal number of boys	≤ 2 Child	9778	1.56	1.407	71.574**
	> 2 Child	4170	0.00	0.071	
Ideal number of girls	≤ 2 Child	9778	1.18	0.898	84.906**
	> 2 Child	4170	0.00	0.041	
Ideal number of either	≤ 2 Child	9778	0.31	0.710	-185.794**
	> 2 Child	4170	3.81	1.511	
Weight in kilograms	≤ 2 Child	9778	98.401	143.9859	-3.570**
	> 2 Child	6893	106.812	157.7181	
Height in centimeters	≤ 2 Child	9778	185.161	130.8728	-1.834

	> 2 Child	6893	189.092	143.6001	
Body mass index for respondent	≤ 2 Child	9531	2813.81	651.708	-14.689**
	> 2 Child	6684	2977.01	755.552	
Rohrer's index for respondent	≤ 2 Child	9531	1723.86	457.084	-13.687**
	> 2 Child	6684	1836.98	594.314	
No. of births were delivered by Caesarean	≤ 2 Child	3768	0.83	1.097	1.586
	> 2 Child	1784	0.78	1.115	

*Significant at the level less than 0.05. **Significant at the level less than 0.01.

The Factors Affecting the Ideal Number (≤ 2 Child) per Egyptian Family

The logistic regression model has been used by including all variables involved by the current study to determine the most important factors classifying the level of the Egyptian household's desire about the ideal number of children whether (≤ 2 Child) or (> 2 Child) as dependent variable. Also, this analysis aimed to building a statistical model based on entering all the proposed explanatory factors for the characteristics of Egyptian households according to the EDHS 2015 survey as independent variables at once in the proposed model of logistic regression, which includes extracting the Odds Ratios to each variable will statistically significant, and to determine which variables has the greatest impact on the adopting the ideal number of children of the household that should be considered by the planners of comprehensive development programs and makers of policies and population strategies in Egypt. Logistic regression analysis has been used because it is suitable for the nature of the dependent variable, so that the expected event value is classified for the dependent variable [the desire of the family for the ideal number of children] into two levels: the 1st group (≤ 2 Child) denotes to the value (0), while the 2nd group (> 2 Child) denotes to the value (1), that is: $P = P(Y = 1)$ which is equivalent to [the probability that the desire of the Egyptian household consists of ≤ 2 Child] P, thus using the characteristics of the logistic distribution, and the estimated probability is as follows (Neter, John, 1996):

$$\hat{P}(y = 1/x) = \frac{1}{1 + \text{Exp}^{(-\hat{B}_i x)}}$$

As the parameters of model were estimated by the Maximum Likelihood Method in terms of it doesn't not require that the independent variables included in the model following the normality distribution, nor the condition of the linearity relationship between these variables and the dependent variable Linearity. This proposed model can estimate the probabilities of occurrence for any of the cases of the dependent variable in addition to estimating the classification efficiency. The logistic regression based on the Stepwise method to find out the most important factors influencing and deleting the non-significant variables from the estimated model equation in determining the desire of the Egyptian family about the ideal number of children as a dependent variable, and the valued of Chi-Square test was significant at the level less than 0.01, and then the null hypothesis (H0: Bi = 0) was rejected, while the alternative hypothesis (Ha: Bi ≠ 0) was accepted, which

indicates the fitness of this model to the logistic regression analysis, as a result this model is correct to represent the relationship between the target variables under-examining. In addition the table of classification showed the overall percentage of classification of the proposed model was 71% which is considered a measure of the model's efficiency in classifying the values of the dependent variable, and this means that the ability of the variables included in the model combined for classifying the observations into two values in which the value (1) indicates the desire of the Egyptian family to have an ideal number of ≤ 2 Child, while the value (0) indicates the family's desire Egyptian to give birth to an ideal number of > 2 Child.

The Logistic regression results has showed the significance of the coefficients of the following independent variables: [*making decisions about how to use money within the family, making health care decisions for the family, marital status, ideal marriage age for a girl, No. of male children within the family*] where its coefficients were significant at the level less than 0.05, thus this means that each one of these variables has significant impact on the change in the logarithm of the preference or odds ratio for the desire of the Egyptian family about the ideal number of children (the dependent variable). Whereas the coefficients of the rest of the independent variables were not significant to be included in the proposed model in the next section directly, as follows:

Using Logistic regression model of the most important variables affecting the classification of the desire of Egyptian household by (≤ 2 Child) or (> 2 Child)

Key Variables	Coding of Variable (0/1)	B	S.E (B)	Sig.	Odds Ratio	Prob.
Make decisions for using money	(Woman/ Man)	0.533	0.183	0.004	1.703	0.630
Make decisions for health care	(Woman / Man)	-0.352	0.086	0.000	0.704	0.413
Marital Status	(Terminate/ Still Married)	0.397	0.154	0.010	1.488	0.598
Ideal age for a girl to marry	N/A	0.049	0.016	0.002	0.952	0.488
No. of male children	N/A	0.459	0.030	0.000	0.632	0.387
Constant	N/A	3.039	0.375	0.000	20.879	0.954
Chi- square test = 484.143	Sig. = (0.000)	Model classification efficiency = (71%)				

* Significant at the level less than 0.05 according to Wald's test. ** Significant at the level less than 0.01 according to Wald's test.

Source: Outputs of SPSS program Ver. 26.

For the influencing variables according to the results of logistic regression model which their coefficients are statistically significant. It has reached that the variable of decision-makers regarding the uses of money within the Egyptian family so that P [Y =1/man] in which means the husband has a chance of 1.703 times approximately compared to the wife's chance about the possibility of increasing the desire of Egyptian families to have an ideal number of ≤ 2 Child, so the probability that (the husband where Y = 1) has significant impact in achieving

the policy of reaching the ideal number of ≤ 2 Child = 63%. Besides, the variable of decision-makers regarding the health care within the Egyptian family, where the probability of P [Y =1/man] so that this variable has an inverse impact on the desire to have an ideal number of ≤ 2 Child, with a probability = 41%, so the probability that (the wife where Y=0) has significant impact in achieving the Egyptian national policy by achieving the ideal number of ≤ 2 Child. Thus, this finding could assert on the natural role of women in maintaining good health care in favor her family compared to the role of men.

For the marital status variable, it has indicated that there was a significant impact on the possibility of increasing the desire of Egyptian families for the ideal target number of ≤ 2 Child so that P[Y=1/currently married , i.e. this marriage is still continuous], and this means that the couples still married have an significant impact of 1.5 times to access meeting the desire of the ideal number of children by having only ≤ 2 Child, with a probability =59% compared to the chances of currently separated couples about achieving that desire. Thus, this finding also means that the separation of spouses is one of the obstacles in front of these families to have the ideal number of children, and this motivates them thinking about remarrying for having more children, and this also has an adverse impact on increasing fertility rates due to the problem of multiple marriages of one person. In addition to the probability of increase in both of the ideal age to marry a girl to marry and the number of male children within the family were 49% and 39%, respectively, in the negative impact on increasing the chances of achieving the desire of Egyptian families to have the ideal target number of two children or less, and considering the nature of these variables that their measurement is quantitative not qualitative, so the high of ideal age for the girl to marry or the high number of male children within the family will increase the chances of meeting the desire of Egyptian families to have the ideal number of children targeted for two children or less.

Further this finding may reflect the demographic situation in Egypt somewhat, as the delay in the age of marriage among females may support the access to the decision of only ≤ 2 Child, especially this result also suitable to the natural conditions of the reproductive health woman, whereas the high age of females at marriage, it will reduce the chances of her to have more children through the rest of their life cycle of childbearing (15-49) age. Similarly, the increase in the births of male children within the family could lead to meeting the family's desire for being satisfied by the ideal number of two children or less without having more than two children, so this indication is likely to show that the Egyptian families' preference to have males' births instead of females. Thus, this matter may be achieved by the birth of the first child male only within the family or by the second child male without the need to have more children later, as this culture regarding the reproductive behavior pushes them to satisfy their desire of ideal number of ≤ 2 Child in case of, they have only children from male births. Consequently, this behavior or culture should call the importance of continuing the efforts of state institutions in order to raise Egyptian families awareness about the urgent need of meeting national policy goals by being satisfied with only ≤ 2 Child, as well as the joint institutional work to show the expected benefits of reducing the population

growth rates at the acceptable level that will be compatible with the opportunities for escalating economic and development developments that Egypt is witnessing at the present time. Also for supporting the strategic directions of the state that pursues to ensure a decent life enjoyed for all family members in education, health, housing, medical insurance, and the other areas of the standard of living, especially among the people with low incomes in Egypt, as well as for supporting the efforts of accelerating the increase in human development opportunities in conjunction with Egypt's vision 2030 based on achieving social justice and comprehensive sustainable development with a competitive and diversified economy system that improves the quality of life and the happiness of Egyptians at the same time, whether for current or future generations.

Recommendations

Obviously, the results of the current study have revealed the most important trends that must be considered by further studies and future paths to support comprehensive and sustainable development opportunities in Egypt. Therefore, the realistic recommendations should be closely provided in front of the decision-makers, planners, and policy makers in Egypt to become more future-proof in the coming decades in conjunction with the pace of global trends and accelerations demographically considering the escalation of the international economic crisis, high unemployment rates, inflation, international conflicts, climate change, energy efficiency, the digital technological revolution, and the epidemic viruses. As well as, the importance of ensuring the sustainability of the components of water and food security at the global level and other global population issues that have become real challenges in facing of the high population growth in many countries over the world, including Egypt, especially that the population increase issue in Egypt will hinder the solution of many problems, including unemployment, illiteracy, housing, covering the insurance health, food and water sufficiency and other population problems that will have negative impacts on achieving a decent quality of life for citizens in Egypt, which may make it a clear threat to Egyptian national security.

As a result, this study is a real catalyst to sharpen the state's capabilities of Egypt by directing the change management towards the highest priorities during facing the huge challenges caused by high population growth that appear on the surface with confidence and steadfastness compared to global levels in managing crises and demographic changes. In addition, this direction will enhance its competitiveness at the levels desired internationally in all development fields, especially Egypt is recently considered one of the countries is re-starting to have emerging markets and newly rising economies in accordance with the indicators of the high rates of economic growth that Egypt is currently witnessing annually. Consequently, facing the high population growth becomes a one of the main obstacles that may hinder this economic progress in Egypt resulting from the continuous pressure on the state's resources without taking into account the prior national planning to how the population growth that meet their reproductive needs

and studying their desires about the ideal number of children in the first place, and this matter inevitable by the State's efforts to adopting long-term forward-looking visions for shaping the future to ensure the continuation of economic and human development levels optimally.

Further, this study emphasizes the importance of continuing to further spread public awareness among all members of Egyptian families, in order to reach the ideal target number of two children or less as a strategic goal for the components of the national population policy in Egypt, in addition to implementing strategic initiatives, programs and projects that promote the achievement of Egypt's forward-looking vision in becoming Future-Proof by 2030, and through diversified expansion in supporting sustainable development opportunities of Egypt, especially the economic dimension. Alongside, this study pursues to re-refine the orientations of the Good Life Project which Egypt launched entitled in the "Project of the Century" at a cost of 700 billion Egyptian pounds in twenty-two governorates to make a qualitative leap in improving the quality-of-life of 60 million Egyptian citizens, and this will be by attracting the attention of Egyptian officials by putting a set of priorities reached by the results of the current study, including focusing on Governorates with a tendency to have more than two children, such as Sharkia, Giza and Luxor, where the Egyptian families' desire to have more than two children tends to reach the ideal number of children that satisfies their choices and reproductive behavior. Also, the head of households with low education, families in which women make decisions about the use of money within the family or health care, families do not use family planning, those do not use the Internet and social media channels, families where reproduction depends on natural births and not caesarean sections, they have behaviors about smoking, households where the partner in the marital relationship is the woman who prefers to have more children.

Besides, the importance of focusing primarily on the factors most impact on classifying the families' desire to have two children or less by focusing on the following 1) the partner concerned with making decisions about the use of money or health care within the family, 2) the couples whose marital relationship still exists and there is no separation between them, 3) the ideal age of marriage for the girl, and 4) the gender's type of children of the family. Furthermore these given factors are statistically significant in the ability to predict the level of classification of the family's desire if they have (≤ 2 Child) or they have (> 2 Child), and thus this direction can be used in any proactive actions or effective treatments or intervention programs that aimed to publish the early awareness in order to limit the high rates of fertility within Egypt and in line with directing the reproductive behavior of Egyptian families to ensure the alignment with the goal of the national population policy as much as possible.

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